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Sport and Tourism Destination Development: Hunting in South Africa c.1890-1939

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Abstract: Scholarship on sport and tourism can be enhanced by a tighter engagement with historical research. The novel contribution of this paper is to document the role of the sport of hunting as a niche for early tourism destination development using the case of South Africa. Beginning in the 1890s hunting as a form of consumptive wildlife tourism was promoted in South Africa mainly to British sports hunters. This form of tourism development in South Africa was only made possible following the restrictions introduced in the country both to regulate hunting and enact conservation measures to protect wildlife following the decimation of animal populations in previous years. It is argued hunting was only a small niche in the emergence of tourism in South Africa during the period 1890 to 1940. Nevertheless, for certain regions of the country the hunting of wildlife for sport constituted a significant element of the local tourism economy.

Keywords: hunting; consumptive wildlife tourism; historical tourism development; South Africa

Introduction

The multiple scholarly works authored by the tourism historian John Walton (1981, 2000, 2005, 2009a & 2010) demonstrate the imperative for researchers of tourism to engage more deeply with the past. According to Walton (2009b, p. 115) the "*present cannot be understood without reference to what has gone before; nor can we attempt to predict or pre-empt the future without achieving some understanding of where we, and others, have come from*". Furthermore, it is asserted that "*every practitioner of tourism studies, however immediately contemporary their ostensible concerns, needs to come to terms with the ever-moving frontier of the past*" (Walton, 2009b, p. 115). Likewise, Saarinen et al. (2017, p. 311) point to the necessity for geographers of tourism to address "*the extended application of historical perspectives in order to inform contemporary debates and practices*". As a parallel to these arguments, scholarship in sport and recreation studies also can benefit from a stronger association with historical research as demonstrated by the recent contribution of Lewis (2025) to *The Oxford Handbook of Tourism History*. Unquestionably, however, the existing sports tourism literature is weighted towards contemporary research studies (Arici et al., 2023). Moreover, in the corpus of works

relating to the evolution of sport and of historical recreation studies most is conducted only in the context of the Global North. Much less developed is scholarship on sport and recreation which applies a historical lens to a Global South context.

One exception, however, is the record of South Africa where in recent years there has emerged several works which have excavated archival sources and deployed oral histories to shed light and historical perspective concerning certain dimensions of the country's sport and recreational landscape. Notable contributions relating to historical sporting activities in South Africa must be acknowledged. Cornelissen and Grundlingh (2012) flag the primacy of race and class as determinants of participation in different sports and the expansion of particular sports. In a seminal study Grundlingh (2013) recovers several aspects of sport and leisure practices in Afrikaner history. The special importance of rugby union in Afrikaner circles is well-documented (Grundlingh, 1994 & 2013). Odendaal (1990, p. 13) reminds us that one of the "enduring legacies of British colonialism has been the institutionalization of British sports in the former colonies" and that nowhere is this "*better reflected than in South Africa*". For example, as British settlers moved abroad so did the sport of cricket. The chequered development of cricket in South Africa has been explored variously by Desai et al. (2002), Allen (2008 & 2013), and Odendaal et al. (2018). The historical role and development of cricket in South Africa and its linkages to British imperialism and colonialism are in evidence (Allen, 2008).

Soccer is another sport, the early evolution of which in South Africa, has garnered much academic attention and highlighting its special importance for Black South Africans (Couzens, 1983; Nauright, 1999; Alegi, 2006; Bolsmann, 2013; Rassool and Slade, 2013). Cecile Badenhorst (2003) and colleagues stress the historically significant role of organized sport and especially of soccer as a vehicle of social control for Africans in the urbanizing environment of Johannesburg during the 1920s and 1930s (Badenhorst & Rogerson, 1986). Further, Cobley (1994) tracks the politics of the provision of playing fields for Africans in Johannesburg. Organised boxing in South Africa's urban Black communities has been highlighted both for Cape Town (Cleophas & Qacha, 2023) and the Witwatersrand (Fleming, 2012). For the (white) working class in Johannesburg from 1932 to 1949 (until the activity was banned because of gambling) greyhound racing has been shown as one of the most popular pastimes (Grundlingh, 2003). In another exploration of sports history, the rise of surfing as a popular beach sport in South Africa has been documented by Thompson (2011). The post-1948 racialized sports landscape of apartheid is examined in works for example by Merrett (2005), Labuschagne (2016) and the rich edited collection by Sikes et al. (2022). Sports boycotts, politics and the desegregation of South African sport in the years of late apartheid are issues interrogated by Booth (1988, 1998 & 2013).

The historical nexus of sport and tourism development here is in focus. In South Africa the relationships between sport, recreation and tourism development have been charted in research investigations concerning the historical evolution of sea angling, trout fishing and mountaineering (Rogerson & Rogerson, 2024a, 2024b & 2024c). Against this backcloth the novel contribution of this article is to expand the intellectual parameters on the role of sport as a catalyst for early tourism development through an investigation of the niche or 'special interest' of sports

hunting. Among others Charl Badenhorst (2003, p. 122) observed that hunting "*is often spoken of as the oldest sport known to man*". In terms of organization, three sections of material are presented before a conclusion. Following a literature review on international research on sports hunting and its relationship with tourism, a brief discussion is given on methodology and source material. The results section documents the evolution of hunting in South Africa and its relationship with the promotion of early tourism from the 1890s to 1939, the outbreak of World War 2.

Literature Review

Wildlife tourism is usually conceptualized as either consumptive or non-consumptive (Tremblay, 2001; Rizzolo, 2023). The category of non-consumptive wildlife tourism includes forms of human recreation (such as photography, game viewing) that does not involve animal mortality. For Lovelock (2008) touristic hunting and shooting are regarded as components of the niche of 'consumptive wildlife tourism' which involves the killing or capture of wildlife. Consumptive wildlife tourism is defined as "*a form of leisure travel undertaken for the purposes of hunting or shooting game animals, or fishing for sports fish, either in natural sites or in areas created for these purposes*" (Lovelock, 2008, p. 4). According to Lovelock (2008, p. 3) this is a sport which represents a small and specialized sector of tourism that "*has received little attention from researchers*". According to Sand & Gross (2019) from the end of the 19th century onwards hunting attracted tourists to natural and adventurous settings. Historically, the traditions of hunting, fishing and shooting for a long time were established bases of recreation in certain layers of British society. With its association with the British landed upper classes, the activity of hunting drew upon notions of 'sportsmanship' (Trapido, 1984).

Griffin (2007) tracks the history of hunting amongst the English landed gentry as far back as the Norman conquest in 1066. Huggins (2008) maintains that from at least the 17th century a significant proportion of the English gentry increasingly revelled in country sports including grouse shooting, deer stalking and fishing. Durie (2008) traces the historical evolution of the elite sport of game shooting. This was a popular focus of the titled and moneyed male in Victorian and Edwardian Britain for whom participation in a good pheasant shoot or partridge manor was a marker of high social standing. Martin (2012, p. 1141) deems this minority sport as the exclusive preserve of the leisured classes of the time and highlights especially the importance of "*the iconic era of the great shoots in the Edwardian period (1901-1910)*". In the Yorkshire Dales of Northern England the pursuit of grouse shooting as sport was integrated as part of the local recreational landscape (Done & Muir, 2001). Overall, for Martin (2011) the late Victorian and Edwardian eras represent the heyday of game shooting as sport in Britain.

The establishment of Scotland as a tourist destination is viewed as inseparable, in part, from the development of the sport of hunting. It is recorded that one of the most significant factors behind the emergence of Scotland as a tourist destination in the nineteenth century was its range of sporting activities from golf to salmon fishing and deer-stalking (Lorimer, 2000; Durie 2013 & 2017). Of considerable significance was grouse shooting which was "*reserved for and by the*

economic and social elite" (Durie, 1998, p. 57). In the 19th and 20th centuries the sporting estate was a place in which the private indulgences of the aristocracy took precedence over issues of social and economic development in the Scottish Highlands (Jarvie & Jackson, 1998; Wightman et al., 2002). During the early decades of the 21st century the sporting estates of the Scottish Highlands and Islands comprised large tracts of land which were managed mainly for such 'sporting' activities as deer stalking, grouse shooting and salmon angling (Macmillan et al., 2010). With its close relationship to Britain, Ireland provides another similar example of early tourism associated with the sport of hunting (Durie, 2013; Rouse, 2015; Griffin, 2018).

By the 19th century the sport of hunting and shooting of game was internationalized. According to Silanpää (1999, p. 172) during the 19th century increasing numbers of British gentlemen "*visited Scandinavia in the pursuit of good, untrodden sporting grounds*" and were "*on the lookout for forests full of grouse, black-game and elk, and rivers and lakes abundant with salmon, trout and char*". Silanpää (2002) maintains that the sporting travels undertaken by British visitors at this time evolved into a phenomenon with its own characteristics, namely the 'Scandinavian Sporting Tour'. As a true sportsman was supposed to be adventurous and 'rough it' the Scandinavian Sporting Tour was "*characteristically connected with some hardship*" and thus "*offered an arena for performing 'manly' acts*" (Silanpää, 2008, p. 60). Scandinavia offered the opportunity for an array of activities that included salmon fishing and the shooting of wild reindeer or red deer (instead of Scottish stags) as well as ptarmigan (instead of Scottish grouse). For British gentlemen undertaking such travels, skill and performance were viewed as very important (Silanpää, 2002).

From 1830 therefore it is well-documented that a flow of visitors from Britain occurred to certain parts of Scandinavia to enjoy the pastimes of hunting, shooting and fishing. It is stated that from "*the 1830s until the outbreak of the First World War in 1914, certain aspects of this sporting tradition became closely associated with the Scandinavian backwoods*" (Silanpää, 2008, p. 59). The visitors were attracted to Scandinavia for various reasons, most importantly the "*overcrowding of the Scottish sporting grounds together with the rising prices for recreational sport in the home country turned the eyes of many sportsmen towards more secluded spots*" (Silanpää, 2008, p. 59). Regions of rural Scandinavia offered spaces, lakes, rivers and forests full of fish and game and "*enabled the sportsmen to engage in recreational fishing, hunting and shooting quite cheaply*" (Silanpää, 2008, p. 60).

The historical records of England, Scotland, Ireland and Scandinavia thus evidence the role of the sport of hunting and shooting as an anchor for early tourism activities. It is argued more broadly by Lovelock (2008) that the tourism industries of several nations and regions have their origins in forms of consumptive wildlife tourism. Unquestionably, at a regional scale, the initial tourism growth in Canada's Yukon Territory is another historical case of destination development which was supported by the activities of sport hunters (Green, 2021). The Adirondack Mountains in the United States provide a further case of early tourism catalysed by hunting (Terrie, 1978; Cohen, 2014). At a national level the example of New Zealand is flagged. Lovelock (2008, p. 21) avers that the country "*built its early tourism industry on the back of the red-deer, wapiti, trout and big game fishing*". South Africa is another

pertinent national case of the significance of the sport of hunting and shooting for the initial opening of a tourism destination.

Methodology

This study was pursued through applying different research methods. At the outset a literature search and survey was done of existing international literature on sport hunting as a trigger for early tourism development. As is demonstrated by the above discussion most current scholarship relates to situations of the Global North. Outside of that literature, research and historical writings on tourism and sport hunting are relatively thin.

The second stage in the research process concerned the collection and application of primary documentary source materials which were extracted from archives. The benefits of archival documents created at some point in the relatively distant past are to provide access that might not otherwise be possible to the organizations, individuals and events of earlier periods (Ventresca & Mohr, 2017). The research utilizes primary documentary sources secured from the collections at the two South African National Library depots in Cape Town and Pretoria. This is supplemented by other documentary material which was accessed through the South African National Archives in Pretoria. Further relevant sources were secured at the collections of historical papers lodged at libraries both at the University of Cape Town in Cape Town and the University of the Witwatersrand in Johannesburg.

At the depots of the National Library in South Africa exploration was undertaken of the collections of material and travel guides which were produced in Britain for travellers to South Africa. In addition, the guidebooks and promotional material produced within the country by the South African Railways and Harbours were examined. In the history of tourism development in South Africa one of the key moments was the founding in 1919 of the Publicity and Travel Department of the Railways organization. This department was initiated to furnish publicity material and guidebooks that might encourage tourists as well as potential settlers and investors to come to South Africa (Foster, 2003).

Results

The results are presented in terms of two sections of discussion. In the first, the historical background is sketched of the transition from pre-colonial and settler hunting to elite hunting. The subsequent enactment of controls and restrictions provided the foundation post-1890 for the rise of hunting as a special interest form of tourism. The second section is the major research focus and explores the development of controlled hunting and its promotion as a form of early tourism in South (ern) Africa from 1890 to 1940.

From Animal Slaughter to Hunting Restrictions

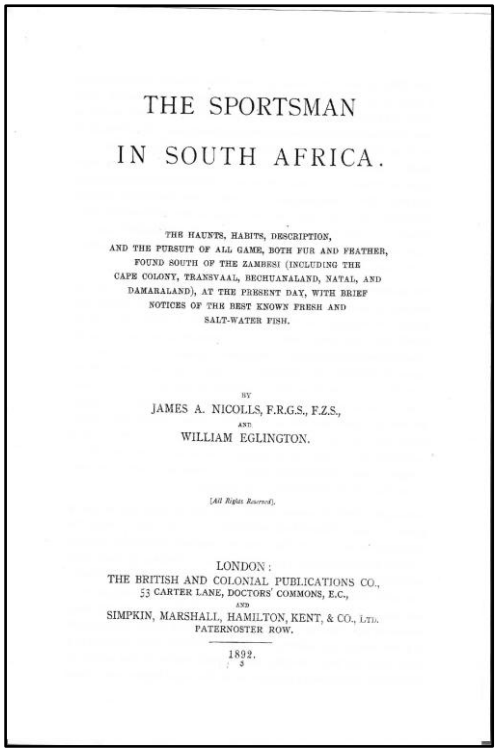
In pre-colonial African societies the hunting of wildlife often was critical for subsistence and trade as well as the protection of people and cattle from predators. Game animals were a significant resource for African societies and hunting significant for subsistence supplies of meat (Beinart, 1989). In Southern Africa Trapido (1984, p.

1) points out, that for at least 200 years between 1670 and 1870, the hunting of wild animals as an occupation within settler and indigenous societies was "*essential for survival, subsistence and often for the creation of income and capital*". Although by the 1830s the plains of southern Africa were still teeming with a rich variety of wildlife, in some spaces, such as around the settler areas of the Cape, many species already had been decimated. According to van Sittert (1998, p. 334) by the mid-19th century "*the once prolific wild game of the Cape Colony had been decimated by the vanguard of expanding white settlement and replaced with domestic small stock on the interior grasslands and Karoo*". For Trapido (1984, p. 3) "*it was the Victorian sportsman-authors, often with Indian military experience, who brought a sense that in the wild-life of South Africa, lay a world waiting to be subjugated*" and that subjugation could be undertaken "*not by great armies but by individuals reliant upon only courage and a well-aimed rifle*". Beinart (1989) points out that the British in particular engaged in hunting for the sake of 'sport'.

During the early 1890s several travel guides were available to settlers, tourists, and sportsmen on their ocean travels from Southampton in England to the Cape. The information provided in these travel guides stressed the destruction of wildlife that had occurred over previous centuries (Figure 1). For example, in the guide produced in 1892 specifically directed at the sportsman travelling to South Africa it was stated that:

" …we cannot be blind to the fact – and it is sad for those who take an interest in such an important subject to relate – that, with the exception of a few wild Elephants and perhaps Buffalo, which still eke out a harried existence…the remnant of the noble game which once roamed in countless thousands all over the country, and for which Southern Africa was pre-eminently renowned, has been by wanton and ruthless slaughter decimated or driven far beyond the outermost boundaries of civilization into the pathless veldt of the Kalahari, or the inhospitable territories of the aborigines of the interior" (Nicolls & Eglington, 1892).

Unquestionably by the close of the 1890s, European rule and merchant capitalism in Southern Africa had "*by their efforts to subjugate nature brought about the almost complete destruction of wild-life on the sub-continent*" (Trapido, 1984, p. 1). Beinart (1990, p. 162) observes that during the 19th and early 20th centuries "*British writers published a large number of narratives on their hunting trips, their encounters with wild game and related adventures in Africa*". Hunters often proclaimed proudly their prodigious achievements in the slaughter of the wildlife of South Africa (Adams, 2009). Overall, the role of recreational hunting of game in the Cape is a classic example of its impact in local extinctions (Hutton et al., 2009).



THE SPORTSMAN

IN SOUTH AFRICA.

THE HAUNTS, HABITS, DESCRIPTION,
AND THE PURSUIT OF ALL GAME, BOTH FUR AND FEATHER,
FOUND SOUTH OF THE ZAMBESI (INCLUDING THE
CAPE COLONY, TRANSVAAL, BECHUANALAND, NATAL, AND
DAMARALAND), AT THE PRESENT DAY, WITH BRIEF
NOTICES OF THE BEST KNOWN FRESH AND
SALT-WATER FISH.

BY
JAMES A. NICOLLS, F.R.G.S., F.Z.S.,
AND
WILLIAM EGLINGTON.

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LONDON:
THE BRITISH AND COLONIAL PUBLICATIONS CO.,
53 CARTER LANE, DOCTORS' COMMONS, E.C.,
AND
SIMPKIN, MARSHALL, HAMILTON, KENT, & CO., LTD.
PATERNOSTER ROW.

1892.

Figure 1. Guidebook Promoting South Africa as Destination for Consumptive Wildlife Tourism, 1890s (*Source: Nicolls and Eglington, 1892*).

The complex relations between imperial hunters, empire and conservation which unfolded in the sub-continent of Southern Africa are teased out by Beinart (1990 & 2008). Among others Munro (2021) points out that fledgling wildlife conservation initiatives in colonial Africa emerged during the late 19th century and accompanied the establishment of different laws to restrict hunting as well as the setting up of game reserves for conservation purposes. Key influential voices behind conservation measures were aristocratic European hunters who sought to preserve game populations by protecting them from settlers as well as African hunters in order that elite sports hunting might continue (Munro, 2021). By the late 19th century groups of landowners in Southern Africa "*began to view with alarm the decline in game and the opportunities for hunting as a socially exclusive pleasure pursuit*" (Beinart, 1990, p. 175). Arguably, the notion of 'protecting the hunt' and of the attitudes brought to game preservation in Africa were reminiscent of those relating to the great landed estates of Britain (Adams, 1989). For whatever reason, the late 19th century witnessed the increasing restriction and regulation of hunting beginning in the Cape Colony (Brown & Brown, 1901). By the opening years of the twentieth century hunting had become a closely regulated pastime across South Africa (Brown & Brown, 1898; Trapido, 1984). As is demonstrated in the following sections a regime of controls and conservation regulation facilitated opportunities for the growth of sports hunting as a tourism niche in South Africa.

Sportsmen, Hunting and Tourism

From the 1890s Southern Africa was promoted regularly as a destination for sportsmen interested in hunting wildlife. Initially the marketing was through the medium of travel guides such as Brown's guide that were often essential reading on the steamships from the United Kingdom to the Cape. From the early years following the formation of the Union of South Africa in 1910 the activities of South African Railways (subsequently retitled South African Railways and Harbours) become increasingly of significance. This growth in the promotion of South Africa as a tourism destination for sports hunters was targeted primarily at international travellers and most especially to 'sportsmen' hunters from Britain.

The standard annual Brown's guide to South Africa stated, notwithstanding the years of animal slaughter, that the territory represented still "*the finest hunting grounds in the world*" (Brown a& Brown, 1901, p. xv). The 1893 issue drew attention to the conservation measures enacted by the Cape Government designed "*to put an end within the limits of the Colony to this indiscriminate butchering, and with a view to remedy in some measure the evils of the past*" (Brown, 1893, p. 76). Under the game laws enacted by the Colony special protection was accorded to certain wildlife which could not be shot for a three-year period without special permission from the Colonial Governor. Such restrictions included for elephants, hippopotamus, buffalo, zebra and a range of antelopes. In addition, the colonial legislation introduced a close season (varying between districts) during which no killing of any form of game would be permitted without a licence. Information concerning the details of such close seasons for particular forms of game was provided in several pages of the dedicated guide issued in London during 1892 for sportsmen heading to South Africa (Nicolls & Eglington, 1892).

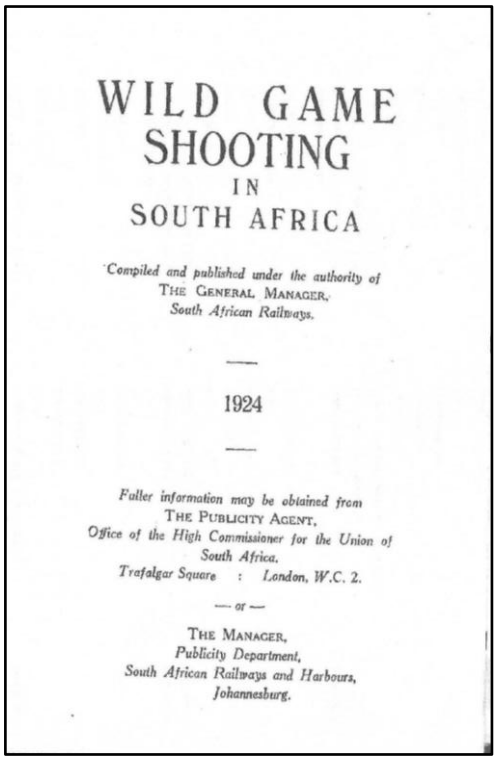
These forms of protection measures which were introduced in the Cape Colony were subsequently replicated across the other provinces of what would in 1910 form the Union of South Africa. By the early years of the 20th century Brown's guide indicated that the geographical axis for sportsmen hunters was no longer the Cape Colony but instead had gravitated to the interior. What were described as the 'most accessible hunting grounds' now were situated in parts of the Transvaal, the Portuguese controlled territory of Mozambique and colonial Rhodesia. Such spaces were viewed as attractive for hunters because they afforded "*all around shooting especially for antelopes*" or a region that "still teems with millions of all sorts of game" (Brown & Brown, 1901, p. 86). In making such recommendations to hunters the caveat was made as follows: "*It is trusted that the sportsmen who go there to shoot will remember that there are others who would like to come after them*" (Brown & Brown, 1901, p. 86). It is notable that one of the first publications produced following Union by the publicity department of South African Railways was a handbook titled *Rhodesia for Tourists and Sportsmen* which appeared in 1912 (South African Railways, 1912). This 110-page booklet was compiled jointly by the South African Railway Administration and The Rhodesia Railways. It profiled 'places of main interest' in Rhodesia as well as attractions in South Africa which were en route with the rail link connections from Cape Town stretching into Rhodesia.

The handbook on Rhodesia constitutes a good example of 'transnational tourism development' in Southern Africa whereby the major attractions of South Africa were promoted collectively with those of the iconic site of Victoria Falls and the ruins of Great Zimbabwe in Rhodesia or of Lourenço Marques in Mozambique (Rogerson, 2024). In the chapter of information provided for sportsmen, Rhodesia is styled as "*one of the few countries where large and small game of many varieties may still be found in abundance*" (South African Railways, 1912, p. 81). The list of large game offered to sportsmen for hunting throughout most of Rhodesia included lion, leopard, elephant, rhinoceros, hippopotamus, eland, buffalo, zebra, sable antelope, and reedbuck. Although it was recorded that there "*is an abundance of game in Rhodesia, for the rarer kinds the sportsman must work hard*"; it was added that "*few things worth having can be obtained without dogged perseverance, and certainly this applies to a rare species of buck living its solitary life in thick bush, or in the heart of wild and remote river marshes*" (South African Railways, 1912, p. 81 and 83). As in South Africa, game laws were enacted in Rhodesia to control the hunt in terms of the enforcement of closed seasons and the requirement for licences. This said, the prospective hunter was assured that controls in Rhodesia "*whilst necessarily strictly enforced to prevent depletion, are not so stringent as to hinder sport*" (South African Railways, 1912, p. 83).

The decades of the 1920s and 1930s witnessed the appearance of a greater flow of publicity material centred on the hunting tourism opportunities available in the territory of South Africa. All this material was produced through the auspices of South African Railways and Harbours (SAR & H) which sometimes functioned alone as compiler of documents and at other times in cooperation with local authorities. In 1923 a chapter on game shooting was included in a large volume produced by SAR & H covering all the country's tourism assets and attractions for potential international visitors (South African Railways and Harbours, 1923). An overview was given for each of South Africa's four provinces of the potential for game shooting and of various provincial restrictions. Sportsmen were informed, for example, of the good bird shooting opportunities in Orange Free State and of the attractions offered to "the true sportsmen" during the three and a half months of the shooting season in Zululand (South African Railways and Harbours, 1923, p. 273).

The most significant statement of South Africa as a destination for sports hunting appeared in 1924 with the publication of a special publicity booklet designed to highlight the opportunities for wild game shooting across the country (South African Railways and Harbours, 1924a). The 1924 booklet began by debunking any thoughts that South Africa in the 1920s provided unrestricted shooting (Figure 2). Instead, it recounted the disastrous impacts of the times of indiscriminate shooting of game which had reduced many species to the edge of extinction. This had triggered an awakening on the part of farmers of the need to preserve animal herds and by government for the formal establishment of protected game reserves. It was stated that this "*change for the drastic preservation of game has resulted in the fact that now the whole of the Union is practically a game preserve as far as free shooting is concerned*" (South African Railways and Harbours, 1924a, p. 5). Nevertheless, it was argued that for hunters, whilst there was no free shooting, "*by taking the proper and*

necessary measures and abiding by the restrictions laid down, much excellent sport is still to be obtained, but it is not possible as it was thirty or forty years ago, to shoot when, where and how one liked" (South African Railways and Harbours, 1924a, p. 6).


WILD GAME
SHOOTING
IN
SOUTH AFRICA

Compiled and published under the authority of
THE GENERAL MANAGER,
South African Railways.

1924

Fuller information may be obtained from
THE PUBLICITY AGENT,
Office of the High Commissioner for the Union of
South Africa,
Trafalgar Square : London, W.C. 2.

— or —

THE MANAGER,
Publicity Department,
South African Railways and Harbours,
Johannesburg.

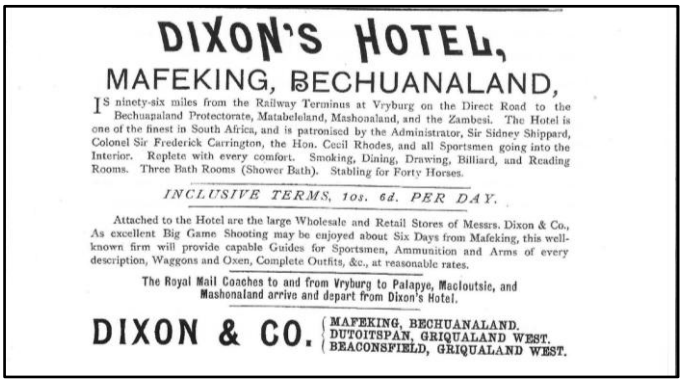
Figure 2. Promoting Wildlife Hunting in South Africa, 1924 (*Source: South African Railways and Harbours, 1924a*)

The areas that were pinpointed as the best for wild game shoots now focused upon Northern Transvaal where "*very fine shooting is to be obtained*" and "*where large numbers of game, both large and small, are to be found*" (South African Railways and Harbours, 1924a, p. 16). Pietersburg, the largest urban centre in this region, was the usual starting point and organizational focus for shooting parties. In terms of the spaces where shooting occurred of small game and game birds it took place on land where farmers gave permission for such activities. Several land companies with offices based in Johannesburg owning large tracts of land in the Northern Transvaal also could be approached for permission to hunt. Beyond opportunities for shooting of small game during the open season these lands provided 'excellent sport' for hunting large carnivores (such as lion and leopard) for what was described as the "*more venturesome*" hunters. The caution was given, however, that these remote spaces in the Northern Transvaal offered "*good sport certainly, even if highly dangerous at times*" (South African Railways and Harbours, 1924a, p. 17). The Northern Transvaal with Pietersburg as its hub was further marketed to international tourists interested in hunting through illustrated handbooks produced by various

local authorities in cooperation with SAR & H (South African Railways and Harbours, 1924b & 1931). In the illustrated handbook produced for Pietersburg and the Northern Transvaal the promotional messaging was striking for an international audience. The Northern Transvaal was styled "*the California of South Africa*" (South African Railways and Harbours, 1924b, p. 11). The region's attractions for wild game shooting outside of the summer malaria season were extensively laid out. It was stated as follows:

Such is the abundance and variety of game, the excellence of the climate from April to August and the attractiveness of the surroundings, that from whatever angle considered the Northern Transvaal is still one of the foremost shooting grounds in the world. And it is probably the most inexpensive and most comfortably accessible for sportsmen coming from Britain. Whether a short or long shooting trip is contemplated, for a small or large party, the cost will be only a fraction of what must be incurred in the Sudan and similar places (South African Railways and Harbours, 1924b).

The guide continued to stress that for overseas visitors to South Africa seeking "*to combine a little pleasure with business, there is in favour of such a visit the added inducement of good hunting in the Northern Transvaal from about April to August; and for men of leisure, if they would enjoy the acme of sport, the Northern Transvaal is the territory*" (South African Railways and Harbours, 1924b, p. 61). Similar promotion was given in another jointly produced booklet that highlighted the sporting opportunities in the Nylstroom and Waterberg district of the Northern Transvaal (South African Railways and Harbours, 1931). Of this region it was declared that "*many farmers make a point of preserving game on their farms, with the result that excellent shooting is obtainable in the district*" (South African Railways and Harbours, 1931, p. 8).


DIXON'S HOTEL,

MAFEKING, BECHUANALAND,

IS ninety-six miles from the Railway Terminus at Vryburg on the Direct Road to the Bechuanaland Protectorate, Matabeleland, Mashonaland, and the Zambesi. The Hotel is one of the finest in South Africa, and is patronised by the Administrator, Sir Sidney Shippard, Colonel Sir Frederick Carrington, the Hon. Cecil Rhodes, and all Sportsmen going into the Interior. Replete with every comfort. Smoking, Dining, Drawing, Billiard, and Reading Rooms. Three Bath Rooms (Shower Bath). Stabling for Forty Horses.

INCLUSIVE TERMS, 10s. 6d. PER DAY.

Attached to the Hotel are the large Wholesale and Retail Stores of Messrs. Dixon & Co., As excellent Big Game Shooting may be enjoyed about Six Days from Mafeking, this well-known firm will provide capable Guides for Sportsmen, Ammunition and Arms of every description, Waggons and Oxen, Complete Outfits, &c., at reasonable rates.

The Royal Mail Coaches to and from Vryburg to Palapye, Macloutsie, and Mashonaland arrive and depart from Dixon's Hotel.

DIXON & CO. { MAFEKING, BECHUANALAND. DUTOITSPAN, GRIQUALAND WEST. BEACONSFIELD, GRIQUALAND WEST.

Figure 3. Mafeking as a Base for Hunting Tourism in Colonial Bechuanaland (*Source: Nicholls and Eglington, 1892*).

Outside of the Northern Transvaal a scatter of other localities were promoted as destinations or basing points for prospective sportsmen hunters. The small town of Vryburg in the north of Cape Province functioned as the capital of Bechuanaland (modern Botswana). With the abundance of game in the 'hunters paradise' of

Bechuanaland its importance, like Pietersburg, was as a centre for making organizational arrangements for shooting parties (South African Railways and Harbours, 1928). Likewise, there is evidence that the town of Mafeking assumed a similar role (Figure 3). In the Orange Free State the town of Kroonstad early laid claim in the 1920s to opportunities in its surrounds for the shooting on local farms of wildebeest, blesbok, springbok and smaller game (South African Railways and Harbours, 1921). During the 1930s it is observed there is a noticeable reduction in the attention given to sportsmen and hunting in the national tourism promotion literature produced by SAR& H. In a 1934 survey only brief mention was given to the potential for 'big game and other shooting' in the Northern Transvaal, Orange Free State, Cape Province, Bechuanaland and Rhodesia (South African Railways and Harbours, 1934). Likewise, in a major national statement of South Africa's tourism assets which appeared in the late 1930s the same territories were identified (Carlyle-Gall, 1937). The statement was added, however, that "*the sportsman who contemplates a shooting holiday in Southern Africa is advised first to become au fait with the country's game laws, conditions governing the issue of licences, etc*." (Carlyle-Gall, 1937, p. 12).

Conclusion

The original contribution of this study is to explore in a Global South context the role of sport in the early evolution of a tourism destination. Over a decade ago Huggins (2013, p. 107) observed that "*until comparatively recently historians of tourism have largely paid little attention to sport, despite its historically important role as a major tourist attraction*". It was demonstrated that from the 1890s the wildlife assets of Southern Africa were promoted to attract 'sportsmen' hunters, mainly from Britain, where there existed a long tradition of hunting as elite sport.

Hunting in South Africa can be interpreted as an element of what has been termed 'consumptive wildlife tourism'. This form of sport was only made possible following the restrictions introduced in the country both to regulate hunting and enact conservation measures to protect wildlife following the decimation of animal populations in previous years. Accurate statistics of the numbers of sportsmen hunters attracted to South Africa, however, cannot be determined. The actual numbers cannot be more than a few thousands. This said, it is clear that from the 1890s consumptive wildlife tourism became an additional element among the range of attractions of South Africa promoted to international tourists, most of whom arrived in Cape Town from ocean trips beginning in Britain. Overall, unlike the New Zealand example, it is not the case that the early tourism economy of South Africa was in any way built upon the foundations of hunting tourism as a wide range of tourism assets were on offer. Nevertheless, for certain regions of the country the hunting of wildlife did constitute a leading element for the local tourism economy.

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The Impact of Smoking on the Mental Health of male Athletes Participating in Official Competitions

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Abstract: This study aimed to examine the impact of smoking on mental health among male athletes in Setif in 2025. A total of 139 athletes randomly selected from various official sports events participated in this study. The sample included 29 smokers and 110 nonsmokers, reflecting the typically lower prevalence of smoking in athletic populations. Mental health was assessed using the 28-item version of the Goldberg and Williams scale, translated by Wadi (1999), which measures four key dimensions: severe depression, anxiety and insomnia, psychosomatic health, and social functioning effectiveness. The scale demonstrated good internal consistency, with Cronbach's alpha values ranging from 0.724 to 0.783 across subscales. Normality of the data was evaluated using the Shapiro-Wilk test, which indicated that most variables deviated from a normal distribution, particularly among nonsmokers. Therefore, the Mann-Whitney U test was used for group comparisons. The results revealed significant differences in severe depression, anxiety, insomnia, and total mental health scores, with non-smokers consistently achieving higher scores than smokers. No significant differences were observed in the effectiveness of psychosomatic and social functioning. This study recommends increasing awareness of the mental health risks of smoking among athletes, particularly regarding mood and sleep. It also suggests that coaches and sports organizations should adopt stricter anti-smoking policies and provide support for athletes who smoke. Further research with a larger and more balanced sample is required to confirm these findings.

Keywords: mental health, Smoking, athletes, competitive, sports

Introduction

Mental health is considered a fundamental determinant of an individual's competence and ability to adapt to the demands of daily life. Its significance is even greater in athletic settings where athletes face high levels of physical and psychological pressure and are required to maintain balanced performance and sustained psychological stability. Mental health plays a key role in regulating emotions, motivating drivers, and supporting concentration and communication. Thus, it is a critical factor in determining both athletic performance and psychological well-being, especially among athletes participating in high-level official competitions.

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Despite advances in physical and psychological preparation methods, many athletes continue to suffer from psychological disorders, such as anxiety, depression, mood disorders, and psychosomatic health issues (Gouttebarge et al., 2019; Runacres & Marshall, 2024). Among the behavioral factors and lifestyle patterns that affect mental health, smoking is a common harmful behavior among athletes (Ferenczi & Lenténé, 2022). A study by Osullivan et al. (2021) revealed that the smoking rate among a sample of 546 athletes was 16%, while Chagué et al. (2024) reported that nearly 64.9% of smokers smoked within two hours of exercise. Evidence suggests that competition-related pressures, injuries, performance stress, and personal problems may lead athletes to adopt negative coping mechanisms such as smoking. Knettel et al. (2023) indicated that lower religious and spiritual coping was associated with a higher likelihood of alcohol use and risky drug-related behaviors, while smoking is sometimes used as a means to alleviate stress and anxiety, or as an illusory aid to concentration. Mündel (2017) noted that nicotine use is particularly high among athletes, especially in team sports, potentially for reasons related to motivation, anxiety reduction, or even social habits.

Nevertheless, such behaviors negatively impact physical capacity, psychological resilience, and overall health. Smoking undermines the physiological efficiency of elite athletes and impairs respiratory functions (Aydin, 2023; Đorđević Šaranović et al., 2019a). Psychologically, it also affects athletes' ability to control their emotions. Yazici and Mergan (2022) found that athletes who smoke or consume alcohol exhibit higher levels of anger and aggression. Additionally, smoking can adversely affect the core cognitive function of athletes. It has been reported that tobacco-using athletes may experience impairments in executive functions, which are crucial for strategic decision-making and performance in multidisciplinary sports (Wang et al., 2024).

Although several studies have highlighted the prevalence of smoking and its individual effects, a knowledge gap remains regarding the in-depth understanding of the impact of smoking on mental health indicators (such as freedom from major depression, anxiety and insomnia, psychosomatic health, and the effectiveness of social functioning), particularly among athletes participating in official competitions who are exposed to unique pressures that may interact differently with smoking behavior. This phenomenon constitutes a significant health problem in sports because of the negative impact of smoking on athletes (Asar et al., 2025). In light of the above, the problem addressed in this study emerges from the need for a deeper understanding of the extent to which smoking affects the mental health of this group and to determine whether there are statistically significant differences between smoking and non-smoking athletes across various dimensions of mental health. This study aims to investigate the extent to which smoking affects the mental health of athletes participating in official competitions.

Methodology

Participants

The study sample consisted of 139 male athletes who were randomly selected from various official sports events held in Setif in 2025. The participants had a mean age of 23 years and an average training experience of 6 years. Of the 166 distributed

questionnaires, 27 incomplete responses were excluded, resulting in a final validated sample of 139 completed questionnaires as it is showed in table 1.

It is noteworthy that the number of smokers in the study sample was considerably lower than that of non-smokers. This distribution can be attributed to the specific characteristics of the sample, which consisted exclusively of the athletes. Numerous studies have shown that athletes are generally less likely to engage in smoking behaviors than the general population, primarily because of the negative impact of smoking on physical performance, endurance, and overall health. Sports participation is often associated with greater health awareness and a stronger commitment to maintaining optimal physiological functioning, which may discourage smoking (Agaku et al., 2015; Đorđević Šaranović et al., 2019b; Xiaogang et al., 2021). Additionally, the influence of coaches and the sporting environment plays a significant role in deterring tobacco use. Coaches frequently advise athletes about the detrimental effects of smoking on performance, and some sports programs have strict policies against tobacco use. Notably, many coaches consider tobacco use grounds for suspension, which helps reduce smoking rates among athletes(Cohen, 1993). Consequently, the lower prevalence of smoking among athletes in this study is expected and consistent with previous literature, reflecting the health-conscious lifestyles typically adopted by those involved in competitive sports.

Table 1. Research participants

		N	Percentage
Gender	Individual	59	42,44
	Team	80	57,55
Type	Individual	59	42,44
	Collective	80	57,55
Smoking	Smokers	29	20,68
	Non-Smokers	110	79,13

Tools

The Mental Health Scale

This scale was developed by Goldberg and Williams and is considered to be one of the most widely used instruments for assessing mental health. The scale is available in four versions; in this study, the 28-item version was used, based on the translation by Wadi (1999). This version comprises four dimensions (Wadi, 1999). The scale consists of six positive and 15 negative items. The respondents selected answers that were applicable to them from among the three alternatives. For the positive items, the responses were scored as follows: “Always” (3), “Sometimes” (2), and “Never” (1). Scoring was reversed for the negatively worded items. Accordingly, the total score ranged from 21 to 63, with a score of 21 indicating low mental health and 63 indicating high mental health as showen in table 2.

Table 2. Distribution of positive and negative items across mental health dimensions

Dimension	Positive Items	Negative Items	Total Items
Severe Depression	\	21, 22, 24, 25, 26, 27, 28	7
Insomnia and Anxiety	\	8, 9, 16, 17, 23	5

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Psychosomatic Health	1	2, 4, 5, 6	5
Social Functioning Effectiveness	11, 12, 14, 18	\	4
Total	5	16	21

Psychometric proprieties

Internal consistency validity and correlation coefficients were assessed between each dimension score and the total score on the Mental Health scale, as shown in Table 3.

Table 3. Internal consistency and item-total correlations for mental health scale dimensions

	Items	Correlation Coefficient	Cronbach's Alpha
Freedom from Severe Depression	7	,859**	,724
Freedom from Anxiety and Insomnia	5	,747**	,754
Psychosomatic Health	5	,723**	,774
Social Functioning Effectiveness	4	,653**	,783
Total score	21	/	0,93

The table displays item-total statistics for the mental health scale dimensions. The corrected item-total correlation values for the subscales ranged from 0.548 to 0.799, indicating moderate-to-strong associations between each dimension and the overall scale. This suggests that all dimensions contribute meaningfully to the construct being measured, and the values for Cronbach's alpha if items are deleted are within an acceptable range (0.724 to 0.783), demonstrating that removing any single dimension would not substantially improve the overall internal consistency of the scale. These results support the reliability and coherence of the instrument, confirming that each dimension is integral to the internal consistency of the scale. Overall, the findings provide evidence for the satisfactory reliability of the scale and justify retaining all the dimensions in the final measurement model.

Statistical analysis

All statistical analyses were performed using SPSS version 26. The internal consistency of the mental health scale and its subscales was evaluated using Cronbach's alpha coefficients and corrected item-total correlations, confirming satisfactory reliability across all dimensions. The normality of the distribution for each mental health dimension was assessed using the Shapiro-Wilk test. Descriptive statistics were calculated to summarize the sample characteristics and mental health scores. For inferential analysis, the Mann-Whitney U test was used to compare mental health dimensions and total scores between smokers and nonsmokers.

Result

Before conducting inferential statistical analyses, the distribution of the data for each dimension of mental health was assessed to determine the extent to which it conformed to the normal distribution. This is also presented in the table.

Table 4. Normality test results (Shapiro-Wilk) for mental health dimensions among smokers and non-smokers

Dimension / Variable	Group	Shapiro-Wilk	df	Sig.	Distribution
Freedom from Severe Depression	Smokers	0.902	28	0.013	Non-normal
	Non-Smokers	0.772	110	0.000	Non-normal
Freedom from Anxiety and Insomnia	Smokers	0.941	28	0.120	Normal
	Non-Smokers	0.966	110	0.006	Non-normal
Psychosomatic Health	Smokers	0.926	28	0.049	Non-normal
	Non-Smokers	0.917	110	0.000	Non-normal
Social Functioning Effectiveness	Smokers	0.895	28	0.009	Non-normal
	Non-Smokers	0.901	110	0.000	Non-normal
Total Mental Health Score	Smokers	0.931	28	0.064	Normal
	Non-Smokers	0.943	110	0.000	Non-normal

Table 4 present the results of the Shapiro-Wilk test for normality across the main mental health dimensions among smokers and non-smokers. The findings indicate that the majority of the variables deviate from a normal distribution, particularly among non-smokers, where all dimensions except "Freedom from Anxiety and Insomnia" and "Total Mental Health Score" yielded significant results (p 0.05), indicating approximately normal distributions for these variables within this subgroup. These results highlight the heterogeneity in the distribution of mental health scores across smoking status and underscore the necessity of employing non-parametric statistical methods for subsequent group comparisons. The observed deviations from normality, especially among non-smokers, may reflect the underlying variability in mental health outcomes associated with smoking behavior, further justifying the use of robust statistical approaches in the analysis.

Despite the noticeable difference in group sizes (29 smokers vs. 128 non-smokers), the Mann-Whitney U test remains statistically appropriate, as this non-parametric test does not require equal group sizes and is robust to such imbalances. Furthermore, the sample size of the smaller group met the minimum requirements for robust statistical analysis, ensuring sufficient power to detect meaningful differences. This distribution reflects the real-world prevalence of smoking among athletes rather than a methodological bias (Bindak, 2014; MacFarland & Yates, 2016; Nachar, 2008).

Table 5. Mann-Whitney U test results for mental health dimensions among smokers and non-smokers

Dimension	Group	Mean Rank	U	Sig
Freedom from Severe Depression	Smokers	47.32	919	0.001
	Non-Smokers	75.15		
Freedom from Anxiety and Insomnia	Smokers	40.93	740	0.000
	Non-Smokers	76.77		
Psychosomatic Health	Smokers	59.30	1254.5	0.120
	Non-Smokers	72.10		
Social Functioning Effectiveness	Smokers	61.88	1326.5	0.246
	Non-Smokers	76.45		

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Table 5 summarizes the results of the Mann-Whitney U test comparing mental health dimensions between smokers and non-smokers. The findings reveal statistically significant differences in the dimensions of "Freedom from Severe Depression" (U = 919, p = 0.001) and "Freedom from Anxiety and Insomnia" (U = 740, p < 0.001), with non-smokers exhibiting substantially higher mean ranks than smokers. These results suggest that non-smokers experience lower levels of severe depression, anxiety, and insomnia than their smokers. In contrast, no significant differences were observed between the two groups in the dimensions of "Psychosomatic Health" (U = 1254.5, p = 0.120) and "Social Functioning Effectiveness" (U = 1326.5, p = 0.246), indicating that smoking status did not appear to significantly impact these aspects of mental health among the studied athletes. Overall, the results highlight the selective negative effects of smoking on certain psychological dimensions, particularly those related to mood and sleep, whereas other aspects of psychosomatic and social functioning remain relatively unaffected.

Table 6. Mann-Whitney U test results for mental health scores among smokers and non-smokers

Variable	Group	Mean Rank	U	Sig.
Mental Health	Smokers	42.18	775	0.000
	Non-Smokers	76.45		

Table 6 presents the results of the Mann-Whitney U test comparing the overall mental health scores between smokers and nonsmokers. The analysis revealed a statistically significant difference (U = 775, p < 0.001), with non-smokers exhibiting a substantially higher mean rank (76.45) than that of smokers (42.18). This finding indicates that non-smokers reported better overall mental health than their smoking counterparts. The significant disparity underscores the detrimental impact of smoking on general mental health status among the athletes studied, further highlighting the importance of preventive strategies and targeted interventions to reduce smoking and promote psychological well-being in this population as showed in figure 1.

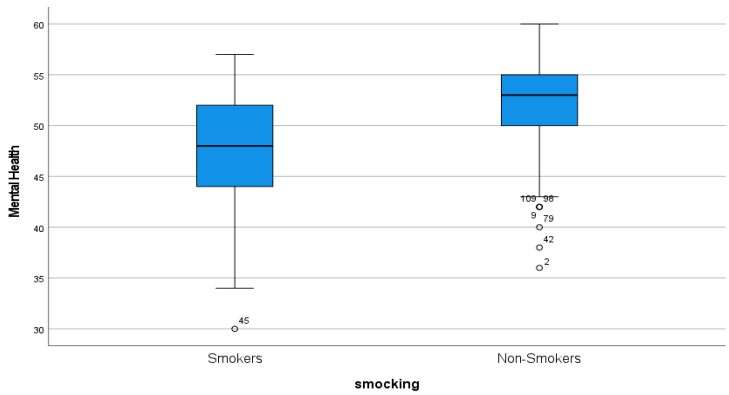

Figure 1. Comparison of mental health scores between smokers and non-smokers among

Discussion

This study aimed to investigate the impact of smoking on various dimensions of mental health in professional athletes. This research focused on four main dimensions of mental health: freedom from severe depression, freedom from insomnia and anxiety, psychosomatic health, and the effectiveness of social functioning. The Mann-Whitney U test was used to compare these dimensions between smoking and non-smoking athletes. The analysis revealed variability in the effects of smoking across different dimensions. While non-smoking athletes demonstrated statistically significantly higher mean ranks in the dimensions of "freedom from severe depression" and "freedom from insomnia and anxiety" than smokers, the results did not show statistically significant differences in the dimensions of "psychosomatic health" and "effectiveness of social functioning." These findings provide valuable insights into the differential effects of smoking on various aspects of mental health among semi-professional athletes, which will be discussed and interpreted in greater depth in the subsequent sections.

The results indicated statistically significant differences in the dimensions of freedom from severe depression and freedom from insomnia and anxiety, with non-smoking athletes recording substantially higher mean ranks than their smoking counterparts did. This advantage among non-smokers can be attributed to the well-documented negative psychological effects of nicotine, which are associated with changes in neurotransmitter levels related to mood and emotional stability, such as serotonin and dopamine. Nicotine leads to marked changes in specific brain regions associated with behavior and emotions (Pascual et al., 2009; Richard et al., 2024). Although dopamine release is temporarily enhanced, creating a reward-like effect, withdrawal causes sharp mood fluctuations and exacerbates anxiety and depression. Furthermore, smoking may contribute to worsening the symptoms of depression and anxiety disorders. Altun (2021) indicated a significant and clear association between nicotine dependence and depression, anxiety, and psychological distress, whether through direct physiological effects or otherwise. Additionally, smoking may exacerbate feelings of social isolation, guilt, or reduced self-esteem among athletes. Previous studies have shown that individuals experiencing severe social isolation were more than five times more likely to smoke compared to those who were not isolated, while avoiding isolation reduced the risk of smoking and thus lowered depression (Copeland et al., 2017). Smoking also has a negative impact, manifesting as insomnia, which, in turn, affects sleep quality among athletes. Smoking has a detrimental effect on sleep quality and architecture, increases the likelihood of sleep disorders, and heightens brain arousal at night, leading to fragmented and shallow sleep (Grigoriou et al., 2024). These factors negatively affect athletes' psychological well-being.

In contrast, the results did not reveal statistically significant differences in the dimensions of psychosomatic health and effectiveness of social functioning. Although nonsmokers had higher mean ranks, the differences did not reach statistical significance, suggesting that the impact of smoking on these dimensions may be weak or indirect. This may be attributed to the lifestyle patterns of athletes. Wang and Geng (2019) indicated that lifestyle had a significant positive effect on both physical and

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mental health among athletes. Moreover, it can be inferred that regular physical exercise, even among smokers, contributes to enhanced psychosomatic health and social functioning. Maintaining a lifelong habit of regular physical activity supports a healthier life and better quality of life (ALMutlaqah et al., 2024). Additionally, and proper nutrition plays an important role in promoting and maintaining psychosomatic health, as a balanced diet is essential for bodily health, supporting growth, strengthening immunity, protecting against chronic diseases, and improving mental health, particularly in children and adolescents (Deif & Lawlor, 2022; Fadhilah, 2024).

These findings are consistent with those of Monshouwer et al. (2021), who indicate a potential causal link between smoking and the development of psychological disorders, particularly mood and anxiety disorders, across the general population. Furthermore, smoking has other markedly negative side effects on athletes' health, diminishing their physical capacity and athletic performance (Xiaogang et al., 2021). This occurs through detrimental effects on vital bodily systems, such as pulmonary function, the cardiovascular system, and the nervous system. Supporting this, Pepera and Panagiota (2021) demonstrated that smoking negatively affects cardiovascular efficiency, even among physically active athletes.

Additionally, smoking athletes often exhibit higher rates of social isolation, feelings of guilt, and lower self-esteem, especially in sports. Matsuyama and Tabuchi (2024) found a clear association between tobacco use and social isolation, revealing that smokers experienced significant social disconnection over time. Moreover, smoking has psychological effects on athletes by reducing their psychological well-being (Barros et al., 2015). This is attributed to the influence of nicotine on norepinephrine and serotonin secretion, both of which are linked to mood regulation in athletes. As noted by Knight (2000), nicotine and cigarette smoke affect key neurotransmitters associated with depression and psychological well-being, such as dopamine (which is responsible for reward and motivation) and serotonin (which regulates mood).

Conclusion

This study demonstrated that smoking has a selective negative impact on certain mental health dimensions among male athletes, particularly on aspects related to severe depression, anxiety, and insomnia. The findings revealed that non-smokers consistently scored higher on measures of mental health than their smoking counterparts, while no significant differences were observed in psychosomatic health or social functioning effectiveness. The lower prevalence of smoking among the athletes in this sample reflects both the health-conscious nature of this population and the influence of sports environments and coaching staff. These results underscore the importance of addressing smoking behaviors within athletic communities to promote overall mental well-being. Based on the study's findings, it is recommended to enhance awareness initiatives regarding the mental health risks associated with smoking among athletes, with a particular emphasis on mood and sleep quality. Additionally, coaches and sports organizations should be encouraged to implement stricter antismoking policies and provide targeted psychological support and

counseling for athletes who smoke. Future research should include larger and more balanced samples of smokers and non-smokers to validate and generalize these results further.

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How eight-weeks of short interval training with plyometric and rapid running exercises effects on maximal speed and agility performance in U19 amateur soccer athletes

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Abstract: The aim of the current study was to explore the effects of an 8-week short-interval training program (SIT) including plyometric and sprint exercises on speed and agility performance in amateur young football players. Participants were divided into two groups: a Short Interval Training Group (SITG, n=13) and a Control Group (CG, n=10) receiving the traditional training. Speed was assessed with the 30-meter max-sprint test (30 m MS), while agility was assessed with the 90° sprint with turns (SWT 90°). Pre- and post-test comparisons were conducted using Wilcoxon signed-rank tests, and between-group differences were compared with Mann-Whitney U tests. The SITG showed significant improvements in both speed (pre: 4.82 ± 0.21 s, post: 4.18 ± 0.20 s, p = 0.000) and agility (pre: 6.56 ± 0.34 s, post: 6.03 ± 0.29 s, p = 0.000). In contrast, the CG did not show significant changes (30m MS: p = 0.127; SWT 90°: p = 0.177). Between-groups post-test comparisons confirmed superior performance in the SITG (30m MS: U = 93.000, p = 0.015; SWT 90°: U = 38.000, p = 0.001). The SIT program significantly enhanced speed and agility in young football players, whereas traditional training did not yield notable improvements. These findings add to evidence that the inclusion of high-intensity interval training, along with plyometric and sprint training, can optimize athletic performance, and offer coaches a useful approach to develop essential physical attributes in young players.

Keywords: team sports, short interval training, plyometric, rapid running exercises, maximal speed, agility performance

Introduction

Modern soccer is characterized by high-intensity play involving quick transitions, sudden explosive movements, and intermittent bursts of activity (Buchheit et al., 2013). As a result of this transformation toward speed, power, and agility, players have to react quickly to increasingly dynamic situations. This is especially important for adolescent athletes (particularly <19) to develop

neuromuscular power, speed, and agility to meet these increased physical demands (Lloyd et al., 2016), which will ultimately support performance in critical moments (sprint duels, rapid change of direction, explosive jumps), and increase injury resilience (Faigenbaum et al., 2016).

Football today is heavily influenced by speed and power, with players achieving unprecedented levels in both areas. Over time, shooting accuracy has improved significantly, and the challenges on the field have become increasingly demanding. Key physical attributes essential for enhanced performance include strength, explosive strength (power output), reactive strength, and speed (Ben Rouisi & Sedouki, 2023). These qualities are vital for executing high-intensity actions such as powerful shots, headers, and rapid directional changes, all of which are crucial for determining match outcomes.

The rapid evolution of football has changed game dynamics, necessitating exceptional adaptability from players. This adaptability requires quick changes in movement, explosive skill execution, and positional adjustments in response to opponents (Kharoubi Faisal et al., 2021). In competitive environments, high-intensity actions like acceleration sprints, vertical jumps, and swift directional shifts are critical for success. Each of these actions significantly influences match results, either through direct contributions to key moments or their cumulative physiological effects (Palucci Vieira et al., 2019). Therefore, enhancing lower body speed and power through targeted training is essential, as these abilities directly impact performance in high-demand situations (Ozbar et al., 2014).

Research by Fajrin et al. (2018) highlights that elite football players must possess exceptional physical attributes, including strong aerobic and anaerobic capacities, to handle repeated bursts of speed and recovery. They also require strength, flexibility, and agility to effectively the numerous sprints, directional changes, and explosive movements typical in matches. Football involves high-energy actions, such as intense sprints, rapid direction shifts, and frequent jumps—approximately 30 to 40 jumps per professional game, as noted by Söhnlein et al. (2014). While these explosive actions represent a small portion of total game time, they are crucial for influencing match outcomes (Reilly et al., 2000). The significance of explosive power and agility has become a central focus in sports research, as these qualities are essential for modern football performance, allowing athletes to execute high-speed maneuvers, including powerful shots, headers, and quick direction changes (Boukratem & Madani, 2019). Acknowledging that traditional training methods may fall short in addressing these advanced needs, researchers and coaches are exploring new training strategies to enhance the physical and technical skills of young players (Arslan et al., 2021; Reilly et al., 2000).

Coaches and trainers are increasingly modifying their strategies to address the demands of modern sports, exploring various training techniques tailored to the specific physical needs of each discipline. Methods such as short interval training, plyometrics, and fast running exercises have gained prominence. Interval training, particularly beneficial for soccer due to its stop-and-go nature, simulates game intensity by alternating high-intensity efforts with recovery periods (Cometti, 1993).

Short Interval Training (SIT), which consists of brief, maximal efforts followed by rest, has proven effective in enhancing explosive performance (Gibala et al., 2012).

High-Intensity Interval Training (HIIT), especially SIT, has demonstrated significant improvements in endurance, strength, speed, and both aerobic and anaerobic fitness. Research shows that SIT positively affects the performance of young football players, making it a vital component of training programs (Iaia et al., 2009). These methods are time-efficient and provide substantial physiological benefits, as they engage multiple energy systems simultaneously. The intense bursts characteristic of SIT promotes anaerobic adaptations, such as improved phosphocreatine resynthesis and increased glycolytic enzyme activity (Burgomaster et al., 2008). Furthermore, incorporating plyometric and fast running exercises enhances these benefits by improving motor unit recruitment and the rate of force development, particularly through optimizing the stretch-shortening cycle (SSC) (Markovic & Mikulic, 2010). Combining SIT with plyometric drills and fast running creates a strong stimulus for developing strength, power, speed, and agility, which is particularly advantageous for U19 athletes whose neuromuscular systems are highly adaptable (Lloyd & Oliver, 2012).

Recent studies indicate that Short Interval Training (SIT), which incorporates plyometrics and short sprints, significantly improves power, speed, and agility in adolescent athletes, especially U19 soccer players. Plyometric exercises, known for their explosive movements, enhance muscular power and neuromuscular efficiency, essential for quick acceleration and dynamic actions on the field (Markovic & Mikulic, 2010). Fast running drills, featuring high-intensity sprints, aim to increase anaerobic capacity and neuromuscular coordination, thereby boosting sprinting performance and agility (Sandra et al., 2023; Bishop et al., 2009). Research shows that combining SIT with plyometric drills and sprinting yields greater improvements in lower limb power and speed compared to traditional training methods (Baker et al., 2008). This approach maximizes the athletic potential of U19 soccer players by enhancing their ability to generate rapid force, change direction quickly, and improve agility, all crucial for competitive success (Faude et al., 2012). Additionally, incorporating plyometric and high-intensity interval exercises can enhance coordination and endurance in young athletes (Cormie et al., 2010). For U19 players, SIT not only boosts physical capabilities but also helps reduce fatigue and accelerate recovery, leading to improved performance during matches (Bishop et al., 2018). The focused nature of SIT makes it a practical training option for young athletes, allowing them to optimize their training time. Overall, current research supports the effectiveness of combining SIT with plyometric and fast running exercises for the physical development and performance enhancement of young soccer players (Laursen & Jenkins, 2002).

While there is increasing interest in combining various training methods, research on their collective benefits for youth soccer players remains limited. This combination has significant potential to enhance multiple performance aspects, making it an excellent choice for youth training programs. Most existing studies have examined these training protocols in isolation (Asadi et al., 2016), with less focus on their synergistic effects on strength, soccer-specific performance, speed, and agility,

areas that require further investigation (Meylan et al., 2014). This study aims to explore the effects of Short Interval Training (SIT), which includes plyometric and fast running exercises, on improving speed and agility in U19 amateur soccer players. Additionally, the research will assess whether a targeted, integrated training program can effectively enhance these essential physical skills in young athletes. Ultimately, the findings will assist coaches and trainers in developing efficient, sport-specific conditioning programs tailored to the developmental needs of U19 players, preparing them for the high-intensity demands of modern football.

Methodology

Participants

Fifteen adolescent amateur soccer players from MCN Amateur Club, competing in Algeria's second division Batna regional league, participated in this study. They were randomly assigned to two groups: the control group (CG) comprised 10 players with an average age of 18.87 ± 0.051 years, height of 175.09 ± 4.86 cm, weight of 69.64 ± 1.866 kg, and a BMI of 23.35 ± 4.82 m/kg^2. The Short Interval Training group (SITG) included 5 players with an average age of 19.00 ± 0.06 years, height of 176.05 ± 5.04 cm, weight of 70.50 ± 5.911 kg, and a BMI of 24.50 ± 5.08 m/kg^2 (Table 01). All players underwent a brief medical evaluation to confirm their eligibility, with none reporting prior surgeries or pain during testing. Before participation, detailed information about the study's objectives, procedures, variables, and potential risks was provided to the players, their parents, and coaches. The ethics committee of Mohamed Boudiaf University of M'sila, Algeria, approved the research plan on February 20, 2025.

Table 1. Participant characteristics

Variables	Groups	
	Control group (n = 10)	SIT group (n = 13)
Age (year)	18.87 ± 0.051	19.00 ± 0.06
Height (cm)	175.09 ± 4.86	176.05 ± 5.04
Weight (kg)	69.64 ± 1.866	70.50 ± 5.911
BMI (kg/m^2)	23.35 ± 4.82	24.50 ± 5.08

Notes: (HRmax) maximum heart rate; (BMI) body mass index

Design and procedures

This study examined the effects of an SIT program using plyometric and fast running exercises on various physical attributes in amateur athletes. This study sought to assess the impact of an eight-week short interval training (SIT) program, which includes plyometric and rapid running exercises, on enhancing maximal speed and agility in U19 amateur soccer players.

The study was conducted during the winter season of 2024/2025. It utilized a quasi-experimental pre-test and post-test design and lasted for eight weeks, beginning with the recruitment of participants. An experimental setup with randomized pre- and post-assessments for both the control and intervention groups was used to test the study's hypotheses. This methodology was chosen for its effectiveness in comparing participants' baseline conditions with their post-intervention outcomes, thereby allowing for attribution of changes specifically to the training intervention. To reduce potential confounding factors, two familiarization

sessions were held to acquaint participants with the testing procedures. Testing was carried out outdoors on a synthetic turf field, with participants dressed in their usual training attire and soccer cleats (Figure 01).

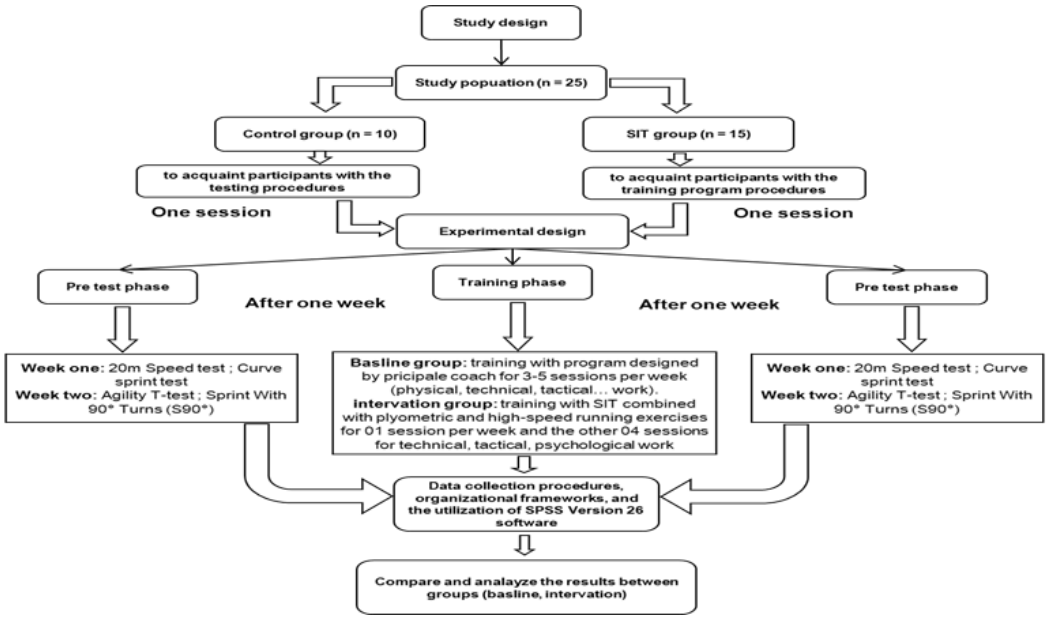

Figure 1. Study design

Training protocol

Based on diverse references and scientific sources such Gökkurt et al., (2021), the researchers developed a program of modified physical exercises aimed at improving specific physical abilities in young soccer players (Chaalal et al., 2025). While the exercises implemented in the study may not represent the most optimal options, they are versatile and applicable across different sports disciplines. These exercises were customized to align with the unique characteristics of the athletes in the experimental group (Bulz et al., 2023).

During the study period, subjects engaged in 3 to 5 soccer-training sessions weekly, each lasting between 90 and 105 minutes. Both groups underwent standard soccer training sessions lasting 8 weeks. The soccer training program included exercises that emphasized rapid footwork, technical skills involving both simple and complex maneuvers, positional games of different scales, 1 vs. 1 offensive and defensive drills, and tactical games aimed at various offensive and defensive objectives. For the experimental group, the physical training component of regular soccer practice was substituted with one session of SIT combined with plyometric and fast running exercises. These sessions were conducted at the start of the week, immediately following the regular soccer warm-up sessions, as organized by the physical conditioning coach.

The 8-week intervention included once-weekly 90-minute sessions, structured as follows: Warm-up (30 min) consisting of conventional running, bodyweight

strength and flexibility exercises, dynamic stretching, and sprint-specific drills; Main training (30–40 min) using the SIT method with combined plyometric and high-speed running exercises; and Cool-down (20–25 min) involving stretching and recovery exercises.

Table 2. Plyometric exercises with SIT method

Plyometric Exercise	Weeks							
	01 + 02		03 + 04		05 + 06		07 + 08	
	Sets	Reps	Sets	Reps	Sets	Reps	Sets	Reps
Vertical Jumps	3	8	3	10	4	8	4	10
Bounding	3	8	3	10	4	8	4	10
Lateral Plyometric Jumps	3	8	3	10	4	8	4	10
Drop Jumps	3	8	3	10	4	8	4	10
Total	96		120		128		160	
Rest Between Sets	30 sec		60 sec		60 sec		90 sec	
Rest Between Exercises	90 sec		90 sec		120 sec		120 sec	
Target intensity	85-90%		85-90%		90-95%		90-95%	

Notes: (Sets) setups; (Reps) repetition

The plyometric conditioning protocol utilizing Short Interval Training (SIT) aims to enhance maximal speed and agility over an eight-week period. The program consists of four main exercises: vertical jumps, horizontal bounds, lateral plyometric jumps, and drop jumps. In the first two weeks, participants perform three sets of eight repetitions for each exercise, with rest intervals of 30 to 90 seconds between sets and exercises, at an intensity of 85-90%. During Weeks 3 and 4, the regimen shifts to 3 sets of 10 repetitions, with longer rest periods of 60 to 90 seconds. In Weeks 5 and 6, the training progresses to 4 sets of 8 repetitions, incorporating extended rest intervals of 120 seconds and increasing the intensity to 90-95%. This periodized approach is designed to promote greater neuromuscular adaptation by systematically increasing both volume and intensity, ultimately leading to improved maximal speed and agility (Table 02).

Table 3. speed running exercises with SIT method

Weeks	Fast running program structured				
	Repetitions		Rest Between sprint	Total sprints	Target intensity
	Sets	Dits			
Week 01	3	15m	1.5 min	45m	80-85%
Week 02	4	15m	1.5 min	60m	85-90%
Week 03	5	15m	2 min	75m	90%
Week 04	3	15m	1.5 min	45m	80-85%
Week 05	4	15m	1.5 min	60m	85-90%
Week 06	5	15m	2 min	75m	90%
Week 07	6	15m	2 min	90m	95%
Week 08	7	15m	2 min	105m	95%

Notes: (Sets) setups; (Dits) distances

The speed running workouts using Short Interval Training (SIT) are structured over an eight-week period to enhance maximal sprinting ability and anaerobic capacity. Participants start with three sets of sprints in the first week, gradually increasing to seven sets by Week 8. The training emphasizes maintaining high

intensity, beginning at 80-85% of maximum effort and reaching 95% in the later weeks to boost both speed and endurance. The recovery time between sprints is standardized at 1.5 minutes during the first two weeks, allowing for full recovery, and increases to 2 minutes as volume and intensity rise from Weeks 3 to eight. The total sprinting volume starts at 45 meters in Week 1 and progresses to 105 meters by Week 8, facilitating progressive overload and adaptation. This structured approach aims to improve maximal speed performance, muscular endurance during sprints, and overall athletic performance by systematically adjusting volume, intensity, and recovery (Table 03).

The aim of this planned program was to develop muscular power and explosive strength, as well as to use various movement patterns. This, in turn, would enhance speed, coordination, and agility, providing a comprehensive SIT training program based on plyometric and rapid course exercises. This approach is an effective way for athletes to improve their performance in competitive situations.

Measures

The testing protocol started with a 5-minute conventional running warm-up, followed by 10 minutes of body-weight strength and flexibility exercises, a 2-minute dynamic stretching routine, and a 5-minute sprint-specific warm-up. Participants rested for 5 to 10 minutes between trials. Each participant performed three attempts per test, and the best result was recorded for analysis.

Table 4. Specific warm-up protocol

Phase	Duration	Components
General Warm-up	5 min	Light jogging
Strength/Flexibility	10 min	Bodyweight exercises (e.g., squats, lunges, dynamic stretches)
Dynamic Stretching	2 min	Leg swings, high knees, walking lunges
Sprint-Specific Drills	5 min	Accelerations, decelerations, short sprints
Rest between Tests	5–10 min	Active recovery (walking, light stretching)

30m maximal sprint test

The 30-meter all-out sprint is a crucial measure of linear speed in soccer players, offering insights into both acceleration and maximum velocity. This test mimics the explosive efforts required in match situations over a short distance (Figure 02). Timing was performed using a handheld Casio HS-3V-1R stopwatch by four observers, recording times to the nearest 0.01 seconds at both the start and finish lines for accuracy. The test shows high reliability, with intraclass correlation coefficients (ICC) above 0.90 (Beato et al., 2021), and has a strong correlation with on-field sprinting performance (r = 0.75–0.84) (Altmann et al., 2023). This establishes it as a standardized, sport-specific measure of linear sprinting ability in soccer athletes.

Sprint with 90° turns (S90°)

The Sprint with 90° Turns (S90°) test evaluates soccer players' change-of-direction speed and agility by measuring their ability to quickly decelerate, turn, and reaccelerate—key movements in match situations (Figure 02). Times were recorded using a Casio HS-3V-1R stopwatch by four observers, accurate to 0.01 seconds. The test shows high reliability, with intraclass correlation coefficients (ICC) ranging from 0.88 to 0.94 (Spiteri et al., 2022), and has a strong correlation with in-game agility metrics (r = 0.76–0.82), confirming its validity as a sport-specific measure of multidirectional speed and dynamic agility in soccer players (Chaouachi et al., 2023).

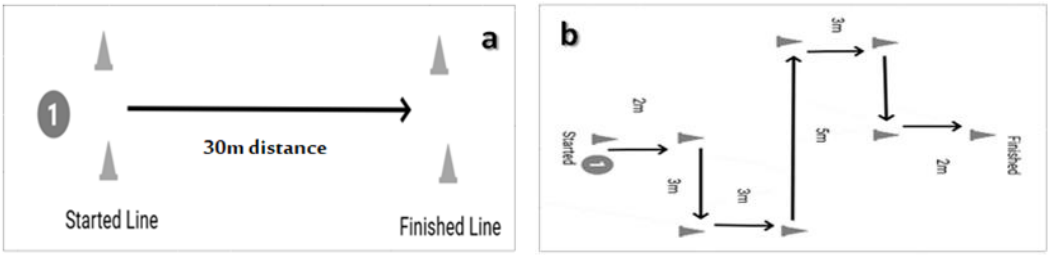

Figure 2. How performed Sprint and agility test *(a-30m maximal sprint test; b -sprint with 90° turns (S90°) set-up)*

Statistical Analysis

All values in this study are reported as mean ± standard deviation (SD). Data were organized using Microsoft Excel (Excel 2007, Microsoft, Washington, USA) and imported into SPSS (SPSS 26, IBM, Armonk, USA) for statistical analysis. Mann-Whitney tests were conducted to compare differences between the HIITG and CG groups, while Wilcoxon tests assessed within-group effects for both groups. The significance level was set at $p \leq .05$, and effect size (ES) was calculated to evaluate the magnitude of differences between groups.

Results

The analytical process in this study involved three steps: applying the Shapiro-Wilk test, Wilcoxon tests, and Mann-Whitney tests. The Shapiro-Wilk test confirmed the non-normal distribution of the data based on the pre- and post-test values of the control and SIT groups, as shown in Table 5.

Table 5. Presents the results of the normality test, which evaluates the effect of combining SIT with plyometric and fast running exercises on maximal speed and agility in young football players

Variables	test	Shapiro-Wilk			
		Statistic		Significant	
		SITG	CG	SITG	CG
30m MS test	Post	0,806	0,709	0,005	0,050
	Pre	0,764	0,635	0,024	0,008
SWT 90° test	Pre	0,948	0,850	0,045	0,009
	Post	0,909	0,827	0,041	0,012

Notes: (SITG) Short Interval Training Group ;(CG) Control Group; (30m MS) 30m Max-sprint test; (SWT 90°): Sprint with Turns 90° (S90°)

The Shapiro-Wilk normality test results presented in Table 5 indicate that the data for both the Short Interval Training group (SITG) and the control group (CG) were non-normally distributed both before and after the tests. For the 30m fast running test (30m FR), the post-test results were 0.806 for the SITG and 0.709 for the CG, with non-significant p-values of 0.005 and 0.050. The pre-test results for the 30m FR showed values of 0.764 for the SITG and 0.635 for the CG, with p-values of 0.024 and 0.008, further confirming non-normality. In the Sprint with turns 90° (SWT 90°), the pre-test results were 0.948 for the SITG and 0.850 for the CG, with p-values of 0.045 and 0.009. The post-test results were 0.909 for the SITG and 0.827 for the CG, with p-values of 0.041 and 0.012. These findings indicate that non-normality is present for all tested variables, supporting the use of non-parametric statistical methods.

Table 6. Conduct a Wilcoxon tests analyzing the pre- and post-test of 30m max-sprint and sprint with turns 90° (S90°) performance levels of both participating groups

Groups	Variables	test	Wilcoxon Tests results			
			Statistic		Z	Sig
			Mean	SD		
SITG	30m MS	Pre	4,822	0,213	-6,339	0.000
		Post	4,181	0,201		
	SWT 90°	Pre	6,556	0,342	-7,678	0.000
		Post	6,030	0,291		
CG	30m MS	Pre	4,481	0,220	-1,526	0,127
		Post	4,499	0,224		
	SWT 90°	Pre	5,818	0,551	-1,351	0,177
		Post	5,838	0,451		

Notes: (SITG) Short Interval Training Group ;(CG) Control Group; (30m MS) 30 m Max-sprint test; (SWT 90°): Sprint with Turns 90° (S90°); (SD) Standard deviation; (Sig) significant value

The Wilcoxon test results (Table 06), revealed significant performance differences between the short interval-training group (SITG) and the control group (CG). In the SITG, both speed and agility showed improvements after the training. The 30-meter sprint times decreased from 4.82 seconds to 4.18 seconds, representing approximately a 13.3% improvement. The 90° sprint with turns also improved by 8.0%, dropping from 6.56 seconds to 6.03 seconds. On the other hand, the CG did not show any real change in performance. Their 30m sprint times barely changed, going from 4.48 seconds to 4.50 seconds, and their performance in the 90° sprint stayed the same at 5.82 seconds. These results clearly indicate that the SIT workout, along with plyometric and fast running exercises, helps boost both straight-line speed and agility in amateur young football players. Meanwhile, the traditional training methods did not lead to any noticeable improvements in these areas (Figure 03).

These results suggest that mixing plyometric and sprint exercises with the SIT method could be a great way to boost speed and agility for soccer players in their late teens. This gives coaches solid options to help players improve and get closer to the performance level of pros.

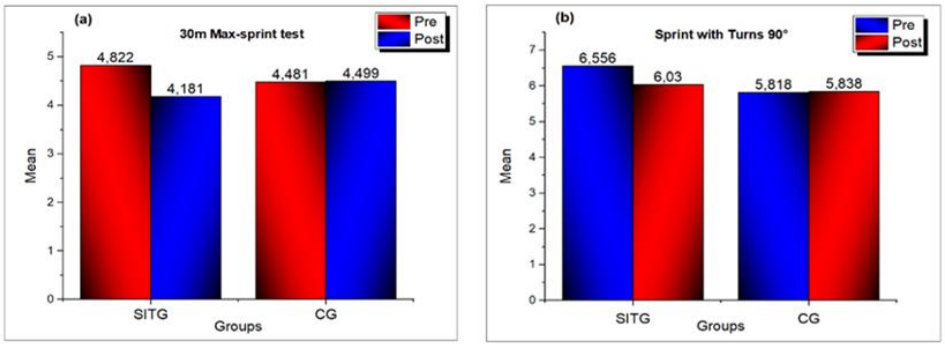

Figure 3. Compared the performance changes in (a) 30 m max-sprint test, (b) sprint with turns 90° between groups; CG = control group; SITG = Short interval training group

Table 7. Presents comparative measurements of speed and agility after the 8-week study period for both the SIT group and the control group

Variables	test	Groups	Mann-Whitney tests results			
			Statistic (Mean ± SD)	U of Mann-Whitney	Z	Sig
30m MS	Post-test	SITG CG	4,258 ± 0,248	93,000	-2,441	0.015
SWT 90°		SITG CG	4,258 ± 0,248	38,000	-3,257	0.001

Notes: (SITG) Short Interval Training Group ;(CG) Control Group; (30m MS) 30 m max-sprint test; (SWT 90°): sprint with turns 90° (S90°); (SD) Standard deviation; (Sig) significant value

The results of the 8-week intervention revealed significant improvements in both speed and agility among participants in the SIT group compared to the control group (Table 07). Specifically, the SIT group demonstrated a notable reduction in 30-meter sprint times post-intervention (mean ± SD: 4.258 ± 0.248 seconds), with the Mann-Whitney U test confirming a statistically significant difference (U = 93.000, Z = -2.441, p = 0.015). Likewise, agility, measured using the 90° shuttle run, showed significant improvement in the SIT group (mean ± SD: 4.258 ± 0.248 seconds). The Mann-Whitney test revealed a highly significant difference when compared to the control group (U = 38.000, Z = -3.257, p = 0.001).

These findings underscore the efficacy of a mixed short-interval training regimen that combines plyometric and fast-running exercises in improving rapid movement and change-of-direction capabilities. The findings indicate that incorporating targeted high-intensity training methods can significantly improve speed and agility. This highlights the value of including plyometric and sprint-focused exercises in training programs to maximize athletic performance.

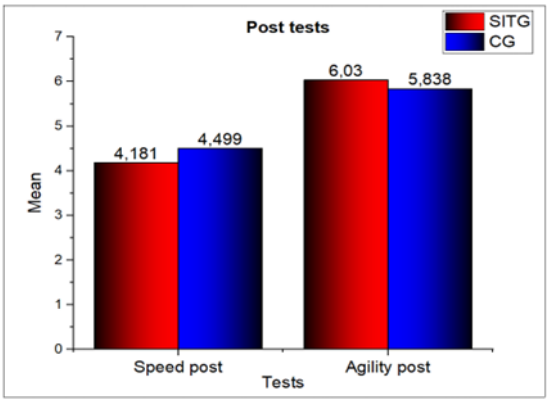

Figure 5. Mean post-test results of speed and agility performance for control group versus short interval training group

Discussion

This study aimed to determine if an 8-week integrated short interval training (SIT) program, which combined plyometric and sprinting exercises, could enhance maximal speed and agility in U19 amateur soccer players. The results revealed significant improvements in sprint performance and change-of-direction ability for the intervention group after the training. These findings are consistent with research showing that high-velocity, explosive resistance training enhances neuromuscular activation and anaerobic energy system performance (Xu et al., 2023). Additionally, studies indicate that plyometric exercises on rigid surfaces improve the stretch-shortening cycle, resulting in better jumping performance and reactive strength (Cormie, McGuigan, & Newton, 2010). Brief, high-intensity sessions typical of SIT, a type of high-intensity interval training (HIIT), promote essential physiological adaptations for athletic performance (Buchheit & Laursen, 2013). Engaging high-threshold motor units, including Type II muscle fibers, through explosive exercises may provide unique benefits, although further research is needed to fully understand their effects on athletic performance (Cormie et al., 2011).

This study highlights the effectiveness of an eight-week SIT protocol that integrates plyometric and sprint training to enhance maximal speed and agility in U19 amateur soccer players. The intervention group showed significant improvements in both maximal speed and dynamic change-of-direction performance, while the control group exhibited minimal changes. The superior outcomes in the experimental group can be attributed to the use of multi-planar plyometric exercises, such as vertical jumps, bounding, lateral jumps, and drop jumps, combined with progressively increasing sprint distances. These exercises fostered greater neuromuscular adaptations compared to single training methods, as noted by Sánchez-Ottado et al. (2025). The physiological improvements stem from enhanced stretch-shortening cycle (SSC) efficiency through high-velocity eccentric-concentric transitions, as demonstrated by Abdelkader (2025) in young athletes. Furthermore, incorporating sprint-specific intervals in the training not only increased anaerobic power and

refined stride biomechanics but also directly improved on-field agility during challenging match situations (Gürkan & Söyler, 2025).

However, only the experimental group demonstrated statistically significant improvements between the initial and final mean values, indicating that the intervention program positively influenced the development of physical qualities (Liber, O.T., & Hanţiu, I., 2023). The analysis of pre- and post-test performances using Wilcoxon signed-rank tests indicated significant improvements in the Speed and Intensity Training Group (SITG) for both the 30-meter maximum sprint (MS) and the 90° turn sprint (SWT 90°). The SITG demonstrated a notable reduction in mean times for the 30m MS, decreasing from 4.822 ± 0.213 seconds before the intervention to 4.181 ± 0.201 seconds after, with a Z-value of -6.339 and $p < 0.001$. Similarly, their performance in the S90° task improved significantly, with mean times dropping from 6.556 ± 0.342 seconds to 6.030 ± 0.291 seconds, supported by a Z-value of -7.678 and $p < 0.001$. These findings are consistent with recent research by Yue et al. (2025), which highlighted that structured high-intensity training enhances neuromuscular efficiency and anaerobic power, vital for soccer performance. Laidi et al. (2025) also emphasized the benefits of short interval training combined with intensive exercises for neuromuscular adaptations in soccer. Thus, incorporating plyometric and rapid-court exercises into training programs is essential for optimizing athletic performance in youth soccer, fostering both immediate gains and long-term muscular and neuromotor development (Mujika & Padilla, 2000).

In contrast, the control group (CG) showed no statistically significant changes in either variable, with p-values of 0.127 and 0.177. These results underscore the effectiveness of the specialized SIT program, which incorporates plyometric and rapid course exercises, in enhancing maximal speed and agility among U-19 soccer players. This aligns with a recent systematic review by Chen et al. (2025), which highlights the benefits of multi-directional movement training, particularly when combined with plyometrics, for improving key performance indicators like jump height, speed, and change-of-direction ability in young athletes. The significant gains observed in the SITG emphasize the importance of targeted plyometric and rapid movement training for boosting athletic performance, especially in activities requiring explosive speed and directional changes. Existing literature supports that structured plyometric training can lead to substantial improvements in sprinting and agility, crucial for soccer performance (Miller et al., 2006). These findings advocate for coaches and sports scientists to prioritize high-intensity, plyometric-focused training in youth soccer development programs, in line with contemporary evidence for targeted, performance-oriented conditioning (Hung et al., 2025).

The post-test comparison analysis (Table 06) revealed significant improvements in maximal sprinting speed (30m MS) and agility (SWT 90°) for the short interval-training group (SITG) compared to the control group (CG). The SITG recorded a time of 4.258 ± 0.248 seconds in the 30m maximal sprint, with the Mann-Whitney U test showing a value of 93.000, a Z-score of -2.441, and a p-value of 0.015, indicating a significant difference from the CG. In the SWT 90° test, the SITG also achieved faster times (4.258 ± 0.248 s), with even greater statistical significance ($U = 38.000$, $Z = -3.257$, $p = 0.001$). These results highlight the effectiveness of the SIT

protocol, which includes plyometric drills and rapid coursework exercises, in enhancing linear speed and multidirectional agility among U19 amateur soccer players. The improved performance of the SIT group offers a competitive advantage, as maximal sprint speed and agility are known to influence match outcomes in about 68% of scoring opportunities (Faude et al., 2012).

The significant improvements seen in the SITG align with recent findings on the neuromuscular and metabolic adaptations resulting from high-intensity short interval training. For example, Iaia et al. (2009) showed that sprint interval training boosts type II muscle fiber recruitment, which is crucial for explosive acceleration. Additionally, Buchheit and Laursen (2013) found that incorporating plyometrics into SIT enhances the efficiency of the stretch-shortening cycle, enabling faster change-of-direction movements. In contrast, the minimal progress in the control group indicates that traditional training lacks the necessary intensity and variety to foster significant gains in agility and speed. A systematic review by Sun et al. (2025) supports this, noting that speed, agility, and quickness (SAQ) training effectively improves sprint performance and reaction time in young athletes. Since maximal sprinting and rapid acceleration/deceleration comprise over 80% of critical in-play actions in soccer (Faude et al., 2012), SIT's ability to enhance these skills highlights its sport-specific relevance. The emphasis on plyometric and rapid movement training in SIT is particularly effective for improving essential performance metrics like speed and agility, which are vital for U-19 soccer players. Enhanced quickness and change of direction contribute to better match play and tactical adaptability (Sun et al., 2025). The lack of significant improvement in the control group underscores the limitations of generic conditioning programs that often do not address the high-velocity, multi-planar demands of modern soccer (Zheng et al., 2025). Therefore, integrating SIT protocols that focus on plyometric and rapid movement drills is a valuable strategy for enhancing the physical performance of adolescent soccer players, in line with contemporary training principles aimed at improving neuromuscular efficiency, power, and agility (Hammami et al., 2023).

These findings emphasize the need to incorporate structured, high-intensity sprint interval training (SIT) that includes plyometric and agility components into the training programs for adolescent soccer players. Such interventions can significantly enhance speed and agility, which are vital for competitive performance and injury prevention in this age group (Ramirez-Campillo et al., 2018). Physiologically, extensive research supports the benefits of interval training, with recent meta-analyses indicating that SIT protocols yield greater improvements in both anaerobic power and aerobic capacity compared to traditional continuous training, while requiring about 40% less training time—an essential advantage for young athletes managing various commitments (Hall et al., 2023). Overall, the evidence highlights the importance of specialized SIT protocols in enhancing physical performance, making them crucial in modern athletic development strategies for youth in team sports like soccer. Future research should investigate the long-term effects of these interventions on injury prevention and technical performance under fatigue, areas that remain under-explored in young athletes (Aloui et al., 2021). Nonetheless, the current data strongly advocate for including SIT that combines plyometric and agility

elements in standard training regimens for U19 soccer players to optimize their physical capabilities.

This study reveals significant differences in maximal speed and agility between the experimental group that participated in the Short Interval Training (SIT) program and the control group that followed a standard training regimen. However, the small sample size of 30 participants limits the generalizability of these findings. Additionally, relying on only two physical assessments may impact measurement accuracy. Future research should involve larger, more diverse groups and utilize more objective and comprehensive testing methods to enhance precision. Investigating other training modalities and combining various approaches could yield deeper insights into performance enhancement. Despite these limitations, the results support the effectiveness of the SIT program, which includes plyometric training (PT) and rapid course exercises, in improving fitness and performance among young athletes.

This study emphasizes the importance of including targeted physical training interventions, like short-interval workouts combined with plyometric and sprint exercises, to improve athletic performance in U19 amateur soccer players. Over an eight-week period, this type of training can significantly enhance maximal speed and agility, which are essential for competitive soccer. Implementing structured and scientifically designed training programs not only improves physical abilities but also promotes discipline, resilience, and mental focus—qualities that are valuable both on and off the field. These findings highlight the potential benefits of integrating specialized training modalities into youth sports development, ultimately contributing to the athletes' overall growth and success in their athletic careers.

Conclusions

The trial results strongly demonstrate the effectiveness of the 8-week short interval training (SIT) program, which incorporates plyometric and fast-course exercises, compared to traditional training methods. The SIT group achieved significant improvements in maximal sprint speed, with a 13.3% reduction in 30m sprint time, and an 8.0% enhancement in change-of-direction agility as measured by the SWT 90° test, both statistically significant ($p<0.001$). In contrast, the control group showed minimal changes, with mean 30m sprint times slightly increasing from 4.481s to 4.499s and no measurable improvement in agility. Post-intervention comparisons confirmed that the SIT group had significantly better performance in both speed ($p=0.015$) and agility ($p=0.001$) compared to the control group.

These findings highlight the effectiveness of a periodized high-intensity short interval training (SIT) program in enhancing soccer-specific physical attributes in U19 players. The observed improvements are likely due to enhanced neuromuscular coordination and power production resulting from the combined effects of plyometric and rapid running training. Practically, these results strongly support the implementation of structured SIT protocols in youth sports programs, especially given their time efficiency and superior training outcomes compared to traditional methods. The study underscores the value of adopting science-based SIT models to maximize the athletic potential of developing soccer players.

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Investigation of the Relationship Between Dynamic Leg Force and Change of Direction Running in Youth Football Players

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Abstract: Dynamic lower limb force, characterized by explosiveness, speed, and muscular strength of the lower extremities, plays a significant role in the athletic performance of soccer players. However, previous studies have reported inconsistent findings regarding the relationship between agility and dynamic leg force. When agility is defined specifically as running involving changes of direction, the likelihood of a correlation with physical capacities such as speed and dynamic leg power increases. The present study aimed to examine the relationship between dynamic lower limb force and change of direction (CoD) performance. Specifically, we investigated how these two physical qualities relate in youth athletes aged 10 to 13 years participating in individualized training programs. Dynamic leg power was assessed using the standing broad jump test, while change of direction speed was evaluated with the T-test. The results revealed significant improvements in both measured capacities following training. However, no statistically significant correlation was found between dynamic leg force and change of direction performance. Although a weak relationship was observed, it did not reach statistical significance.

Keywords: dynamic lower limb force, agility, change of direction performance, football

Introduction

Numerous studies have investigated the role and significance of dynamic lower limb force in football, confirming that this capacity, encompassing explosiveness, speed, and muscular strength of the lower extremities, plays a key role in football performance. The research of Czimbalmos et al. (2020) highlighted that the development of dynamic leg force significantly enhances on-field performance in youth football players.

Dynamic leg power plays a crucial role in sprinting speed, as it directly influences rapid accelerations and quick changes of direction (Smirniotou et al., 2008; Alemdaroğlu, 2012; Bret et al., 2002). It is also a determining factor in change of direction (CoD) speed (Matlák et al., 2014), which is a component of agility. Within agility, researchers differentiate between perceptual and decision-making factors and the physical ability to perform rapid directional changes. The latter refers to high-speed running with directional changes not necessarily triggered by external stimuli, commonly referred to as change of direction running. Research findings on the

relationship between agility (both cognitive-perceptual and physical aspects) and dynamic lower limb force are inconsistent (Young et al., 2002; Peterson et al., 2006; Barnes et al., 2007). According to Sheppard and Young (2006), a stronger association exists between these abilities during short-distance tasks involving multiple changes of direction. Bloomfield et al. (2007) emphasized that both speed and dynamic lower limb power contribute substantially to agility. As these are trainable qualities, they were given considerable emphasis in training routines, and the development of either or both has been shown to improve athletic performance (Bloomfield et al., 2007).

Regarding the relationship between dynamic leg power and agility, when agility is defined specifically as CoD running, a stronger correlation is likely to emerge between performance variables such as speed and dynamic leg strength (Bloomfield et al., 2007).

However, studies that did not directly examine the correlation between these capacities, but instead investigated how improving one affects the other, reported mixed results. For example, high-resistance strength training did not show a meaningful effect on CoD speed, whereas programs targeting dynamic power (e.g., explosive strength training) revealed significant improvements in CoD performance (Brito et al., 2014; Hammami et al., 2016; Váczi et al., 2013; Garcia-Pinillos et al., 2014).

Matlák et al. (2014) also demonstrated that plyometric training can effectively improve agility, particularly CoD speed, in young football players.

Agility, defined as a complex movement coordination skill involving accelerations, decelerations, and directional changes, plays a critical role in football. Players are often required to make rapid decisions and adapt to constantly changing game scenarios. Agility is therefore closely related to overall performance, especially in both defensive maneuvers and offensive transitions (Sheppard & Young, 2006). A study by Chaouachi et al. (2014) showed that elite-level football players achieved significantly better results in agility tests compared to lower-level athletes, supporting the view that agility is a key determinant in performance level differentiation.

Returning to dynamic lower limb force, it has also been shown to be a major contributor to vertical jump performance, which is crucial in both offensive and defensive heading situations. Furthermore, dynamic leg power contributes to the execution of high-speed, accurate shots and long passes. The speed and accuracy of kicking actions are largely dependent on explosive lower limb strength (Trolle et al., 1993). Strength training can improve kicking performance as a result of increased force production (DeProft et al., 1988). Similar findings were reported by Taina et al. (1993), who found that maximal strength training of the lower limbs increased kicking speed.

Interestingly, Trolle et al. (1993) found that various types of resistance training did not affect kicking performance, and that high-load strength training did not improve kicking speed. Cabri et al. (1988) suggested that isokinetic strength training may be more effective for enhancing kicking performance in athletes.

The aim of our research was to investigate the relationship between dynamic lower limb force and change of direction speed, based on empirical performance data.

Based on the results, the study aims to provide recommendations for improving the effectiveness of training methods designed to enhance these performance variables.

Methodology

Although during a match the various conditional and coordinative abilities do not manifest in isolation but interact and contribute collectively to performance, their assessment is more commonly conducted using an isolated approach. In our research, with this consideration in mind, we selected several sport-specific motor tests aimed at evaluating key performance-related abilities, specifically agility and dynamic lower limb force. Given the inconsistent findings in the literature regarding the relationship between the development of these abilities, particularly between dynamic leg force and agility, we aimed to investigate what kind of correlations can be observed in the players included in our study.

While numerous parameters were assessed, the present study focuses specifically on the results related to change of direction (CoD) speed (as an indicator of agility) and dynamic lower limb force.

The study involved 15 participants, all male athletes registered in youth football teams. Their mean age was 11.67 years (SD = 0.900), indicating a homogeneous sample, as the age range was narrow (10–13 years). This provided a reliable basis for comparing agility test results while minimizing the influence of age-related variability.

The players participated in additional training sessions structured using a holistic training methodology, delivered individually or in small groups, in addition to their regular team practices. As a result, they trained 6 to 7 times per week.

Data collection occurred on two separate occasions, with a one-year interval between them. The assessments were carried out on an artificial turf surface. Each test was performed twice by the players, except for the explosive strength test, where three attempts were allowed, in accordance with literature recommendations (Csáki, 2020). For the statistical analysis, the mean execution time was used for each test, while for explosive strength, the longest distance achieved was considered.

To assess CoD speed, we used the T-test. The test area was set up within a 20x20 meter space using three cones, following the protocol described by Semenick (1990). The starting point was marked 80 centimeters before the timing gate. After crossing the photocell gate, the player sprinted 5 meters in a straight line to the first cone, performed a directional change by circling the cone, then continued 5 meters to the second cone. After a full turn around the second cone, the athlete ran 10 meters in a straight line to the third cone, circled it completely, and returned toward the first cone. Following another change of direction at the first cone, the player sprinted through the finish line. Performance was measured in seconds using the OXA Starter+ infrared gate timing system.

To measure dynamic lower limb force, we applied the standing long jump test, as vertical and horizontal jump tests are most commonly used for this purpose (Csáki, 2020; Matlák et al., 2014). The protocol followed Csáki's (2020) methodological recommendations. A 4-meter measuring tape was used to record the jump distances to the nearest centimeter. The baseline served as the starting point, from which the

athlete was required to perform a maximal jump forward using arm swing and countermovement. Each athlete completed three attempts, and the farthest jump was recorded.

We conducted both descriptive and correlational statistical analyses. For each measured variable, we calculated the mean and standard deviation. As the normality test indicated a normal distribution, we used an independent samples t-test. For the correlation analysis, a significance level of $p \leq 0.05$ was applied. In the tables, statistically significant correlations ($p \leq 0.05$) are marked with an asterisk. Data analysis was performed using the SPSS-27 statistical software.

Results and discussion

Let's first look at the results of running speed with direction changes (agility) and dynamic leg strength between the two measurement times. In the first measurement, in the agility, the average execution time on the right side was 9.78 seconds (SD = 0.717), while in the second measurement this value decreased to 9.20 seconds (SD = 0.534). This reduction indicates an improvement in the players' performance, which can be partly attributed to practice and the effect of repetition.

In the first measurement on the left side, the mean was 9.98 seconds (SD = 0.812), which also decreased in the second measurement to 9.38 seconds (SD = 0.612). The results demonstrate progress in performance on the left side as well (Table 1).

During the agility tests, a lower standard deviation was observed in the second measurement on both sides, reflecting more consistent performance among the players.

Table 1. Changes in agility test results between two measurement time points

	Measurement	Mean (sec)	SD	Asymp. Sig. (2-tailed)
Agility right	1st measure	9,86	0,717	
	2nd measure	9,24	0,534	0,000***
Agility left	1st measure	10,06	0,812	
	2nd measure	9,45	0,612	0,000***

Wilcoxon test *p≤0.05; ** p≤0.01; ***p≤0.001 Source: Own elaboration

The results of dynamic lower limb power also improved between the two measurements. The average result in the first measurement was 167.59 cm, which increased to 179.47 cm in the second measurement (Table 2).

Table 2. Changes in dynamic lower limb power test results between two measurement time points

	Measurement	Mean	Asymp. Sig. (2-tailed)
Standing long jump	1st measure	167,59 m	
	2nd measure	179,47 m	0,000***

Wilcoxon test *p≤0.05; ** p≤0.01; ***p≤0.001 Source: Own elaboration

Our main research question was whether there is a correlation between agility (change-of-direction running speed) and the explosive power of the lower limb muscles. Dynamic lower limb power, encompassing explosiveness, speed, and muscular strength of the lower extremities, plays a key role in soccer performance (Czimbalmos et al., 2020). Bloomfield and colleagues (2007) state that dynamic

lower-body power substantially contributes to change of direction running speed. Since these abilities are trainable factors, and were therefore emphasized in our training sessions, the development of one or more of them is expected to lead to improved performance (Bloomfield et al., 2007). With this in mind, we now turn to the results. Dynamic lower limb power is a crucial ability, as it plays a significant role in both speed and agility. The results indicated that no significant correlation was found between the two measured abilities. A weak correlation was observed, but it was not statistically significant. The same observation has been confirmed by several other studies: generally, only low correlations are reported between strength, speed, and agility (e.g., Sheppard & Young, 2006; Buttifant et al., 1999; Young et al., 1996). For instance, Marković (2007) reported correlation coefficients ranging between 0.33 and 0.44, which, although statistically significant, indicate only weak to moderate relationships. Strength tests, regardless of their apparent relevance, explain only a small proportion of the variance in agility performance. Similarly, in the case of reactive agility, no strong associations were found, likely due to the fact that agility is not merely a physical attribute but rather a complex interplay of physical, technical, and perceptual factors.

The literature presents divergent findings regarding the relationship between agility and Dynamic Lower Limb Power. While some studies have identified strong associations in short-distance, change-of-direction running tasks (Sheppard & Young, 2006), others investigating the effects of high-resistance strength training have reported no significant relationships (Brito et al., 2014; Hammami et al., 2016). Our findings therefore contribute to the current scientific discourse by highlighting that improvements in both explosive lower-limb power and change-of-direction running speed may independently result in substantial performance gains, yet their interrelationship is complex and influenced by multiple factors.

The correlation coefficient (ρ) for agility on the right side was -0.270, and for the left side -0.384. This indicates a weak negative correlation between standing long jump performance and agility (speed) measurements based on the second measurement. Since the coefficient ranges between -1 and +1 (where -1 represents perfect negative correlation and +1 represents perfect positive correlation), the results suggest that if any association exists, it is very weak.

The significance levels were $p = 0.295$ for the left side and $p = 0.128$ for the right side, indicating no statistically significant relationship between the two variables at the 5% significance level (significance would be considered at $p < 0.05$). Therefore, based on this sample, it cannot be conclusively stated that a true correlation exists between the two measured outcomes (Table 3).

Table 3. Results of the correlation analysis between agility and explosive lower limb power

			2nd Measurement Standing Long Jump	2nd Measurement Agility Right
Spearman's rho	2nd Measurement Standing Long Jump	Correlation Coefficient	1,000	-,270
		Sig. (2-tailed)	.	,295
		N	17	17
	2nd Measurement Agility Right	Correlation Coefficient	-,270	1,000

		Sig. (2-tailed)	,295	.
		N	17	17

			2nd Measurement Standing Long Jump	2nd Measurement Agility Left
Spearman's rho	2nd Measurement Standing Long Jump	Correlation Coefficient	1,000	-,384
		Sig. (2-tailed)	.	,128
		N	17	17
	2nd Measurement Agility Left	Correlation Coefficient	-,384	1,000
		Sig. (2-tailed)	,128	.
		N	17	17

Spearman's correlation; *p≤0.05; ** p≤0.01; ***p≤0.001 Source: Own elaboration

Sample size (N): The sample size here was 15 (N = 15), which is relatively small, so the results should be interpreted with caution, as the strength of the correlation may differ in a larger sample.

A recent study on youth soccer players of a similar age group (Franca et al., 2024) examined the relationship between Dynamic Lower Limb Power and agility. The authors reached an interesting conclusion: body composition (specifically body fat percentage) proved to be a stronger predictor of agility than vertical jump performance, which showed only moderate correlations with agility, similar to the findings of the present study. Although lower-limb explosiveness contributes to sprinting and change-of-direction ability to some extent, it is not a sufficient factor on its own and was found to be particularly relevant only for longer sprint distances (35 m). These results suggest that agility and speed are complex abilities in which, alongside muscular power development, favorable body composition plays a crucial role. Consequently, in the training programs of youth soccer players, strength development should be complemented by strategies for body weight and fat control, as well as the practice of functional, sport-specific movement patterns. Achieving optimal performance therefore requires a multidimensional development strategy that does not rely solely on lower-limb strength but also accounts for body composition and complex movement coordination.

Conclusions

In our study, we began with the premise that previous research has reported inconsistent findings regarding the relationship between agility and dynamic lower-limb strength. When agility is defined as the ability to perform sprinting with changes of direction, it is more likely that performance attributes such as speed and dynamic lower-limb strength are interrelated. The present study specifically examined this relationship, focusing on sprinting with directional changes and dynamic lower-limb strength. Our results indicated that there was no significant correlation between these two performance variables. Although a weak association was observed, it did not reach statistical significance.

Based on the findings, it can be concluded that, among male youth soccer players, the speed of sprinting with changes of direction (agility) and dynamic lower-limb strength both improved significantly over the one-year observation period; however, no significant correlation was detected between them. The performance

gains observed in agility tests for both right- and left-sided execution, along with the increases in dynamic lower-limb strength, clearly demonstrate that a structured, holistic training program effectively enhances both abilities. Nonetheless, the correlation analysis revealed a weak negative relationship, which was not statistically significant, indicating that a direct link between these two capacities cannot be confirmed in the current sample.

Our findings support previously reported evidence in the literature, suggesting that the development of dynamic lower-limb strength and agility can independently, as well as synergistically, contribute to improving soccer performance. However, detecting stronger associations would require studies with larger sample sizes and participants across different age groups and training levels. From a practical perspective, training programs should specifically address both lower-limb strength and change-of-direction sprinting, as simultaneous improvement in these qualities may contribute to players' stable and rapid performance on the field.

In summary, the correlation between the two measurement outcomes is weak and not significant; therefore, based on the current sample, it cannot be stated that there is a strong association between standing long jump performance and agility test results. The results show a trend toward a weak relationship, but it is not statistically meaningful.

Limitations of the study

This study has several limitations that should be acknowledged. First, the relatively small sample size (N = 15) limits the statistical power and the generalizability of the findings. The sample was composed exclusively of 10–13-year-old youth soccer players, meaning that the results cannot be extrapolated to other age groups, genders, or sports. Moreover, the measurement tools applied were limited: lower-limb explosive strength was assessed only through the standing long jump, and agility was evaluated exclusively with the T-test, each capturing only one aspect of these complex performance qualities. In addition, the short-term design did not allow for the assessment of long-term training adaptations, and the absence of a control group makes it difficult to attribute performance changes solely to training effects. Finally, although weak, tendential relationships were observed between dynamic lower-limb strength and agility, the correlations did not reach statistical significance, which necessitates cautious interpretation of the results.

Future research should therefore employ larger and more diverse samples, incorporate multiple testing methods, and adopt longitudinal designs to provide a more comprehensive understanding of the relationship between explosive lower-limb strength and agility in youth athletes.

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The Impact of the ROSE Summer School Program in Supporting Students' Transition to Higher Education

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Abstract: This study investigates the effectiveness of the ROSE (Romanian Secondary Education) Summer School program in supporting the transition of vulnerable high school students to higher education. The 2024 edition of the Varadinum Summer School, organized by the University of Oradea, was analyzed using a quantitative research design. A structured questionnaire with 20 items was completed by all 56 participants at the end of the program. Items addressed motivations for participation, perceived usefulness of activities, overall satisfaction, and socio-demographic characteristics. Data were analyzed using descriptive statistics (frequencies, means, standard deviations) and inferential tests (independent samples t-tests, one-way ANOVA, Pearson correlations). Findings show that 82.5% of students attended a summer school for the first time, and all expressed willingness to recommend the experience. Physical Education and Sports courses received the highest scores (M=8.9, SD=1.2), followed by career counseling (M=8.3, SD=1.8) and Geography courses (M=8.2, SD=1.8). A significant difference was found between Sports and Geography courses ($t(54)=2.36$, $p=0.02$), while study visits showed no differences. A positive correlation was observed between career counseling and Sports courses ($r=0.28$, $p=0.03$). Socio-demographic analysis revealed that most participants came from rural or low-income families, with notable proportions having parents working abroad or special educational needs. In conclusion, the ROSE Summer School – Varadinum 2024 had a positive influence on students' academic motivation, self-confidence, and perception of university life, confirming its value as an inclusive and effective intervention.

Keywords: summer school, ROSE program, educational inclusion, high school-to-university transition, participant feedback

Introduction

Reducing school dropout and facilitating the transition from secondary to higher education represent central objectives of contemporary educational policies, both nationally and internationally. Students from vulnerable backgrounds frequently face structural, economic, and psychosocial barriers that limit their access to higher education and increase the risk of educational exclusion (OECD, 2025; National Academies, 2019). In this context, targeted interventions become essential to ensure equity and inclusion.

The ROSE Program (Romanian Secondary Education Project), implemented with the support of the World Bank and the Ministry of Education, aligns with this objective. Through the Summer Schools organized annually in various Romanian universities, final-year high school students are offered the opportunity to experience university life, consolidate their academic knowledge, and strengthen their motivation to pursue higher education.

These programs combine academic courses, educational counseling, and extracurricular activities, creating an inclusive and motivating learning environment. International literature confirms the effectiveness of such initiatives, highlighting their role in reducing the phenomenon of summer melt and supporting students' adaptation to university life (Castleman & Page, 2014; Kitchen et al., 2021; Estrada et al., 2020; Kuhfeld, 2023; Brumfield, Mohammadi-Aragh, & Winkler, 2024; Lynch, 2025). Programs such as Upward Bound and GEAR UP in the United States provide further evidence that integrated interventions of this type increase access to and success in higher education for students from disadvantaged backgrounds (Perna & Swail, 2002; U.S. Department of Education, 2023). Moreover, theoretical models of experiential learning emphasize the role of interactive and practice-based activities in enhancing students' engagement and persistence (Kolb, 2015).

In recent years, the specialized literature has increasingly emphasized the importance of non-formal educational interventions carried out during the summer break, particularly for students from vulnerable groups. Such interventions contribute to preventing school dropout, maintaining motivation for learning, and developing socio-emotional and professional skills (Borodi, 2022; Câmpeanu, 2022; Por, 2022; Robinson & Salvestrini, 2020; Youth Endowment Fund, 2024; Palid, 2023). International research has shown that summer programs can significantly reduce educational inequalities and improve students' transition to higher education (Perna & Swail, 2002; Castleman & Page, 2014; OECD, 2025). At the same time, experiential learning theories (Kolb, 2015) provide a conceptual framework that highlights the role of practical and dynamic activities in enhancing motivation and academic persistence.

The ROSE Project (Romanian Secondary Education Project), implemented with the support of the World Bank, fits into this paradigm by offering students the opportunity to experience the transition to higher education through an inclusive and participatory approach. According to Eurydice (2025), the ROSE Project explicitly provides funding for bridge summer programs targeting disadvantaged students, thus confirming its systematic support at the national level. These initiatives reflect a broader European trend in which non-formal learning environments are increasingly recognized as critical mechanisms for inclusion and educational equity (European Commission, 2023).

Several examples of good practice reflect the diversity and effectiveness of summer schools organized in Romania. In Dobrogea, the program coordinated by Drăguța Hogaș combined educational activities with the rediscovery of local heritage and intergenerational cohesion. In Satu Mare, the Education – the Path to Changing the World summer school focused on personal development and inclusion, with the active involvement of teachers, parents, and volunteers. In Dej, the Holiday School

project included ecological, cultural, and sports activities in partnership with the local community, highlighting the role of collaboration between school, family, and local institutions (Papp et al., 2019; Giurgiu et al., 2023). Other notable initiatives included summer kindergartens for children with special educational needs (Câmpeanu, 2022) and thematic activities in Alba Iulia, where the idea of a balanced holiday through family education was promoted. At the academic level, the summer school Centenary + 1 / 1918–2019, organized in Sibiu and Avrig, brought together experts from multiple fields and provided an interdisciplinary framework for educational, cultural, and philosophical reflection (Bulz, 2019).

Analyzing recent initiatives and the results obtained within the ROSE Project, the significant impact of summer schools on facilitating the transition to higher education becomes evident. The active involvement of universities in fields such as Physical Education and Sports or Geography highlights a practical and student-centered approach tailored to the needs of young people from disadvantaged backgrounds (Papp et al., 2019; Herman et al., 2020). The diversity of themes and the variety of good practices demonstrate the commitment of higher education institutions to creating an inclusive and motivating learning environment.

In this respect, the implementation of ROSE summer schools in several universities across Romania confirms the active role of institutions such as Babeş-Bolyai University in Cluj-Napoca, Alexandru Ioan Cuza University in Iaşi, West University of Timişoara, and the University of Oradea. These universities have developed programs in areas including Physical Education and Sports as well as Geography.

Romanian universities have developed a wide range of summer schools and remedial programs in the field of Physical Education and Sports. The emphasis is placed on stimulating motivation for performance, career orientation, and combating university dropout. Centers such as Craiova, Galaţi, and Timişoara strongly emphasize counseling and integration through sports, while UNEFS Bucharest and other universities focus more on remedial programs.

Figure 1 details the involvement of each university, differentiated by field. The results highlight the major academic centers that implement multidisciplinary programs (e.g., Babeş-Bolyai University, Alexandru Ioan Cuza University, West University of Timişoara, University of Oradea), in contrast with institutions focusing on a single domain.

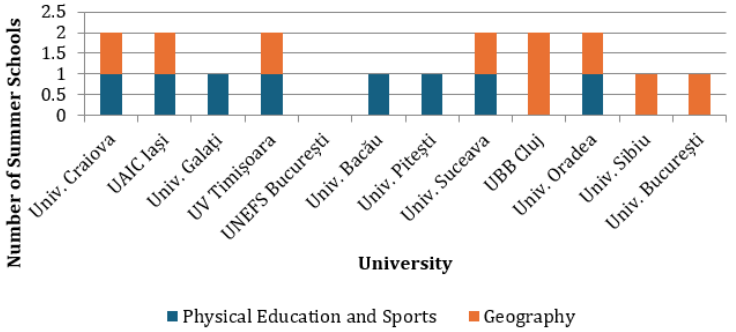

Figure 1. Distribution of summer schools by universities and fields

The data presented confirm the trend of consolidating non-formal educational programs within Romanian universities, with a stronger concentration in major academic centers and a clear openness toward multidisciplinary approaches. Against this backdrop, the present study investigates how the Varadinum 2024 Summer School integrates both national good practices and international recommendations in order to foster inclusion and academic motivation among disadvantaged students.

Previous research on the Varadinum Summer School edition of 2023 highlighted that, although students' perception of the program was predominantly positive, their motivation to pursue higher education remained relatively weak, underscoring the importance of refining program strategies (Herman et al., 2024a and b). This continuity provides a valuable framework for analyzing the 2024 edition. Recent research on the Varadinum Summer School, edition 2023, conducted at the University of Oradea highlighted that while participants' perceptions were predominantly positive, their academic motivation remained fragile. These findings reinforce the importance of continuously improving the structure and content of summer schools to ensure both satisfaction and long-term educational engagement (Herman et al., 2024a).

The present article aims to assess the impact of the ROSE Summer School – Varadinum 2024, organized by the University of Oradea, from the perspective of students' perceptions. Beyond describing satisfaction levels and socio-demographic profiles, the study also employs comparative and correlational analyses to provide deeper insights into the program's effectiveness.

Materials and Methods

To evaluate the impact of the educational program ROSE Summer School – Varadinum 2024, organized by the University of Oradea, a quantitative research design with a descriptive and inferential component was employed. The main data collection instrument was a standardized questionnaire administered to all participants at the end of the program. The questionnaire was completed anonymously, with the informed consent of respondents, and included 20 items structured into four categories: motivation for participation, perceived usefulness of activities, overall satisfaction, and socio-demographic information. Most items were closed-ended, with pre-defined response options and evaluation scales ranging from 1 to 10, allowing for the quantification of students' perceptions.

A total of 56 students from the 11th and 12th grades participated in the Varadinum 2024 edition, representing several counties across Romania. Participants were selected according to the vulnerability criteria established by the ROSE project, such as rural background, low-income families, parents working abroad, or belonging to disadvantaged groups.

The collected data were aggregated and analyzed using both descriptive statistical methods (frequencies, percentages, arithmetic means, standard deviations) and inferential statistical tests. Comparative analyses were conducted using independent samples t-tests (e.g., between Geography and Sports courses), and differences across activities were tested through one-way ANOVA. In addition, Pearson correlation coefficients were computed to explore the relationships between

career counseling and other evaluated activities. Statistical analyses were carried out using Python (pandas, scipy, matplotlib), which provided both tabular results and graphical outputs.

This methodological approach allowed not only the description of participants' perceptions but also the testing of differences and associations across variables, thereby strengthening the validity of the findings and offering a more rigorous assessment of the educational intervention.

Results

The analysis of responses collected through the questionnaire administered at the end of the Varadinum 2024 Summer School highlights several significant trends regarding participants' perceptions of the activities carried out.

Figure 2 shows that 82.5% of students attended a summer school for the first time, confirming both the attractiveness of the program for its target group and its ability to open new educational opportunities. Only a small minority (17.5%) had previously participated in similar initiatives, which indicates a strong potential for both expansion and long-term participant engagement.

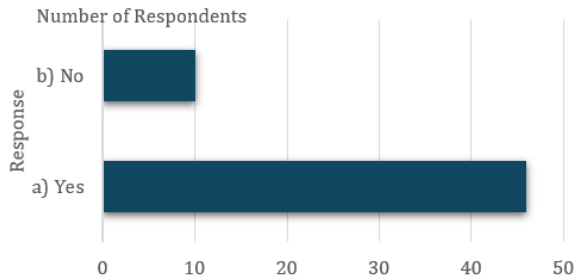

Figure 2. Participants' responses regarding first-time attendance at the summer school

With regard to the level of engagement and awareness, the results presented in Figure 3 are remarkable: 100% of respondents reported understanding the role of the activities, indicating a clear structuring of the program and effective communication between organizers and students. Moreover, the uniformly positive feedback reflects a high level of satisfaction, suggesting that participants are likely to recommend the Summer School experience to their peers, which further validates the quality of the educational intervention.

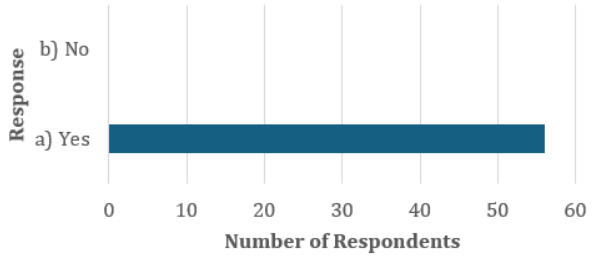

Figure 3. Participants' awareness of the role of activities

Another important element is the students' motivation for participation. According to Figure 4, the most frequent reasons were the desire to spend leisure time in a pleasant way (75.4%) and curiosity (68.4%). These were complemented by free access to the program (40%), opportunities for personal development (35%), and cultural interest (28%). Taken together, they suggest a diverse motivational profile, yet dominated by intrinsic factors (pleasure, curiosity). This diversity confirms that the summer school succeeds in attracting participants with different expectations and in responding to varied educational and social needs.

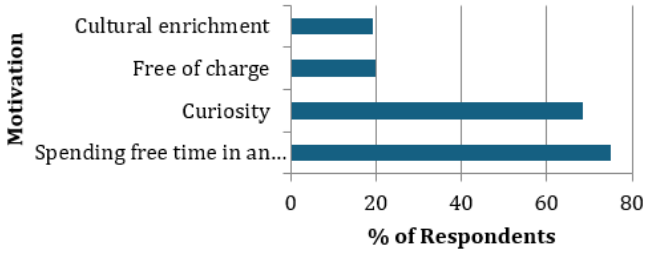

Figure 4. Motivations for participation in the summer school

The evaluation of the activities, carried out on a 1-to-10 scale, revealed very positive feedback. To facilitate interpretation, the results were synthesized in a single comparative figure (Figure 5). Career counseling sessions were perceived as extremely useful (M=8.3, SD=1.8), while Physical Education and Sports courses received the highest evaluation (M=8.9, SD=1.2). Geography courses were slightly lower (M=8.2, SD=1.8). Study visits (M=8.7) and workshops (M=8.3) in Geography were consistently rated lower than their counterparts in Sports (M=9.0 and M=8.7, respectively).

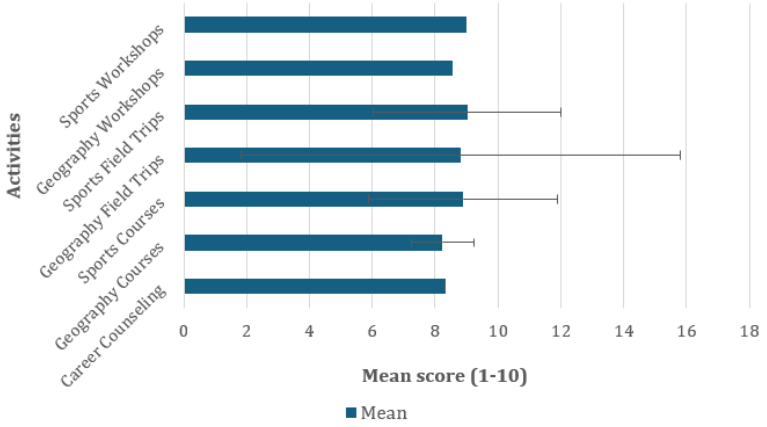

Figure 5. Perceived usefulness of summer school activities (mean ± SD)

As shown in Table 1, all activities were evaluated very positively, with mean scores ranging between 8.2 and 9.0. Sports-related activities (courses, visits, and workshops) systematically obtained higher means than Geography, while Career

Counseling also received strong evaluations (M=8.3). These descriptive results indicate that participants perceived the Summer School program as highly useful across all its components.

Table 1. Descriptive statistics (N, mean, SD) for the evaluation of summer school activities

Unnamed: 0	N	Mean	SD
Career Counseling	57.0	8.33	1.79
Geography Courses	57.0	8.23	1.79
Sports Courses	57.0	8.89	1.16
Geography Visits	57.0	8.81	1.37
Sports Visits	57.0	9.02	0.9
Geography Workshops	57.0	8.54	1.44
Sports Workshops	57.0	9.0	1.12

Building on these descriptive findings, inferential analyses confirmed some significant differences, as reported in Table 2. A t-test indicated that Sports courses were significantly better evaluated than Geography courses ($t(54)=2.36$, $p=0.02$), while the differences between Sports and Geography visits were not statistically significant ($t(54)=0.97$, $p=0.33$). ANOVA results highlighted significant overall differences across all activities ($F(3,220)=3.86$, $p=0.01$). Furthermore, a positive correlation was observed between the evaluation of Career Counseling sessions and Sports courses ($r=0.28$, $p=0.03$), suggesting a potential complementarity between professional guidance and practical, interactive experiences.

Table 2. Comparative statistical tests for activity evaluations

Test	Statistics	p-value
t-test Courses (Sports vs. Geography)	2.36	0.02
t-test Visits (Sports vs. Geography)	0.97	0.33
ANOVA (all activities)	3.86	0.01
Correlation Counseling – Sports Courses	0.28	0.03

From a socio-demographic perspective, Figure 6 shows that a significant proportion of students came from disadvantaged backgrounds. Among the 46 respondents who answered the relevant items, 67.4% reported coming from rural or isolated areas, 47.8% from low-income families, 19.6% had parents working abroad, 8.7% faced special educational needs, and 4.3% belonged to vulnerable ethnic groups. These findings highlight the inclusiveness of the program and its focus on target groups at risk of educational exclusion.

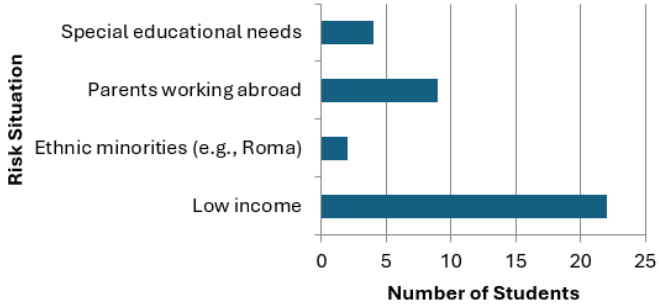

Figure 6. Risk situations identified among participants

The results show that the Varadinum 2024 Summer School succeeded not only in providing an attractive educational experience but also in effectively reaching the target audience of the ROSE project. The high level of satisfaction, the diversity of motivations, and the active participation of students from disadvantaged backgrounds confirm the program's effectiveness and its relevance for supporting the transition to higher education.

Discussion

The findings of this study demonstrate that the Varadinum 2024 Summer School achieved its primary objectives of enhancing academic motivation, broadening access to higher education, and fostering inclusion among students from disadvantaged backgrounds. The fact that 82.5% of participants attended a summer school for the first time confirms the program's accessibility and attractiveness for its target audience, which is consistent with the goals of the ROSE project. This outcome aligns with international evidence showing that preparatory summer programs can significantly reduce barriers to university entry for vulnerable students (Perna & Swail, 2002; Castleman & Page, 2014).

The high levels of satisfaction and the unanimous willingness of participants to recommend the experience suggest that the program succeeded not only in meeting but also in exceeding students' expectations. Activities perceived as most valuable—such as career counseling, Physical Education and Sports, and Geography courses—reflect the importance of combining academic preparation with personal development and experiential learning. Similar results have been reported in studies evaluating U.S. initiatives like Upward Bound and GEAR UP, which emphasize the role of integrated interventions in promoting both academic success and socio-emotional growth (U.S. Department of Education, 2023; Estrada et al., 2020).

Regarding the evaluation of activities, all scored highly (above 8 on a 1–10 scale), but statistical analysis revealed significant differences. Physical Education and Sports courses were significantly better evaluated than Geography courses ($t(54)=2.36$, $p=0.02$), while study visits showed no significant differences between the two domains. This pattern indicates that activities with a strong practical and dynamic component are more attractive to high-school students, which confirms previous literature highlighting the impact of experiential learning (Kolb, 2015). ANOVA results ($F(3,220)=3.86$, $p=0.01$) also confirmed significant differences among

activities. Furthermore, a positive correlation was observed between the evaluation of career counseling and the assessment of Sports courses ($r=0.28$, $p=0.03$), suggesting a complementarity between guidance activities and applied learning.

The diversity of motivations for participation, ranging from curiosity to personal development and leisure, highlights the heterogeneous nature of the student population targeted by the program. This confirms findings from previous research that students from vulnerable backgrounds are not a homogeneous group but have varied expectations and needs (Kitchen et al., 2021). By responding to this diversity, the ROSE Summer School contributes to reducing educational inequalities and strengthening the sense of belonging among participants, two key factors in supporting long-term academic persistence.

The socio-demographic profile of the participants further underscores the relevance of the program for vulnerable groups: students from rural areas, low-income families, or with parents working abroad represented a significant proportion of the cohort. These findings confirm the importance of tailored interventions to mitigate systemic barriers to higher education access, particularly in contexts marked by socio-economic disparities (OECD, 2025; National Academies, 2019).

Nevertheless, the study also has limitations. The relatively small sample size (56 students) and the descriptive design do not allow for generalization of the results to the entire population of ROSE participants. Future research should employ longitudinal and comparative approaches to examine the long-term effects of summer schools on academic trajectories and retention in higher education. In addition, qualitative methods, such as interviews or focus groups, could provide deeper insights into students' subjective experiences and perceived challenges.

In conclusion, this study confirms the effectiveness of the ROSE Summer School model in supporting at-risk students and reducing educational inequalities. By aligning with international evidence and adapting to the specific needs of Romanian students, the program represents a promising framework for educational policy and practice, with strong potential for replication and scaling at the national level.

Conclusions

This study confirms the effectiveness of the ROSE Summer School – Varadinum 2024 as a relevant educational intervention designed to support students from vulnerable backgrounds in their transition to higher education. The results highlight a high level of satisfaction, a clear understanding of the role of the activities, and an increased motivation to pursue university studies.

The significant participation of students at educational risk—such as those from rural areas, low-income families, with parents working abroad, or with special educational needs—demonstrates the program's capacity to meet its objectives of inclusion and equity. Thematic activities, career counseling, practical workshops, and the stimulating university environment contributed to participants' personal and academic development, strengthening their confidence in their own abilities.

Moreover, the integration of components from different fields (Sports, Geography, counseling) underscored the value of an interdisciplinary approach, reflecting European and international trends in remedial and non-formal education

(European Commission, 2023; OECD, 2025). This model can be successfully expanded to other university centers and integrated into national strategies to reduce school dropout and to promote equitable access to higher education.

In the long term, it is recommended to monitor participants after program completion, conduct longitudinal evaluations, and extend research to other ROSE summer schools. Such steps would provide more robust evidence regarding the long-term impact of summer programs on academic persistence and social inclusion. The findings of this study thus provide a solid foundation for formulating educational policies oriented toward inclusion, prevention, and active support for students in educational transition.

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Motor skills as predictors of applied route performance in Romanian Police Academy candidates

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Abstract: The purpose of this study was to investigate the contribution of different motor skills to final performance in the applied route of the Romanian Police Academy. The research included 32 candidates (male and female) preparing for admission, tested between February and March 2025 in Bihor County. The applied routeconsisted of 12 standardized obstacles, and performance was measured as total time including penalties. Descriptive statistics indicated a mean completion time of 160.29 ± 21.50 seconds, with Obstacle 12 (12 × 20 m shuttle run with cones) accounting for 52.7% of the total time. Moderate contributions were also observed for agility and coordination obstacles (Obstacles 3–9), while early elements such as Obstacle 1 had little direct influence. Pearson correlations showed that Obstacle 12 was strongly associated with total performance ($r = 0.81$, $p < 0.01$), whereas agility- and coordination-based obstacles presented moderate but significant correlations ($r \approx 0.40–0.43$, $p < 0.05$). Anthropometric variables (height, weight, BMI) were not significantly correlated with results. These findings confirm that endurance, speed, and coordination are decisive in the applied route, while morphological factors are negligible. The study highlights the need for balanced preparatory programs that combine endurance development with agility, coordination, and technical drills, to optimize candidate performance and ensure operational readiness.

Keywords: motor skills, physical performance, police academy, physical ability

Introduction

Physical readiness remains a critical determinant of police occupational performance and safety, with inadequate fitness linked to reduced task efficiency, higher injury risk, and greater absenteeism (Papp et al., 2019; Erdely et al., 2020; Orr et al., 2025). Within European and international police academies, applied obstacle-course tests are widely used to evaluate compound motor abilities (speed, strength, agility, coordination, and endurance) under time pressure and with technical accuracy, reflecting operational demands such as sprinting, vaulting, crawling, lifting/carrying, and casualty drags (Zulfiqar et al., 2021; Massuça et al., 2022; Șandra et al., 2023; Dicks et al., 2023).

Recent evidence emphasizes that these motor abilities are not independent; rather, they interact to underpin performance in complex tasks. For example, aerobic capacity and muscular endurance commonly co-vary and predict success in running- and obstacle-based assessments, while power and agility support rapid accelerations,

direction changes, and explosive actions required by obstacles (Monteiro et al., 2024). Moreover, normative datasets and multi-test batteries suggest that cardiorespiratory fitness and muscular endurance form the foundation upon which task-specific skills are layered (Bulz et al., 2024; Marins et al., 2025).

Beyond foundational fitness, reliability and validity of police-specific tasks are essential to guide training and selection. Recent analyses show acceptable test–retest reliability for obstacle crossing and highlight greater variability for tasks like victim transport and suspect arrest, underscoring the need for repeated practice and technique refinement in addition to generic conditioning (Ramos & Massuça, 2025). In parallel, programmatic evaluations at police academies indicate that fitness test batteries must align tightly with curricular goals and operational realities to remain predictive and defensible (Caetano et al., 2021; Koedijk et al., 2023; Săvescu et al., 2024).

Studies on applied obstacle courses in law-enforcement and tactical populations further support the multifactorial nature of performance. Time to completion is most consistently associated with higher levels of speed/anaerobic capacity and coordination/agility, with strength contributing notably to load-bearing segments (e.g., dummy drags), while endurance underpins consistency across successive obstacles (Dicks et al., 2023). Selection settings employing standardized obstacle courses, such as Harre's steeplechase variant for counterterrorism units, explicitly target coordination, spatial abilities, rolling and jumping mechanics, and rapid changes of direction, reinforcing the centrality of coordinative qualities alongside speed and strength (Arvey et al., 1992; Tedeholm et al., 2023).

In Romania, the applied obstacle course is formally regulated at national level for admission to Ministry of Internal Affairs (MAI) institutions. The current annex to Order no. 177/2016 defines a standardized 12-obstacle practical route, specifies execution algorithms, penalties (typically + 3 seconds), and timing thresholds, thereby anchoring selection and training to job-relevant psychomotor demands (MAI, 2016/2022). Public-facing summaries and guides reflect the same 12-obstacle structure and the emphasis on both speed and technical accuracy (AdmiterePoliție.ro, 2024; Academiadepolitie.com, 2025). Complementing these regulations, recent Romanian work with local police officers reported meaningful improvements in speed and strength after a three-month targeted program, underscoring the responsiveness of job-relevant fitness qualities to structured training (Bucur, 2024). Likewise, regional analyses advocate integrating psychophysical drills and rigorous fitness assessments into holistic police education in Romania, to better align academy curricula with operational needs (Iorga et al., 2024). These developments motivate the present study's focus on how distinct motor skills contribute to total time on the Romanian Police Academy applied route.

Accordingly, the present study examines how distinct motor skills contribute to final performance in the Police Academy applied route. We hypothesize that speed and coordination will show the strongest associations with total time; strength will be a key determinant in load-bearing and vaulting elements; and endurance will support stable performance across the entire sequence of obstacles. These

hypotheses are grounded in current evidence and aim to inform balanced, task-specific training programs for candidates and instructors

Materials and methods

Participants

The study included 32 candidates (16 male and 16 female) preparing for admission to the Police Academy. Participants were recruited from four training groups in Bihor County, Romania, and testing was conducted during a structured preparation period. The study took place between February 28 and March 15, 2025, in the sports hall of Nucet, Bihor County.

Anthropometric characteristics of the sample were: mean height 1.74 ± 0.08 m, mean body mass 72.35 ± 15.48 kg, mean BMI 23.76, classifying participants in the normal range. Both sexes were included in the analysis, as the Police Academy physical test applies the same standards regardless of gender (MAI, 2016/2022). Similar sample sizes and demographic profiles have been used in previous research on tactical populations (Dicks et al., 2023; Ramos & Massuça, 2025).

Procedure and Testing Protocol

Participants performed the 12-obstacle applied route established by the Ministry of Internal Affairs for admission to law-enforcement institutions (MAI, 2016/2022). The obstacles included sprinting, crawling under and over barriers, slalom runs, jumping over plinths, precision ball throwing, and a dummy drag.

Each candidate completed the course once under standardized conditions, following a 10-minute warm-up (running, dynamic stretching, obstacle familiarization). The execution algorithm for each obstacle was strictly respected, with penalties of +3 seconds applied for errors (e.g., incorrect technique, missed target). Performance was measured as total completion time (seconds), including penalties, using an electronic stopwatch. This protocol aligns with validated approaches for obstacle-based tactical performance testing (Zulfiqar et al., 2021; Koedijk et al., 2023).

Variables and Measures

The dependent variable was the total course completion time (s). The independent variables were the motor skills hypothesized to influence performance: Speed – sprints and direction changes; Strength vaulting and dummy drag; Agility and Coordination – slalom, rolling, precision throw; Endurance sustaining efficiency across all obstacles. In addition, the number and type of penalties were recorded for qualitative interpretation of errors.

Data Analysis

All results were tabulated in Microsoft Excel and statistically processed using SPSS v.25. Descriptive statistics (mean, standard deviation, minimum, maximum) were calculated for anthropometric and performance variables. In addition, 95% confidence intervals (CI) were computed for mean values to provide more robust estimates of central tendency and precision. Associations between motor skills and

total performance time were examined using Pearson correlation coefficients. To estimate the predictive power of specific abilities, linear regression analyses were applied. The level of statistical significance was set at $p < 0.05$, and effect sizes were interpreted according to Cohen's thresholds. Similar statistical procedures are commonly employed in police and military fitness research (Monteiro et al., 2024; Marins et al., 2025).

Ethical standards were respected according to the Declaration of Helsinki, and the study protocol was approved by the institutional ethics committee.

Results

The 32 candidates achieved a mean total completion time of 160.29 ± 21.50 s (95% CI: 149.3–171.2), with times ranging from 60.0 to 114.0 seconds across the group. The variability (SD = 21.50) highlights differences in motor skill execution efficiency. Obstacles varied greatly in difficulty: while simple elements such as Obstacle 1 (0.16 ± 0.18 s) were executed almost uniformly, Complex tasks such as Obstacle 12 (84.83 ± 16.51 s, 95% CI: 76.2–93.5) consumed most of the route duration and showed wide performance dispersion. Moderate durations were observed for agility- and coordination-based obstacles, such as Obstacle 5 (11.27 ± 2.15 s, 95% CI: 10.2–12.4) (Table 1)

Table 1. Descriptive statistics, correlations and regression coefficients for the 12 obstacles of the applied route

Obstacle	*Mean*	*SD*	*95% CI*	*Percent of Total (%)*	*Correlation (r)*	*Significance (p)*	*Regression Coeff. β)*
1 - Start Sprint	*0.16*	*0.18*	*(0.07, .25)*	*0.11*	*-0.12*	*n.s.*	*n/a*
2 - Obstacle 2	*6.92*	*1.72*	*(6.05, .79)*	*4.38*	*0.05*	*n.s.*	*n/a*
3 - Coordination	*6.42*	*2.14*	*(5.34, .50)*	*4.00*	*0.4*	*< 0.05*	*4.22*
4 - Vault/Jump	*9.46*	*2.44*	*(8.23, 0.69)*	*5.93*	*0.43*	*< 0.05*	*3.85*
5 - Crawl	*11.27*	*2.15*	*(10.18,2.36)*	*7.11*	*0.41*	*< 0.05*	*3.96*
6 - Precision Throw	*6.35*	*2.48*	*(5.09, 7.61)*	*3.97*	*0.42*	*< 0.05*	*4.05*
7 - Obstacle 7	*6.85*	*1.99*	*(5.84, 7.86)*	*4.30*	*0.08*	*n.s.*	*n/a*
8 - Rolling	*6.27*	*4.72*	*(3.88, 8.66)*	*3.82*	*0.4*	*< 0.05*	*4.11*
9 - Agility/Slalom	*14.62*	*6.71*	*(11.22, 8.02)*	*9.08*	*0.43*	*< 0.05*	*4.2*
10 - Obstacle 10	*8.46*	*3.22*	*(6.83, 10.09)*	*5.30*	*0.07*	*n.s.*	*n/a*
11 - Obstacle 11	*7.96*	*5.48*	*(5.19, 10.73)*	*4.98*	*0.09*	*n.s.*	*n/a*
12 - Shuttle Run (12x20 m)	*84.83*	*16.51*	*(76.47, 3.19)*	*52.72*	*0.81*	*< 0.01*	*8.45*
Total Time	*160.29*	*21.50*	*(149.41, 71.17)*	*100.00*	*nan*	*n/a*	*n/a*

Mean = average completion time; SD = standard deviation; 95% CI = confidence interval based on standard error of the mean (n=32); % of Total Time = contribution of each obstacle to the overall course time; Correlation (r) = Pearson correlation with total completion time; Significance (p): < 0.05 = statistically significant, < 0.01 = highly significant, n.s. = not significant, n/a = not applicable; Regression Coeff. (β) = effect of a 1-second increase in obstacle time on the overall completion time., n/a- not applicable

Contribution of obstacles

Analysis of time distribution showed that Obstacle 12 accounted for 52.7% of total time, followed by Obstacle 9 (9.08%), Obstacle 5 (7.11%) and Obstacle 4 (5.93%)(Figure 1; Figure 2).

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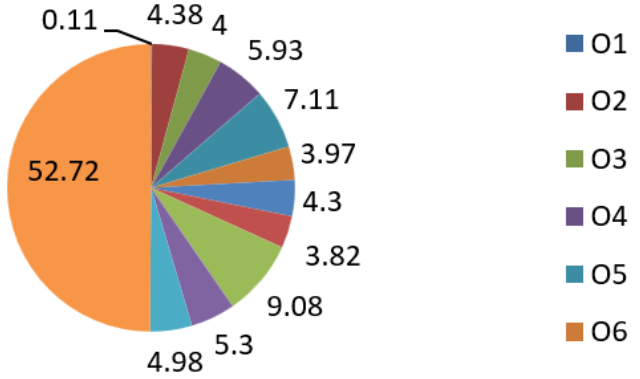

Figure 1. Mean obstacle times in the Police Academy obstacle course

Figure 1 illustrates the mean completion times for each obstacle, highlighting the dominance of endurance-based tasks. To complement this, figure 2 presents the relative percentage contribution of each obstacle to the total completion time, showing the disproportionate weight of Obstacle 12 compared to all others.

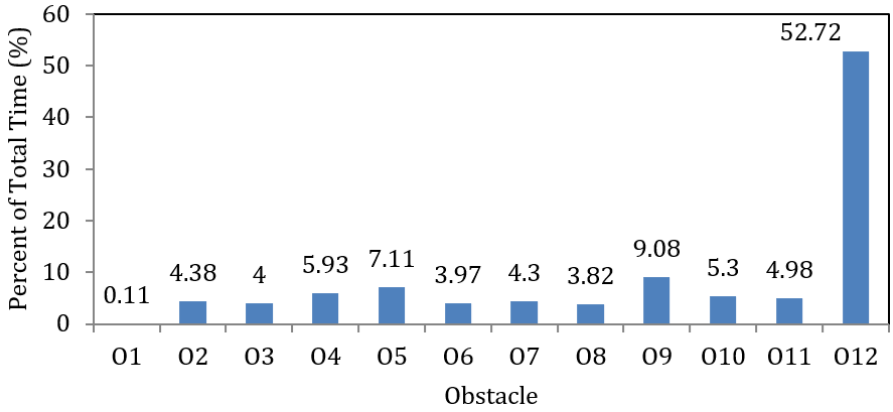

Figure 2. Percentage contribution of each obstacle to total completion time

Correlation and regression results

Pearson correlations demonstrated that Obstacle 12 strongly predicted total performance (r = 0.81), while Obstacles 3, 4, 6, 8 and 9 showed moderate correlations (r = 0.40–0.43). Interestingly, Obstacle 1 (a very short task) presented a negative correlation (r = –0.12) but regression coefficients indicated that delays at the beginning could disproportionately affect overall results (Figure 3).

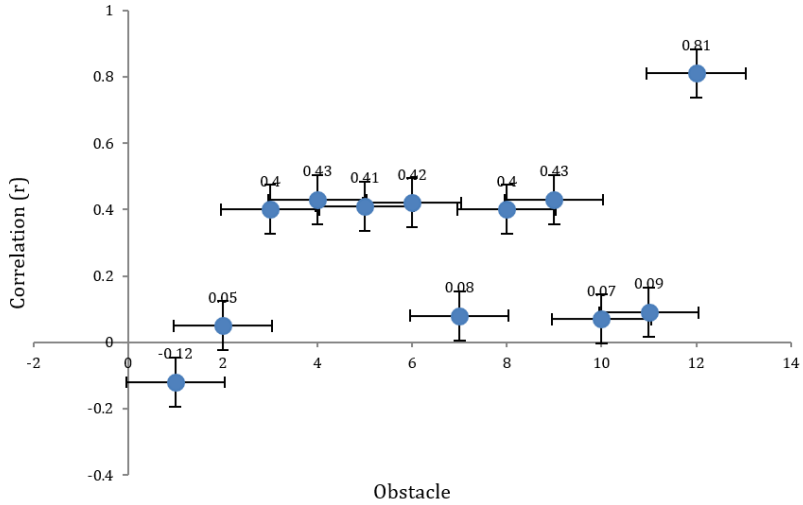

Figure 3. Correlation coefficients (Pearson's r) of each obstacle with total completion time; asterisks indicate statistical significance

Anthropometric influences

Neither height (r = 0.028, p = 0.893), weight (r = 0.149, p = 0.467), nor BMI (r = 0.181, p = 0.377) significantly influenced performance.

Interpretation and practical implications

Overall, the results support the hypothesis that motor skills contribute unevenly to final performance. Endurance tasks (Obstacle 12) dominate in weight, but speed, agility and coordination tasks (Obstacles 3–4, 6, 9) also critically influence outcomes through their correlation and regression effects. Training programs for Police Academy candidates should therefore balance general conditioning with focused skill development on high-impact obstacles. These results echo international findings in tactical populations while providing Romania-specific benchmarks for preparatory programs.

These results provide partial confirmation of the initial hypothesis, showing that endurance (Obstacle 12) had the strongest impact, while speed and coordination tasks had moderate but significant contributions.

Discussion

The present study confirms that motor skills contribute unequally to the performance of the Police Academy applied route, with endurance, speed, and coordination emerging as decisive factors. The finding that Obstacle 12 (12 × 20 m shuttle run with cones) accounted for more than half of the total completion time underlines the dominant role of aerobic and anaerobic endurance in sustaining performance across a multi-stage obstacle sequence. This result is consistent with international evidence that cardiorespiratory fitness and running endurance are

among the strongest predictors of tactical obstacle-course success (Monteiro et al., 2024; Marins et al., 2025).

At the same time, significant correlations observed for coordination- and agility-based tasks (Obstacles 3, 4, 6, 8, and 9) highlight the multifactorial nature of applied performance. These results resonate with studies reporting that agility and coordination tests (e.g., Illinois Agility Test, slalom runs) are reliable discriminators of high versus low performers in police and military populations (Dicks et al., 2023; Ramos & Massuça, 2025). In Romania, similar observations have been made: errors in precision throwing or in obstacle-vaulting frequently separate successful from unsuccessful candidates during the admission process (MAI, 2016/2022; AdmiterePoliție.ro, 2024).

The absence of significant correlations between anthropometric indicators (height, weight, BMI) and performance confirms that morphological traits are less influential than functional abilities. This supports findings from Bucur (2024), who demonstrated that targeted training interventions improved strength and speed in local police officers independent of body mass index. Similarly, international reviews conclude that relative fitness (e.g., speed per body mass, endurance capacity) outweighs static body measures in predicting task outcomes (Zulfiqar et al., 2021).

A notable aspect is the cumulative effect of early obstacles: although Obstacle 1 did not correlate strongly with total time ($r = -0.12$), regression analyses suggested that early inefficiencies had downstream effects on overall performance. This "domino effect" has also been identified in academy training abroad, where errors in initial sprint or coordination tasks increased psychological stress and reduced efficiency in later tasks (Koedijk et al., 2023).

From a practical perspective, these findings stress the importance of integrated training programs for candidates preparing for admission to the Romanian Police Academy. Programs should emphasize not only general conditioning (endurance, strength) but also task-specific motor abilities such as agility, coordination, and technical accuracy. Iorga et al. (2024) argues for the integration of psychophysical training within holistic police education in Romania, a position strongly supported by the present results.

Finally, by aligning with international benchmarks and highlighting Romanian-specific features of the applied route, this study provides valuable evidence for optimizing preparatory curricula. Future research should extend the sample size, include longitudinal tracking, and test the effectiveness of targeted interventions (e.g., agility circuits, endurance intervals) on improving applied route performance.

Conclusions

The study demonstrated that motor skills exert differentiated influences on Police Academy applied route performance. Endurance tasks, particularly the shuttle run with cones (Obstacle 12), accounted for more than half of the total time, confirming the central role of aerobic and anaerobic capacity. At the same time, speed, agility, and coordination-based tasks showed strong correlations with overall results, indicating that high performance is achieved through a balanced profile of motor abilities.

Anthropometric characteristics (height, weight, BMI) were not significant predictors, underlining that functional qualities outweigh morphological traits in this context. These findings align with both national and international research emphasizing the primacy of motor skills over static body measures.

From a practical standpoint, the results suggest that preparatory programs for admission to the Romanian Police Academy should: Prioritize endurance training to sustain performance across the longest and most demanding obstacle; include targeted drills for agility and coordination, such as slalom, precision throwing, and vaulting; integrate strength development, especially for load-bearing tasks (e.g., dummy drag); simulate the entire applied route under competition conditions to reduce errors and improve consistency.

In conclusion, the applied route represents a multifactorial test of police readiness, where success depends on the integration of endurance, speed, coordination, and strength. Tailored training programs that address all these domains are essential not only for admission success but also for the operational efficiency and safety of future police officers.

Limitations and future directions

The present study has some limitations that should be acknowledged. The relatively small sample size (n = 32) and the focus on a single regional cohort may limit the generalizability of the findings to broader populations of Police Academy candidates. In addition, the cross-sectional design does not allow causal inferences about the effects of specific training methods on performance outcomes. Future research should include larger and more diverse samples, longitudinal designs, and interventional studies to assess how targeted training programs can improve obstacle course performance and better prepare candidates for police admission tests.

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Specific interventions for optimizing reaction speed in fencing in 10-12 year old children

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Abstract: In the context of fencing, reaction speed refers to the athlete's ability to respond promptly and effectively to external stimuli, such as the opponent's movements. This involves not only physical speed, but also the ability to make quick and correct decisions in stressful and competitive situations. The purpose of this study is: a) to develop reaction speed and execution accuracy; b) to determine whether there are differences in the results obtained by 10-12-year-old girls and boys practicing fencing. The sample studied was composed of 14 athletes, 7 girls and 7 boys, aged between 10 and 12 years old, and was carried out over a period of 11 weeks, with a frequency of 3 times a week and 3 tests: initial, intermediate, and final. The reaction speed was assessed using the EFT-1 platform. Each athlete performed 10 blows with the sword, from a distance of 1 m from the apparatus, from the guard position, and the results were calculated by the testing apparatus, which averaged the 10 blows to obtain a score for each participant. The results obtained by girls compared to those obtained by boys do not present a statistically significant difference, although the effect size highlighted small values of 0.17 in the girls' group and 0.46 in the boys' group. But we obtained progressive differences between the 3 tests, which shows us that the program implemented by us was well structured, applied, and designed in accordance with the requirements of the group. Regarding the correlations between reaction speed and age and gender of the subjects, the statistical results show that there is no statistically significant difference. We believe that these results may be influenced by the small number of girls and boys in the applied study.

Keywords: reaction speed, fencing, children athletes, motor skils, coordination training

Introduction

Fencing is an open-skilled combat sport between two athletes who fence each other using one of three types of weapons (ie, foil, sabre, and epee), each contested with different rules. Fencing, described as "physical chess," integrates mind and body, and even beginners can overcome bigger, stronger opponents through strategic thinking (Shaw, 2008). This activity is intermittent and involves a series of high-intensity actions (eg, attack), with changes of direction (COD) (mainly back and forth displacements and lunges) interspersed by low-intensity movements with various recovery durations (Turner et al, 2016). It is well known that the lunge represents the most common form of attack in fencing (Turner et. al. 2014; Aquili et al. 2013). These lunges are commonly delivered after numerous feints and/or changes of direction, typically used to escape an opponent's hit (Turner et al. 2014, Roi & Bianchedi 2008). Roi and Bianchedi showed that fencer athletes cover between 250 m and 1000 m,

attack 140 times, and change direction, which differs in boys and girls. In view of the large number of COD occurring, fencing could be described as a combat sport in which an athlete's agility level, speed, and accuracy are strong determinants of success (Turner et al., 2016a; Tsokalis & Vagenas, 2010; Turner et al., 2016b; Sorel et al., 2019).

The specialists agree that lunging and changing direction, which are essential for optimal performance, are claimed to be the most frequently used actions in fencing. In fact, previous researchers have found that elite-level fencer athletes are faster than non-expert ones in both lunging and changing directions (Roi GS, Bianchedi, 2008; Tsokalis & Vagenas, 2010; Guilhem et. al., 2014).

On the other hand, the study of reaction time to visual stimuli holds significant importance in various sports (Şandra et al., 2023; Giurgiu et al., 2024), particularly in fencing, where rapid responses can determine success (Schumacher et al., 2020). Given the multifaceted nature of fencing, which demands a complex interplay of perceptual and psychomotor skills, understanding the nuances of reaction time in this age group is crucial for optimizing training methodologies (Turner et al., 2014). The current investigation aims to elucidate the potential for enhancing reaction time, a pivotal component of speed capabilities, in young fencers through targeted training interventions (Lopatenko et al., 2021). Reaction time is a critical factor in fencing, directly influencing a fencer's ability to respond effectively to an opponent's actions (Koppelaar et al., 2019). Reaction time, viewed through a more precise lens, represents the temporal duration encompassing the entirety of cognitive processing, from initial stimulus perception to the ultimate execution of a motor response, and is therefore intricately linked to the efficiency of an athlete's cognitive functions (Khan & Naqvi, 1995). The importance of reaction time in fencing cannot be underestimated, as it plays an essential role in the success of athletes, allowing them to respond quickly and efficiently to their opponents' movements and make quick decisions during matches.

This study aims to enhance reaction speed and execution accuracy in fencing, and to investigate whether performance outcomes differ between 10–12-year-old girls and boys.

Methodology

A group of 14 athletes, composed of 7 girls and 7 boys, aged between 10 and 12 years, participated in the study. There were no significant differences in age, training level, or training conditions of the subjects within this group, thus ensuring a uniform and fair context for the study. The detection of reaction speed was achieved using the EFT-1 platform. Using reactive agility exercises with FITLIGHT excited the players, stimulated their senses, and encouraged them to exert a significant effort within the training module. The diversity and various forms of exercises added an element of suspense and limited boredom during the training, thus contributing to the development of more than one variable, whether physical skill or visual (Hassan, Alhumaid, Hamad, 2022).

The device works by randomly displaying red in one of the 5 areas. Athletes must quickly hit the illuminated area to get a good score. This mechanism tests both

reaction speed and accuracy of shots, as an inaccurate shot imposes a time penalty added to the final time. It is measured in milliseconds.

The study began with the initial testing, in which each athlete performed two attempts of ten strikes each. Each athlete performed 10 strikes with the sword, from a distance of 1 m from the apparatus, from the guard position, and the results were calculated by the testing apparatus, which averaged the 10 strikes to obtain a score for each participant. During the testing, if the athlete does not hit the lit point exactly, he receives a time penalty, which is added to the final time. The study was conducted over a period of 11 weeks, starting on April 1, 2024, and ending on June 23, 2024. Within this time frame, 3 tests are planned: initial, intermediate, and final. These tests will allow the progress and effectiveness of the proposed training methods to be evaluated. The intermediate test will be performed after the first five weeks of training. This will provide a first assessment of progress and will allow the training program to be adjusted, if necessary, to maximize its effectiveness. The final test will take place in the last week of the experiment and will provide a complete assessment of the results obtained throughout the entire training period. The initial, intermediate, and final testing were conducted after a specific warm-up for fencing training, thus ensuring that the athletes were properly prepared to begin the activity.

The athletes trained three times a week, each session lasting approximately one and a half hours. During the training, we allocated between 5 and 15 minutes to exercises and games to influence reaction speed. It is important to note that in fencing, reaction speed cannot be evaluated without considering accuracy.

During the three months of training, various exercises and games were used to develop reaction speed. The program was designed to stimulate reaction speed through several indicators: visual, auditory, and even tactile. For example, reflex games and speed exercises with rapid changes of direction are designed to improve not only reaction speed, but also the athlete's ability to anticipate and execute precise movements under stress. The data obtained were statistically processed in the Microsoft IBM SPSS version 26 program.

To maintain this balance, all athletes followed a similar training program, which included the same types of exercises and games aimed at developing reaction speed. This program was designed to be adapted to the capabilities and needs of each participant, without creating discrepancies between training levels, together with the specialized coach.

The study was conducted in accordance with the Helsinki Declaration of 2013. Following familiarization and explanation of the study objectives, procedures, and methodology, all participants consented to participate.

Each training session was structured to include a variety of exercises that would stimulate and develop the athletes' reaction capacity. The exercises practiced were grouped as follows:

Visual stimulus exercises: These included activities such as tracking and hitting moving targets, using flashing lights to signal attack points, and hand-eye coordination games. Auditory stimulus exercises: The athletes participated in games in which they had to react quickly to specific sounds, such as a whistle or a horn, indicating the exact moment to hit. Tactile stimulus exercises: These included

exercises in which the athletes had to respond to touches or vibrations, thus developing the ability to react quickly to tactile stimuli. The data collected during the pre-test and post-test stages allowed for an objective comparison of the evolution of motor performance.

Results

To determine the type of statistical analysis applied, we used the Shapiro-Wilk small-sample normality test for the variable reaction speed to visual stimuli. The results obtained reflect the average reaction speed of the hits measured in milliseconds.

Table 1. Results of the normality test

Tests of Normality						
	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistical	df	Sig.	Statistical	df	Sig.
initial millisecond testing	,139	14	,200*	,972	14	,899
millisecond intermediate testing	,128	14	,200*	,954	14	,630
final millisecond testing	,126	14	,200*	,939	14	,408
*. This is a lower bound of the true significance.						
a. Lilliefors Significance Correction						

Thus, according to the Shapiro-Wilk test in Table 1, for small samples the normal distribution assumes $p>0.05$. So next we will apply correlation tests for samples with normal distribution as seen below (Figure 1).

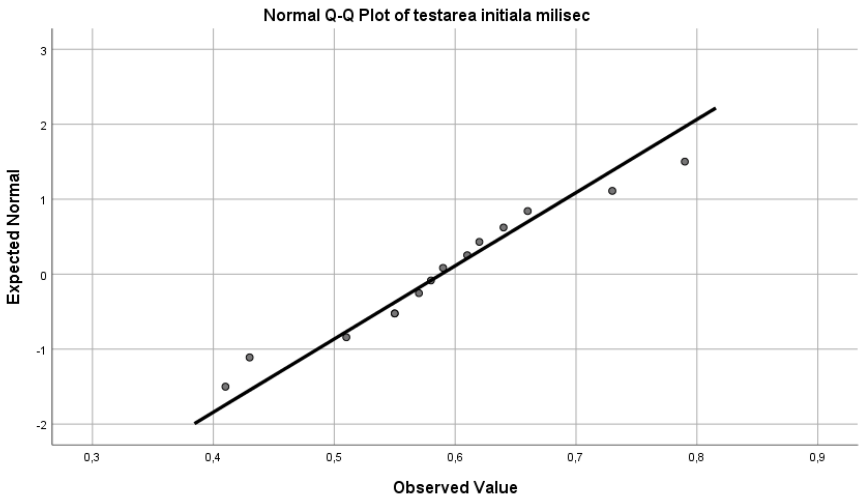

Figure 1. Validation of the normal distribution

Regarding the descriptive analysis, the statistical parameters used were: mean, minimum and maximum limits, standard deviation and effect size (Table 2).

Table 2. Descriptive analysis

Descriptive Statistics						
	N	Minimum	Maximum	Mean	Std. Deviation	Variances
Age of athletes	14	10	12	11.14	,864	,747
Initial millisecond testing	14	,41	,79	,5886	,10242	,010
Millisecond intermediate testing	14	,43	,69	,5550	,07419	,006
Final millisecond testing	14	,43	,61	,5336	,05679	,003
Valid N (listwise)	14					

Thus, from the analysis of the data presented in the first table, it can be seen that each athlete presents distinct individual results, highlighting natural variations in terms of reaction speed and accuracy of shots. We observe an average of 0.58 milliseconds in the initial testing, 0.55 milliseconds in the intermediate one, and 0.53 milliseconds in the final one. The standard deviation and variation present small values, which indicate the high homogeneity of the group. Also, an important observation is that at this age, the differences between the sexes are insignificant, demonstrating that boys and girls have similar performances in this specific context.

Table 3. Results of the Pearson test for correlations

Correlations						
		age of athletes	the type of athletes	initial millisecond testing	millisecond intermediate testing	final millisecond testing
Age of athletes	Pearson Correlation	1	-,343	-,067	,216	,067
	Sig. (2-tailed)		,230	,820	,458	,820
	N	14	14	14	14	14
The type of athletes	Pearson Correlation	-,343	1	-,043	-,270	-,248
	Sig. (2-tailed)	,230		,883	,351	,393
	N	14	14	14	14	14
Initial millisecond testing	Pearson Correlation	-,067	-,043	1	,476	,718**
	Sig. (2-tailed)	,820	,883		,085	,004
	N	14	14	14	14	14
Millisecond intermediate testing	Pearson Correlation	,216	-,270	,476	1	,912**
	Sig. (2-tailed)	,458	,351	,085		,000
	N	14	14	14	14	14
Final millisecond testing	Pearson Correlation	,067	-,248	,718**	,912**	1
	Sig. (2-tailed)	,820	,393	,004	,000	
	N	14	14	14	14	14
**. Correlation is significant at the 0.01 level (2-tailed).						

We can say that, between the ages of 10 and 12, both boys and girls have the same opportunities to develop motor and cognitive skills essential for fencing. The lack of significant differences between the sexes at this level indicates that training

programs can be applied uniformly to all athletes, without requiring specific adjustments based on gender criteria. However, the correlations obtained between the 3 tests, initial, intermediate, and final, show us the following results: between the initial and intermediate testing, r=0.476 at p=0.085 shows a moderate correlation. If we refer to the correlation between the intermediate and final testing, which is r=0.718 at p=0.004, this is a strongly significant one. The correlation obtained between the initial and final testing is r=0.912 at p=0.001, which is a very strong statistical correlation.

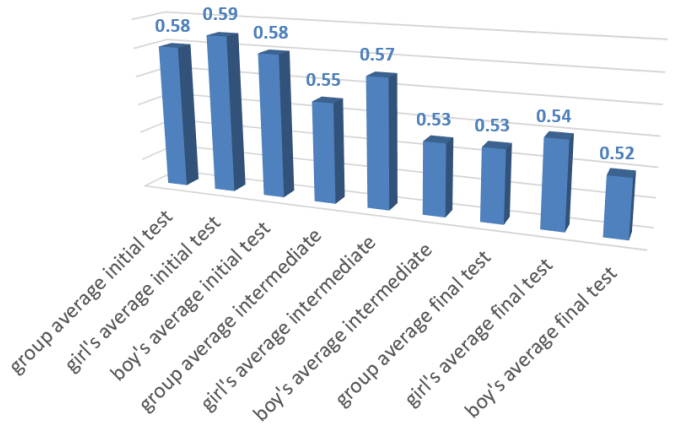

Figure 2. Evolution of the averages in the 3 tests, girls-boys and group

The graph above shows the dynamics of the results obtained by girls and boys, as well as the group as a whole (Figure 2). The group average oscillates between 0.58 milliseconds at the final test, 0.55 milliseconds at the intermediate test, and 0.53 milliseconds at the final test. The girls' group, taken separately (Figure 3), obtained an initial average of 0.58 milliseconds and at the final test, 0.53 milliseconds. The boys' group fell within the following values: 0.58 milliseconds at the initial test and 0.52 milliseconds at the final test (Figure 4).

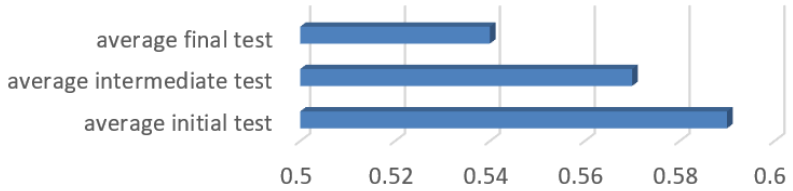

Figure 3. Evolution of girls' group averages

Figure 4. Evolution of boys' group averages

To ensure the efficiency of the applied program, we also calculated the effect size, which estimates the degree to which a cause influences the effect and represents the standardized difference between means. Thus, the effect size obtained by girls is 0.17, and for boys it is 0.46; from these values, we can see that for girls the effect size is small and for boys it has an average value.

Discussions

The study proposed by us aims to develop reaction speed and precision of exercise, and whether there are differences in the results obtained by 10-12-year-old girls and boys who practice fencing. From the data presented above (table 3), we can see that there are progressive differences between the 3 tests, which shows us that the program implemented by us was well structured, applied, and designed in accordance with the requirements of the group. Regarding the correlations between reaction speed and age and gender of the subjects, the statistical results show that there is no statistically significant difference. We believe that these results may be influenced by the small number of girls and boys in the applied study.

To discuss the reaction speed in 10-12-year-old children who practice fencing, it is necessary to analyze biological factors and specific developmental stages (Rodrigues & Pandeirada, 2018). On the other hand, Karadeniz et al. (2024) state that reaction speed can improve with age and due to personal predispositions and accumulated motor experiences. In addition, other specialists propose taking into account early puberty when debating the difference between the sexes in different sports, as well as environmental factors and socio-cultural influences (Smits-Engelsman et al., 2023).

The diversity of sports and the multitude of factors involved make generalization difficult, but identifying clear trends can help optimize training strategies (Fernández-Fernández et al., 2014; Papp et al., 2019). In addition, it is important to consider that a child begins to practice sports primarily to improve existing sports skills and acquire new ones, as well as for fun and entertainment, socializing and making new friends, excitement and challenge, achieving success, winning, gaining physical fitness, competitions, pursuing a career to a higher level (Erdely et al., 2020). Ropret & Jevtić, (2019) and Șandra et al. (2022) stated that it is important to select the means and methods regarding speed development, agility, and coordination/skill in the training process of young footballers U12 years old as well as to pay attention to the applied training cycle.

Experts say that research should primarily investigate how fencing-specific training can influence reaction speed and whether there are more effective training approaches for girls or boys. It should also be borne in mind that the synergistic development of muscle strength and motor skill competence is essential for long-term physical fitness (Radnor et al., 2020). On the other hand, understanding the coordination aspects of the beginning of speed exercises is also essential to improve speed and agility in fencing (Borysiuk et al., 2018). In addition, regular participation in sports activities has a positive impact on mental and physical health, as well as on academic success and psychosocial development, which are extremely important and

necessary in our day. Therefore, it is necessary that exercise programs be adapted to their unique developmental needs, so it is important to understand gender specificities (Yunfei et al., 2022).

Conclusions

The results obtained by girls compared to those obtained by boys do not present a statistically significant difference, but the effect size highlights the improvement of the performances in the 2 groups, girls and boys, for the proposed theme. By implementing specific exercises, dynamic games, and relays, the athletes not only developed their reaction speed but also became more competent and efficient in fencing. This will contribute to their continuous progress and to achieving superior performances in the sport they practice.

We can state that although the overall results are encouraging and validate the benefits of exercises, games, and relays on the majority of subjects, attention must also be directed to those special cases where the interventions did not have the desired effect. This will allow for a more personalized and effective approach in the future, thus ensuring that all participants fully benefit from the implemented program. We believe that our results would be greatly improved if the study included a larger number of athletes.

Limitations

The study included a small sample of participants; therefore, the results cannot be generalized to this age group. We plan to include a larger number of participants to validate the results. Also, including other athletes who practice different sports in the study could bring added value to the topic studied.

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The Role of Physical Activity in Enhancing Social Intelligence among Secondary School Students

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Abstract: This study examines the influence of physical activity on the augmentation of social intelligence among secondary school students in Ain Beida, Ouargla. A total of 128 students from both the Arabic Literature and Natural Sciences streams took part. The Social Intelligence Scale and a Physical Activity Questionnaire were used to gather data. Both of these tools were shown to be very valid and reliable. The findings indicated that the majority of students participated in consistent physical activity and exhibited relatively elevated levels of social intelligence. There was a statistically significant positive association ($r = 0.399$, $p < .001$) between physical exercise and social intelligence. This means that kids who played sports, especially team sports, were more likely to learn how to communicate, work together, lead, and feel for others. These results underscore the necessity of including physical education and extracurricular sports into school curricula to facilitate adolescents' social and emotional development, while simultaneously advocating for additional longitudinal and experimental research to enhance comprehension of this relationship.

Keywords: physical activity, social intelligence, team sports, secondary school students

Introduction

High school students need to play sports in their lives. This is because sports help them stay fit, both physically and mentally, and socially. One of these traits is social intelligence. This pertains to the ability to understand and manage social relationships proficiently (Goleman, 2006; Al-Badri, 2010; Al-Mubayyid, 2007). Recent research indicates that engagement in sports may enhance social intelligence, particularly among adolescents (Shuaib, 2017; Zahwani, 2018). This is important because social intelligence is a key part of daily life. Playing team sports with other people helps people learn how to work together, lead, and control their desires (Anderson, Brown, & Carter, 2018; Omrani, 2015). These activities can help teens learn how to talk to and work with their friends, which will help them get better at talking and solving problems (Al-Ayed, 2016; Adham, 2012).

Daniel Goleman's theory of social intelligence (2006) backs this up. He says that social intelligence is the ability to understand and feel what other people are going through and to build strong relationships. When you play sports, whether you're working with others or against them, you're always interacting with them. This offers

a pragmatic method for cultivating these skills. Bandura's Social Learning Theory also shows that teens learn new skills by watching other people (Bandura, 1997; Abou Jadu, 2000). This means that playing sports can help teens learn new social skills.

Vygotsky's (1978) social framework theory posits that social interaction is crucial for cognitive development. This theory suggests that sporting events serve as a suitable environment for enhancing these skills within a collaborative framework (Ismail, 2006; Al-Qaryouti, 2000).

Several previous studies have established the correlation between social intelligence and physical engagement. For example, Smith and Johnson (2015) found that teens who play team sports interact with their peers more than teens who don't play these sports. Anderson et al. (2018) conducted a study that found that playing team sports helps teens improve their communication and cooperation skills, which makes it easier for them to make friends. Miller and Green (2020) assert that children engaged in team sports are more inclined to cultivate friendships and possess an enhanced sense of self-confidence. Furthermore, studies conducted in the Arab world affirm that sports positively influence social intelligence (Al-Adly, 2009; Al-Ayed, 2016; Zahwani, 2018).

The main goal of this study is to find out how much playing team sports like football and basketball, among others, affects the social intelligence of high school students. We are trying to figure out how these activities affect teenagers' ability to talk to each other, work together in groups, and share their thoughts and feelings in a variety of social situations.

Most people agree that sports are good for both mental and physical health, but some people don't think that sports help kids learn how to get along with others, especially in school. Al-Badri (2010) and Al-Ayed (2016) say that kids who play team sports can meet new people, learn how to interact with people they don't know, and become more socially aware, which will help them later in life. At this point in time, their emotional and social growth has only just begun.

Based on the above, the following hypotheses can be advanced:

- The level of physical activity is high among the respondents;
- The level of social intelligence is high among the sample members;
- There is a statistically significant(positive) correlation between physical activity and the level of social intelligence.

Materials and methods

The Sample

It was essential to make use of a particular sort of sampling approach, specifically random sampling, because the research being conducted was of a kind that centred on the function of physical sports activity in the development of social intelligence among students in secondary school in the Ain Beida area of Ouargla. The students who participated in the study were divided between the Arabic Literature stream and the Natural Sciences stream. There were 128 students in total.

Research Tools

In this study, we used the *Social Intelligence Scale* (Alian, 2007), which was adapted into Arabic. The scale consists of 21 items distributed across three dimensions: processing social information, social skills, and social awareness. Responses are recorded on a five-point Likert scale (*Strongly Agree – Agree – Neutral – Disagree – Strongly Disagree*). Negative items are reverse-scored. The total score ranges from 21 to 105 points. This instrument was also adopted in previous research (Al-Hamoudi , 2019).

In addition, we made use of the Physical Activity Questionnaire in this investigation in order to gather information pertaining to students' participation in physical activities. This questionnaire was prepared on the basis of prior research and scientific reviews with the goal of evaluating the degree to which students participate in physical activities both inside and outside of the school environment. A collection of questions directed at students was included in it, examples of which are as follows:

- Are you a student in physical education classes?
- Are you involved in any extracurricular activities that are offered at the school?
- Do you participate in any of the sports teams at your school?
- How often do you participate in athletic activities that are not affiliated with the school?
- Do you participate in any sports teams or clubs as a member?
- What kind of sport is it that you typically engage in?

Psychometric Characteristics of the Research Instruments:

The square root of the reliability coefficient was calculated in order to evaluate the intrinsic validity (self-validity) of the scale. A pilot sample of thirty students, both male and female, were given the scale, and the inherent validity coefficient was determined to be 0.91, which is considered to be a high and acceptable value. This is evidence that the scale has a high degree of self-validity. In addition, as shown in Table 1, the correlation coefficient was computed for each item and the total score of the scale.

Table 1. Correlation coefficients between each item of the Social Intelligence Scale and the total score

Item	r	Item	r	Item	r
1	.82	8	.88	15	.74
2	.78	9	.71	16	.85
3	.73	10	.68	17	.81
4	.62	11	.69	18	.69
5	.80	12	.72	19	.77
6	.79	13	.61	20	.81
7	.72	14	.82	21	.85

Note. All correlation coefficients are significant at $p < .01$.

In order to ensure the reliability of the scale, it was administered to a pilot sample of thirty students on two separate occasions, with a two-week delay between the first administration and the second administration of the scale. The test-retest

reliability of the assessment was evaluated using Pearson's correlation coefficient. Furthermore, the Spearman-Brown method was used to investigate the split-half reliability of the test by calculating the correlation between the items with odd numbers and those with even numbers. Additionally, the Cronbach's alpha coefficient was used to conduct an assessment of the internal consistency reliability. The reliability coefficients of the Social Intelligence Scale are presented in Table 2.

Table 2. Reliability coefficients of the Social Intelligence Scale

Scale	Test–retest	Split-half	Cronbach's α
Total score	.83	.91	.90

Note. All reliability coefficients are considered high and acceptable ($\alpha \geq .70$).

Because it gives accurate information regarding the extent to which students participate in physical activities, the Physical Activity Questionnaire was chosen as well. This decision was made due to the questionnaire's reliability and relevance to the issue of this study. Sufficient data were obtained with the assistance of this questionnaire to facilitate the analysis of the association between the amount of physical activity and social intelligence.

Statistical Examination

The researchers utilised a combination of descriptive and inferential statistical techniques to analyse the study data. To find out the overall trends in the sample and how much the answers varied, we found the means and standard deviations. A one-sample T-test was utilised to compare the sample mean with the standard value, whereas an independent-samples T-test was employed to analyse differences between groups, including males and females. Additionally, a one-way ANOVA was performed to ascertain differences among many groups, and Pearson's correlation coefficient was utilised to evaluate the associations between the study variables.

Results

Table 3 contains the results of the analysis of the sample characteristics (N = 128). The results revealed that the proportion of males was larger, with 85 participants (66.4%), compared to 43 females (33.6%). One hundred percent of the participants were enrolled in the same grade level (third year). The average age of the participants was 18.07 years (with a standard deviation of 0.26). When it comes to sports practice, 43.0 percent of participants indicated that they participated in solo sports, while 32.8 percent said that they participated in team sports. On the other hand, 24.2 percent stated that they did not engage in any kind of sports activity. The findings of this investigation suggest that the sample group was composed of a majority of males and that it was highly homogeneous in terms of both age and grade level, however there was a notable diversity in the amount and kind of sports engagement.

Table 3. Sample characteristics (N = 128)

Variable	Category	N	%	M	SD
Gender	Male	85	66.4		
	Female	43	33.6		
Grade level	Third year	128	100.0	3.00	0.00
Age (years)	18–19	128	100.0	18.07	0.26
Type of sports practice	Team sports	42	32.8		
	Individual sports	55	43.0		
	No practice	31	24.2		

Note. *M* = mean; *SD* = standard deviation.

Table 4. Descriptive Statistics of Physical Activity Practice and Social Intelligence (N = 128)

Variable	Minimum	Maximum	Mean	SD
Item 1 of Physical Activity Practice	0.00	1.00	0.98	.15
Item 2 of Physical Activity Practice	0.00	1.00	0.98	.15
Item 3 of Physical Activity Practice	0.00	1.00	0.89	.31
Item 4 of Physical Activity Practice	0.00	1.00	0.74	.44
Item 5 of Physical Activity Practice	1.00	3.00	1.23	.46
Average of Physical Activity Practice Questionnaire	0.25	1.00	0.90	.17
Total of Physical Activity Practice Questionnaire	1.00	4.00	3.95	.69
Average of Social Intelligence Scale	2.29	4.24	3.65	.26
Total of Social Intelligence Scale	48.00	89.00	76.66	5.44

The descriptive data that are presented in Table 4, which pertain to the degree of physical activity practice, showed that the overall mean of the variables was comparatively high, with a standard deviation of 0.17 and an average practice score of 0.90. This demonstrates that the majority of participants engaged in physical exercise at a high level of intensity. The mean score of the participants was 3.95, while the total scores varied from 1 to 4. This reflects the fact that the participants' levels of experience in practice were not exactly the same.

Regarding social intelligence, the overall mean was approximately 3.65, with a standard deviation of 0.26. At the same time, the total scores of social intelligences lay between 48 and 89, with an average score of 76.66. This suggests that the individuals who took part in the study possess a comparatively high degree of social intelligence. In general, the findings of this study indicate that the sample group that was examined possesses a high degree of social intelligence. This is generally connected with a high level of participation in physical activity. This could be an indication that the two variables share a positive association, which would necessitate more examination of the statistics in order to determine whether this link actually exists.

Table 5. The Relationship Between the Level of Physical Activity Practice and the Level of Social Intelligence (N = 128)

Variable	Social Intelligence Total	Physical Activity Total
Social Intelligence Total	1	0.399
Physical Activity Total	0.399	1
***p*-value**	0.000	0.000
Cross-Product Sums of Squares	191.195	61.055
Variance	1.505	0.481
Number of Participants	128	128

The findings of the correlation study, which are shown in Table 5, suggest that there is a modest positive link between social intelligence and the practice of physical activity, as indicated by the Pearson correlation coefficient of r = 0.399. This implies that there is a comparatively substantial correlation between people who participate in physical activities and their respective levels of social intelligence. The relevance of the link is confirmed by the fact that the finding is statistically significant at p = 0.000.

The conclusions drawn from this research indicate that there is a favorable correlation between higher levels of social intelligence and increased participation in physical activities. To put it another way, there is a correlation between people who frequently participate in athletic activities and people who exhibit a higher degree of social intelligence. The significance of physical activity in improving social abilities and encouraging pleasant interpersonal interaction may be reflected in this relationship. As a result, this creates an opportunity for more thorough investigations to be conducted in order to gain a better understanding of the effect that sports have on the social and emotional development of individuals.

Discussion

The results revealed that the majority of students (third-year secondary school) engaged in high levels of physical activity. This aligns with observations in educational settings, where students actively participate in physical education programs and sports both during and after school hours (Mohamed Hadi, 2021; Hassan, 2013). Similar findings have been reported in prior studies indicating that consistent sports participation contributes to better focus, self-management, and interpersonal skills (Kwon & Roh, 2024; Li & Shao, 2022; Fu, Zhang, & Lee, 2025).

Participants demonstrated moderately high social intelligence, which can be attributed to adolescence being a key stage for social interaction development (Al-Mubayyid, 2007; Adham, 2012). Sports practice, particularly team sports, had a positive effect on social intelligence components such as communication, leadership, cooperation, and empathy (Al-Ayed, 2016; Omrani, 2015; Shuaib, 2017; Zahwani, 2018). Systematic reviews indicate that interventions involving physical activity positively impact the social and emotional well-being of children and adolescents (Fu, Zhang, & Lee, 2025).

Statistical analysis confirmed a moderate positive correlation between social intelligence and physical activity ($r = 0.399$, $p < .001$), consistent with studies by Kwon and Roh (2024) and supported by Bandura's Social Learning Theory (Bandura, 1997; Abou Jadu, 2000). Vygotsky's social framework theory (Vygotsky, 1978; Ismail, 2006) also supports the notion that social interactions during sports facilitate cognitive and emotional development.

Physical activity provides opportunities for social interaction, cooperative learning, and emotional regulation, confirming findings from Jones (2024) and Wang, Chen, & Liu (2024). These results highlight that participation in sports allows students to develop essential skills to navigate social situations effectively, both inside and outside the classroom. Future research should employ longitudinal designs to examine how sport type, frequency, and quality of social interaction influence social intelligence development.

Overall, these findings demonstrate that physical activity is a practical and effective means of fostering social intelligence in secondary school students, particularly through team-based sports. This underscores the importance of integrating organized physical education and extracurricular sports into school curricula to support adolescents' social and emotional growth (Al-Adly, 2009; Fu, Zhang, & Lee, 2025).

Conclusion

Although this investigation offers important information regarding the connection between social intelligence and physical activity among adolescents attending secondary schools, it does have a few limitations. To begin, the generalizability of the findings to other groups may be limited due to the fact that the sample was restricted to kids from the Ain Beida area in Ouargla. In the second place, the research was based on self-report questionnaires, which are susceptible to mistakes in the responses that students provide as well as social desirability bias. Third, the cross-sectional design prohibits causal conclusions, which makes it impossible to identify whether physical activity actually enhances social intelligence or whether students who are already socially intelligent are more likely to participate in sports. Although these limitations exist, the findings clearly underscore the important role that involvement in sports, especially those that require teamwork, plays in the development of social intelligence, communication skills, and collaboration among teenagers. This highlights the significance of including both organized physical education and extracurricular activities such as sports into school curricula in order to provide assistance to students in their social and emotional development. In addition, it is advised that subsequent longitudinal and experimental studies be conducted to confirm and expand upon these conclusions.

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Sport Events and Environmental Sustainability: Towards an Eco-Friendly Agenda in Malawi

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Abstract: The study aimed to explore the environmentally sustainable measures adopted and implemented by the sporting events sector in Malawi, with a focus on understanding the current practices in place and identifying existing gaps in environmental management. Sporting events are seen as valuable platforms for raising environmental awareness and educating stakeholders. Using a qualitative approach, in-depth interviews were conducted with 24 purposefully selected experts from the sports and tourism sectors. The findings reveal minimal efforts toward making sporting events environmentally sustainable. While ecotourism-rich destinations in developing countries offer potential for sustainable sport tourism, challenges such as limited environmental awareness, financial constraints, and poor intersectoral collaboration persist. The study advocates for collaborative governance to overcome these barriers and support environmentally sustainable tourism. It offers practical and policy insights to strengthen the link between sport tourism and sustainability in developing contexts.

Keywords: sporting events, development agenda, sustainability, Malawi

Introduction

When managed properly, sport events, irrespective of their size and scope have significant importance to destinations that host them (Hemmonsbey & Tichaawa, 2018). This is because such events have been proven to serve as catalysts for economic growth (Daniels & Tichaawa, 2021), social unity (Nyikana et al., 2014) and sustainable development (Tichaawa & Hemmonsbey, 2022). Over the years, the global sport event industry has started recognising the importance of planning and hosting environmentally sustainable events (Ulloa-Hernández et al., 2024). There has been increasing pressure from different stakeholders, particularly the United Nations, environmentalists, and policymakers, for the sports industry to host environmentally sustainable events (Collins & Cooper, 2017). This is because of growing concerns regarding the environmental harm caused by sporting events (Sotiriadou & Hill, 2015; Daddi et al., 2025). As a result, the sector has implemented different strategies, such as green events (Greenhalgh et al., 2015; McCullough et al., 2016; Fermeglia, 2017) and carrying capacity limitations (McCullough et al., 2023; Fang et al., 2025), to ensure that events are environmentally friendly and that stakeholders are conscious of the harm caused to the environment (Gibson et al., 2012; Mchunu et al., 2021; Daddi

et al., 2025; Fang et al., 2025). For instance, one of the requirements set by the International Olympic Committee and FIFA for hosting events is that the bidding host destination must prioritise environmental sustainability and development by hosting green events (Achu, 2019; Pourpakdelfekr & Oboudi, 2022). Green events are defined as events that are planned and hosted in a way that have minimal negative environmental impacts (Li & Liu, 2020).

Sport events rely on the environment because it serves as the 'venue' where the events are hosted (Mallen et al., 2015; McCullough et al., 2021; Eriksson et al., 2025; Trendafilova & Ziakas, 2025). Events are hosted in different environmental settings; for instance, skiing requires environments with snowfall and cold temperatures, while mountain races require dry land and warm temperatures. Toscani et al. (2024) highlight that the sports events sector is constantly evolving and adapting to new environments, including managing scarce resources and addressing climate change. Therefore, it is imperative that destinations host environmentally sustainable events to minimise the negative environmental impacts of hosting such events. Daddi et al. (2025) argue that the environment can be perceived as an important stakeholder or non-human actor in sport tourism because it is directly affected by the events. Events consume renewable and non-renewable resources, such as energy and water, and generate waste, greenhouse gas emissions, and pollution that affect the environment (Gössling et al., 2012; Han et al., 2015; Boggia et al., 2018). Given that events directly interact with the environment and cause environmental sustainability issues, event organisers must adopt and implement effective environmental management strategies. In this context, environmental management refers to the measures and practices implemented by sport associations, event organisers, and attendees to mitigate negative environmental impacts caused by sporting events (Mallen et al., 2015). Toscani et al. (2024) note that events are often hosted in environmentally sensitive areas, causing significant harm to natural habitats. Sport event management addresses environmental sustainability challenges and ensures the implementation of effective measures to protect ecosystems (Zhong et al., 2021). Öztopcu (2023) highlights that the environmental impacts caused by the sport event industry have become a global concern; therefore, it is a global responsibility to host environmentally sustainable events which are essential for the attainment of Sustainable Development Goals [SDGs], especially those related to goals 11, 12 and 13 (Kimbu & Tichaawa, 2018).

This paper advances the agenda for eco-friendly sporting events in the Global South context, with a specific focus on Malawi. This is because existing literature on the environmental management and sustainability of sporting events largely focuses on the developed world and mega-sporting events (Gibson et al., 2012; Tichaawa & Bob, 2015; Zhong et al., 2021; Toscani et al., 2024;). Therefore, this paper makes a

theoretical contribution to the existing body of knowledge in sport tourism and environmental sustainability by advancing the theoretical understanding of the environmentally sustainable measures implemented in underexplored contexts, using Malawi as a case study. Based on the study findings, we demonstrate how sustainable sport events can be achieved through collaborative governance among different stakeholders involved in sport tourism development. More importantly, the study argues that sustainable development can be achieved through the implementation of destination-tailored strategic policies and environmental measures that align and reflect the destination's unique environmental conditions.

Literature Review

Sport tourism development and environmental sustainability

This study is grounded in the principle of environmental sustainability linked to sport tourism development. The principle of environmental sustainability has become a global phenomenon, having been incorporated into the strategic plans and policies of various sectors (Holmes et al., 2015). The concepts of sustainability and sustainable development are often used interchangeably to emphasise the ability of the present generation to meet its needs without compromising the ability of future generations to meet their own needs (Costa et al., 2019; Öztopcu, 2023). In the context of this study, it refers to the ability of present generations to promote the conscious use of renewable and non-renewable resources without depleting these resources for future generations and causing environmental harm (Morelli, 2011; Trendafilova et al., 2014; Watkin et al., 2021). Environmental sustainability further emphasises the importance of efficiently using and conserving both renewable and non-renewable resources (Costa et al., 2019). There are three main pillars of sustainability: economic, social, and environmental. Collins et al. (2007) note that many research studies primarily focus on the economic pillar because of the perception that economic benefits are more important for organisations and destinations. Similarly, Adams (2004) found that several organisations believe that adopting only the economic pillar is the best way to achieve sustainability and to fast-track tourism development. However, there has been an increase in academic studies that focus on the environmental sustainability of the sport tourism industry, and it has become a matter of international importance for sport tourism development (Gibson et al., 2012; McCullough et al., 2021; Martins et al., 2021; Daddi et al., 2025; Trendafilova & Ziakas, 2025). There are global debates on the environmental impacts of by different types of sporting events (Chirieleison et al., 2020). Some studies acknowledge that small-scale sport events can cause environmental harm, albeit not to the same extent as mega-sporting events (Gibson et al., 2012; Chalip, 2017). Sporting events, particularly large-scale events, often have adverse environmental impacts (Orr et al., 2022; Toscani et al., 2024). These events have a significant travel component, as fans

often travel to different destinations to attend, resulting in a substantial increase in greenhouse gas emissions (Sotiriadou & Hill, 2015; Boggia et al., 2018). Additionally, they attract large crowds, which causes an increase in the waste generated at the destination, and in many developing countries, the waste may be incorrectly disposed of, causing health concerns and pollution (Cooper, 2020; Dingle and Mallen, 2021; Pourpakdelfekr & Oboudi, 2022). The large amount of waste generated may also deteriorate the natural environment, which in turn has adverse effects on the sports events sector because sporting events depending on the natural environment cannot be hosted (Collins et al., 2014; Bunds et al., 2019). Interestingly, Daddi et al. (2025) argue that despite growing concerns about the environmental impact of events, it is mostly mega-sporting events that have prioritised environmental sustainability. They argue that smaller-scale sporting events have been less proactive in implementing environmentally sustainable measures, despite their popularity as being the more environmentally friendly alternative. Academic studies have investigated and analysed the environmental sustainability and impacts of small-scale sport events (Gibson et al., 2012; Mchunu et al., 2021). Huang et al. (2024) argue that the differences in event size mean that environmental impacts and sustainability are measured differently. It is essential to note that mega-sporting events attract more global scrutiny than small-scale events (Collins et al., 2007; Cerezo-Esteve et al., 2022; Pourpakdelfekr & Oboudi, 2022). Hence, the attention is mostly skewed towards these events.

The increased attention on the environmental sustainability of sporting events and climate change has compelled different sport tourism stakeholders to implement environmental management strategies (McCullough et al., 2021; Orr et al., 2022; Trendafilova & Ziakas, 2025). Some of these environmental practices are designed to encourage pro-environmental behaviour among sporting attendees (summarised in Table 1), such as encouraging attendees to use recycling bins at events (Mchunu et al., 2021) and to use public transportation to reduce high carbon emissions (Collins & Cooper, 2017; Martins et al., 2021).

Table 1. Summary of management practices implemented at sporting events

Environmental management practices	Purpose of the implemented practices
Waste management	These are environmental practices implemented to reduce the waste generated at sporting events. This includes measures such as reusing, recycling, and reducing materials used at events, and correct disposal of waste (Dodds and Walsh, 2019).
Water management	Measures implemented to reduce water wastage and contamination at sporting events (Lakho et al., 2020).
Transport management	Environmental practices implemented to reduce environmental impacts associated with transportation systems used during events, including encouraging attendees to use public transport (Collins and Cooper, 2017).

Environmental management practices	Purpose of the implemented practices
Green communication	Environmental measures implemented to communicate environmental messages to event attendees, such as encouraging the use of recycling bins and using the correct disposal bins at events (Zhong et al., 2021).
Ecological conservation and management	These measures are aimed at conserving and preserving the natural landscapes when events are held in environmentally sensitive areas (Graefe et al., 2019; Newland et al., 2021).

Research conducted on sport events and environmental sustainability has largely focused on the Global North, investigating green event management strategies (Wang et al., 2019; Li & Liu, 2020), managing scarce resources (Malchrowicz-Mośko & Poczka, 2018; Triantafyllidis et al., 2018), and sustainable event planning (Fotiadis et al., 2016). Studies conducted on the sustainability of sports events from a Global North perspective provide insights into environmental management strategies for sports events. However, the strategies and measures implemented in a developed world context are rooted in structured policies and governance structures, which is not the case for the Global South, where there is a lack of institutional support and effective policies (Acquah-Sam, 2021; Nyikana & Tichaawa, 2024). Given the global concerns about environmental management and mitigating climate change, the discussion on sporting events and sustainability presented above highlights a pressing need to examine the environmental principles associated with sporting events and environmental management from a Global South perspective. The limitations of such research studies are concerning given the increasing number of small-scale, medium-scale, and large-scale sporting events being hosted in environmentally sensitive areas that lack effective environmental strategies and management. Hence, the current study is important because it provides empirical evidence from a geographically specific context in the Global South, thus allowing for comparative analysis to be conducted in academic literature.

Methodology

To achieve the aim of this study, a qualitative research approach was adopted. The qualitative research design was exploratory in nature, grounded in understanding the lived experiences and perceptions of the stakeholders (Creswell & Plano Clark, 2018; Asenahabi, 2019). Qualitative research enables researchers to explore complex subjects and gather detailed responses from participants, providing context for the research problem (Köhler et al., 2024). Existing literature on the environmental sustainability of sporting events in the Global South, particularly in less developed countries, is scarce. Therefore, a qualitative research design allowed the researchers to explore the research area and provide a holistic understanding of this phenomenon. In-depth, semi-structured interviews were conducted with stakeholders (n = 24) from the sports and tourism sectors in Malawi. Table 2 provides

a summary of the participants from the public and private sectors of the sport and tourism industries.

Table 2. Summary of interviewed stakeholders (*n*=24)

Participant code	Participant	Participant field
PT1	Department of Tourism	Public sector
PT2	Department of Tourism	Public sector
PT3	Department of Tourism	Public sector
PT4	Department of Tourism	Public sector
PT5	Department of Tourism	Public sector
PT6	Department of Tourism	Public sector
PT7	Department of Tourism	Public sector
PT8	Department of Tourism	Public sector
PS9	Ministry of Youth and Sports	Public sector
PS10	Ministry of Youth and Sports	Public sector
PS11	Ministry of Youth and Sports	Public sector
PS12	Ministry of Youth and Sports	Public sector
PS13	Ministry of Youth and Sports	Public sector
PSA14	Sports association	Public sector
PSA15	Sports association	Public sector
PSA16	Sports association	Public sector
PSA17	Sports association	Public sector
PSA18	Sports association	Public sector
PSA19	Sports association	Public sector
PSA20	Sports association	Public sector
PE21	Event organiser	Private sector
PE22	Event organiser	Private sector
PDM23	Destination marketer	Private sector
PDM24	Destination marketer	Private sector

The participants were diverse stakeholders from the public sector, including the Ministry of Youth and Sports, sports associations, and the Department of Tourism, as well as representatives from the private sector, such as event organisers and destination marketers. The participants were purposively selected by the researchers owing to their expertise and knowledge in their respective fields of sports and tourism, as well as their involvement and experience in environmental management in the context of sporting events. The interviews were conducted face-to-face at the workplaces of the different stakeholders. Each interview lasted from 1 hour to 1 hour 45 minutes, on average. The themes explored in the interviews were environmental sustainability and the management of sporting events. The interviews were transcribed verbatim and uploaded to the ATLAS.ti software, where transcripts were individually coded based on the themes explored in the interviews. Thereafter, the identified codes were grouped into four themes, which are discussed in the results section.

Results

Environmental objectives for hosting sporting events

Several studies note that one way sporting events have incorporated environmental sustainability is using the events as platforms to communicate environmental messages and raise environmental awareness (McCullough et al., 2021). Gibson et al. (2012) and Mchunu et al. (2021) report that sporting events can positively influence attendees to become more environmentally conscious and friendly, therefore they can be a platform to encourage pro-environmental behaviour. More importantly, because sporting events have been used to strategically advance tourism development, sporting events become the ideal platform to test and implement best environmental management practices. The interviews conducted revealed that very few of the events in Malawi have specific environmental objectives. One of the participants, an event organiser, noted the following:

"So, over the years, when the event was organized by us, we used the event as a platform to send out messages about conservation. So, we would bring people together and speak about the conservation of the mountain." (PE22)

This indicates that since the change in the event organising team, no conservation awareness initiatives or programmes have been implemented. A government official from the Department of Tourism noted the following:

"We do have environmental objectives, but these are not clearly communicated, and not every stakeholder involved in event planning may understand them. However, we do try to maintain the environment, keep the surrounding areas clean, and conserve energy." (PT2)

A major challenge mentioned in the interviews by different stakeholders is the limited knowledge of what environmental objectives are and what is required from organising teams to identify such objectives. The findings indicate that most of the events do not have specific environmental objectives in place that guide and inform stakeholders of their environmental performance and ensure commitment to achieving environmental sustainability. The objectives outlined for most events in the country are closely tied to the social aspects of these events, which aim to promote socioeconomic development. In instances where environmental objectives are outlined, they are aligned with general environmental practices that are not specifically tailored for sporting events or events in environmentally sensitive areas. It is regrettable that none of the stakeholders interviewed plan sporting events with specific environmental intentions.

Current environmental management practices for sporting events

The interviews with the government officials from sports and tourism revealed that environmental sustainability and management are not the primary focus in sports tourism development. Most of the sport event stakeholders have not

implemented environmental management practices, despite the fact that some of the events in Malawi are in environmentally sensitive areas. The focus in sport tourism development is boosting tourism statistics and economic growth. This has resulted in environmental sustainability receiving very little focus from stakeholders. However, there are some events that involve both sectors, where specific environmental measures are implemented. This sentiment was captured by one of the sports association representatives and a government official from the Department of Tourism, who said the following:

"So, we want to try and limit the amount of chemicals we use by switching to more environmentally safe chemicals and finding a better way to [treat] waste water. We agree that there is a need to use more environmentally friendly products. That is what we are trying to test at the moment." (PSA16)

Another informant, a tourism public sector official, noted the following:

"In terms of environmental measures with the sporting events we are involved in, we look at the carrying capacity of the event venues. We try to make sure that we have the number of people that fit the carrying capacity for each venue. We also look at waste management and maintaining water usage during the events." (PT7)

These sentiments suggest that some of the events in the country have implemented environmentally sustainable measures. However, these measures are not entirely effective in addressing environmental sustainability issues on a large scale. Furthermore, not many stakeholders in sports or tourism have implemented environmental management practices or measures. This was revealed in one interview, where a public sector official noted that they felt the events they host do not have a significant environmental impact; therefore, they have not implemented any environmental measures. A sports association representative stated the following:

"These events do not cause a big harm to the environment, so we do not have strategies or measures in place. However, we engage in environmental initiatives such as planting trees to raise some awareness about the environment." (PSA18)

The sentiment reveals that there may be a perception that if the sporting events do not cause environmental harm, there is no need to implement environmental measures. Mchunu et al. (2021) notes that environmental impacts are intangible and, in most cases, cannot be realised immediately. This may explain why some stakeholders feel that their events do not have environmental impacts.

Challenges in achieving environmental sustainability

Mchunu et al. (2021) reveal that some small-scale sporting events struggle to implement environmentally sustainable practices for various reasons, including limited finances and a lack of interest in environmental sustainability issues. The

interviews for the current study revealed that the public and private sectors face several challenges in achieving environmental sustainability. One of the challenges in Malawi is that environmental impacts are not documented. This is a problem because if environmental impacts are not captured and reported, it is difficult to identify which events have environmental impacts that must be mitigated and managed. A government official from the Department of Tourism shared the following sentiment:

"Every time there is a sports event, the impact is there. The only problem now is for us to be measuring the impact immediately, to say, within this sport event, within this international sport tournament, this is how the change or the impact has been made." (PT5)

The second challenge identified in the interviews is a lack of policy development and implementation that specifically address environmental sustainability or the management of sporting events. One of the tourism public sector officials said the following:

"The government has not been able to develop or implement strategies that specifically aim to achieve environmental sustainability and management of sporting events." (PS13)

This presents a challenge because an effective policy environment would guide various government departments in the measures and strategies to be implemented for achieving sustainability. The policies would make it mandatory for stakeholders to enforce environmental sustainability measures. Currently, there is no incentive or mandate encouraging stakeholders to host environmentally friendly sporting events in the country. The interviews further revealed a lack of collaboration between the sports and tourism sectors in Malawi. The ministry departments may collaborate to host some events, but the relationship and coordination between the two sectors, as well as government departments, are not well-established. This presents a problem because the lack of collaboration has a direct impact on the sustainability strategies or measures that must be implemented. The lack of collaboration suggests that there is ineffective communication between the sectors, and environmental sustainability issues may not be a priority. A government official in the Ministry of Youth and Sport mentioned the following:

"The government departments only work together should there be a sporting event that requires them to do so; thereafter, each department goes its separate ways." (PS11)

The interviews further revealed that another challenge is financial constraints. Several studies (Vicente-Molina et al., 2018; Mchunu et al., 2021) claim that financial constraints or a lack of financial support can be a barrier for event organisers or stakeholders to implement environmentally sustainable measures. This sentiment was captured by a tourism public sector official:

"In order to implement sustainability measures, it requires finances, and as it is, the budget does not allow for that. Implementing sustainability measures is expensive and requires enough funding." (PT3)

Discussion

Based on the research findings presented above, it is evident that the majority of sporting events in Malawi have not prioritised environmental sustainability and limited measures have been implemented in this regard. This is despite the fact that some of the sporting events are hosted in environmentally sensitive areas that require environmental management to ensure they remain protected. In instances where environmental sustainability measures are implemented, they are often not effectively implemented or encouraged. Moreover, some of the measures implemented are merely sustainability initiatives that are not directly linked to the event itself; however, these initiatives are presented in a manner that makes them appear to be part of the environmental sustainability measures implemented for the event. Although environmental initiatives, such as planting trees and raising environmental awareness, are important parts of sustainability, in the context of event management, stakeholders are expected to take more proactive and rigorous actions to manage the environmental impacts of sporting events. For events in environmentally sensitive areas, it is essential to incorporate environmental awareness strategies into the overall planning of the event. More importantly, sport and tourism government stakeholders should make environmental educational programmes mandatory for sporting events. The findings also show that the sporting events do not conduct environmental impact assessments, which causes implementation challenges that make it difficult for stakeholders to achieve sustainability. It is suggested that sporting events in Malawi consider using these events as a platform to initiate pro-environmental management processes in the planning and hosting of sporting events; for example, installing solar energy in sports facilities, such as stadiums, using a grey water system to maintain stadium pitches, and implementing more stringent waste management measures.

Trendafilova & Ziakas (2025) report that most sporting events struggle with environmentally sustainable reporting. This is the case for most events in developing and underdeveloped countries, as some lack the necessary measures or procedures to report on sustainability issues. The scholars suggest that event portfolios can be used to achieve environmental sustainability. An event portfolio is a strategy that outlines how socioeconomic benefits can be maximised (Chalip, 2017). Therefore, incorporating the element of environmental sustainability into event portfolios can encourage event stakeholders to implement sustainability measures. Lastly, the findings reveal a lack of collaboration between stakeholders involved in the sports

and tourism domains in both the public and private sectors. McCauley (2008) describes governance as the complex relationship between government and non-government stakeholders. This study recommends collaborative governance as a strategy to achieve environmental sustainability.

Conclusions

The current study aimed to investigate the environmental sustainability measures and strategies employed by the sports events sector in Malawi. The results reveal that some of the events are not aligned with the environmental sustainability principles linked to sport tourism development, resulting in several negative environmental impacts. This presents significant implications for environmentally sensitive tourist destinations. The findings further reveal that the general perception among the informants was that sporting events are not detrimental to the environment, and as such, most of the events do not have environmental objectives or strategies in place to mitigate negative environmental impacts. The researchers suggest that event organisers and policymakers involved in sport tourism events in Malawi should develop destination-specific environmental strategies to ensure sporting events do not harm the environment, especially in environmentally sensitive areas. Furthermore, the event organisers should integrate environmental sustainability strategies into broader event planning strategies.

Theoretically, this paper makes a significant contribution to the existing body of knowledge by extending the empirical understanding of environmental sustainability measures implemented in underexplored destinations in the Global South, such as Malawi. This study reveals that some countries in the Global South face challenges in implementing environmental sustainability measures because of a lack of collaborative governance and institutional support aimed at ensuring sustainable development and growth in the sport tourism sector. Practically, this study highlights that the lack of collaborative governance between stakeholders hinders the effective implementation of environmental management measures. Thus, this study suggests a more collaborative governance approach between stakeholders in the sports and tourism sectors in Malawi. More importantly, it provides strategic direction on how sporting events can be strategically used to advance sustainability principles for tourism development in the Global South. Incorporating sustainability principles and advancing an eco-friendly agenda for sporting events can ensure the events sector is developed in a sustainable manner and the benefits accrued can be leveraged in the long term.

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Basketball in Romania: Analysis of human resources

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Abstract: This article provides a comprehensive analysis of the evolution of the relationship between coaches and registered sportsmen within the Romanian Basketball Federation and in Romania's sports sections over the period 1992-2024. By examining key indicators such as the average number of sportsmen per coach and the proportion of coaches and sportsmen in sports sections, the study highlights the dynamics of human resources within sports institutions. The analysis focuses on how the Romanian Basketball Federation compares to national trends, offering insights into the development of sports training quality, resource allocation, and the challenges faced by sports organizations in maintaining an optimal balance between coaches and athletes. The findings contribute to a better understanding of the impact of these dynamics on sports performance and provide a basis for strategic planning to enhance the efficiency and effectiveness of sports management in Romania.

Keywords: sports sections, registered athletes, coaches, referees, evolution of human resources

Introduction

The evolution of high-performance sport in Romania has been strongly influenced by the dynamics of human resources within sports sections, both at national level and within specialized sports federations, such as the Romanian Basketball Federation. One of the key factors in the development of sport is the ratio between coaches and athletes, as well as the capacity of these structures to attract, develop and retain specialized technical staff and registered athletes (Giurgiu et al., 2023).

In the context of analysing the evolution of the number of athletes and coaches in the sports sections of the Romanian Basketball Federation and at national level, the period 1992-2024 provides a complex picture of how these resources have changed over time. This article aims to examine the relationship between coaches and registered athletes within sports sections, focusing on two main dimensions: the average number of athletes per coach and the evolution of the proportion of coaches and athletes in relation to the available resources.

By comparing the Romanian Basketball Federation with national trends in Romania, we will highlight the impact of these dynamics on the quality of sports

training, as well as the challenges faced by sports structures in maintaining a balance between the number of coaches and athletes. The analysis of data for the period 1992-2024 will contribute to a deeper understanding of the evolution of these relationships, while also providing a perspective on how strategies for developing human resources in sport can influence future performances in high-performance sport in Romania.

The aim of this study is to analyse, in the long term, the dynamics of the human resources involved in basketball in Romania over the period 1992-2024, based on statistical data provided by the Romanian Basketball Federation. The approach seeks to capture the numerical and structural evolution of the main categories of human resources – sports sections, registered athletes, club coaches and sports referees – both within the federation and in relation to the national sports system as a whole.

Specifically, the study aims to highlight the relationships between these categories (the average number of registered athletes per sports section, the average number of coaches per section, the relationship between the number of coaches and registered athletes), to identify periods of expansion, stagnation or decline, and to reveal possible structural imbalances that may affect the quality of training and sporting performances. Through this analysis, the intention is to provide an empirical framework useful for underpinning the development strategies of the Romanian Basketball Federation, of clubs, and of decision-makers in the field of sports policy.

The analysis of human resources in Romanian basketball is grounded in two complementary strands of literature: human resource management in sports organisations and research on high-performance sport systems and sport development. General management works underline that human resources are the central "capital" of any organisation (Mathis et al, 1997; Manolescu, 2001; Ilieș & Caciora, 2020; Armstrong & Taylor, 2024), while specialised studies on sports clubs in Romania show that performance depends on complex teams of specialists – managers, coaches, medical staff and support personnel – and on the way these are recruited, motivated and retained (Iconomescu et al, 2014). Building on this, Taylor, Doherty and Kerwin (2024) conceptualise an integrated model of human resource management in sport, in which volunteers, administrative staff, coaches and officials form a single "sports workforce" whose structure and quality determine both performance and participation. In parallel, the sport-development literature synthesised by Sherry, Schulenkorf, Phillips and Rowe (2024) treats organisational capacity in terms of the number and quality of people involved – athletes, coaches and club staff – and routinely uses quantitative indicators (for example, athletes per coach, athletes per club) to assess system sustainability.

Within national sport policy, the SPLISS research programme ("Sports Policy factors Leading to International Sporting Success") explicitly integrates the human resource dimension. Early comparative work by De Bosscher and colleagues on the "global sporting arms race" (De Bosscher et al., 2008) and on methods for comparing elite sport systems (De Bosscher et al., 2010) was later systematised in the SPLISS 2.0 model with nine policy "pillars," including funding, organisation, infrastructure, talent pathways and the volume and quality of coaches and support staff (De Bosscher et al., 2015). The edited volume by Sotiriadou and De Bosscher (2013) further develops this perspective by linking macro-level policies with micro-level management of athletes, coaches and sport-science services in elite programmes. In these frameworks, indicators such as the number of registered athletes, the size of the coaching corps and average athlete–coach ratios are treated as proxies for the institutional and technical capacity of sport systems, providing a conceptual foundation for the indicators used in this article.

In the basketball-specific literature, the development of the playing population is closely tied to long-term athlete development models and the organisation of club structures. Radu (2010, 2015, 2019) stresses the need for coherent progression pathways structured by age and performance levels, arguing that the density of sections and the athlete–coach ratio are key determinants of training quality and talent nurturing. Policy documents such as the Basketball England talent plan (Basketball England, 2018) adopt similar indicators – number of registered players, number of teams and athlete–coach ratios – as explicit development targets. At the same time, policy and practice increasingly position the coach as a central node in human resources: the European Commission's Guidelines on minimum skills and competences for coaches (European Commission, 2020) outline core, intermediate and advanced competences and encourage federations to establish certification and continuous education systems, while the BASKI project coordinated by FIBA Europe treats the children's basketball coach as a key resource for both performance and social outcomes (BASKI Consortium & FIBA Europe, 2019). In this context, works on human resource management (Mathis et al., 1997; Armstrong & Taylor, 2024) and on Romanian club management (Iconomescu et al., 2014) provide a conceptual basis for interpreting data on numbers and ratios of coaches in basketball.

The literature on referees and game officials adds another dimension to the analysis of human resources. In Romania, Martinescu (2014) analyses techniques and strategies for evaluating basketball referees, emphasising that performance in officiating depends on theoretical training, decision-making under pressure and continuous assessment by observers and specialised commissions. Internationally, Ferdinand's (2019) study of basketball officials shows that professional development opportunities, organisational support and prospects for progression in

the competition hierarchy significantly influence referees' intention to remain active. FIBA's education programmes for referees, although not always formalised in the academic literature, operate with standardised courses, video evaluation and mentoring, reflecting the same logic of continuous human resource development. In this light, the number of registered basketball referees and their share within all sports referees become relevant indicators of a system's capacity to sustain an expanding competition calendar while maintaining officiating quality.

A more recent direction is the explicit construction of indicator models for human resource development in basketball. Jawad, Tabesh and Dousti (2025) design such a model for the Iraqi basketball system, including indicators on the number of players, coaches and referees, athlete–coach and matches–referee ratios, and the territorial distribution of structures. Their approach mirrors SPLISS-type logic by quantifying both the components of the human resource and the relationships between them. By analogy, the indicators used in the present article – number and share of basketball sections, registered athletes, coaches and referees, together with ratios such as athletes per section, coaches per section and athletes per coach – can be interpreted as an adapted set of human resource development indicators for Romanian basketball, compatible with these international frameworks.

In the Central and Eastern European context, sports systems are often analysed through the lens of institutional transition, financial constraints and organisational change, yet systematic studies of basketball federations' human resources remain scarce. Romanian research on sports management points to structural difficulties related to funding, infrastructure and staffing, but seldom follows the long-term evolution of personnel within a single federation (Iconomescu et al., 2014). A first quantitative-spatial approach to Romanian basketball is provided by Pop, Feflea and Marinău (2021), who examine the territorial distribution and geographical dispersion of teams in the men's National League. More recently, Feflea, Gherdan and Stupariu (2023) explore the theoretical impact of geographical factors on basketball, underlining the need to link spatial patterns with institutional and human resource dynamics. At the same time, the works of Radu (2010, 2015, 2019) maintain a primarily methodological and applied focus on coaching and education, rather than on the aggregated volume and structure of human resources. Against this background, a longitudinal, indicator-based analysis of sections, athletes, coaches and referees within the Romanian Basketball Federation positions the present study at the intersection of human resource management, SPLISS-inspired sport-policy analysis and sport-development models (De Bosscher et al., 2008, 2010, 2015; Sotiriadou & De Bosscher, 2013; Sherry et al., 2024), filling a visible gap in the literature on team sports in post-transition East European contexts.

The study aims to analyse, over the period 1992-2024, the numerical and structural dynamics of the human resources involved in basketball in Romania – sports sections, registered athletes, club coaches and referees – both within the Romanian Basketball Federation and in relation to the national sports system, on the basis of consistent statistical series. By constructing and interpreting a set of synthetic indicators (shares within national totals, average numbers of athletes and coaches per section, athletes-to-coach ratios, etc.), the analysis seeks to delineate phases of expansion, stagnation and contraction, to identify structural imbalances between the participant base and the technical and officiating resources, and to infer their implications for the functioning of the federation and for sports policy.

The novelty of the study lies in providing the first longitudinal, indicator-based and system-level diagnosis of human resources in Romanian basketball over more than three decades, adapting SPLISS-type and human resource development frameworks to a single sport discipline and positioning the Romanian Basketball Federation within the broader post-transition East European sports context.

Methodology

The methodology of the study is based on a quantitative, longitudinal and comparative approach, having as main units of analysis the sports sections, registered athletes, coaches and sports referees within the Romanian Basketball Federation, respectively within the entire set of sports sections in Romania, over the period 1992-2024. The analysis relies exclusively on secondary statistical data, drawn from the databases and statistical reports of the Romanian Basketball Federation, supplemented by official, nationally aggregated data on the number of sports sections, registered athletes, coaches and referees in Romania for the same reference period.

For each year in the interval 1992-2024, absolute values were collected regarding: the number of sports sections affiliated to the Romanian Basketball Federation and the total number of sports sections in Romania; the number of registered athletes in the sections of the Romanian Basketball Federation and the total number of registered athletes at national level; the number of coaches and the number of referees within the Romanian Basketball Federation, as well as the corresponding values for all sports structures. On the basis of these time series, derived indicators were constructed that capture both the share of basketball within the national sports system and the internal structure of human resources within the Romanian Basketball Federation.

The indicators calculated include, first of all, proportions (shares, in percent) of sections, athletes, coaches and referees of the Romanian Basketball Federation in relation to the national total (for example, the share of sections of the Romanian

Basketball Federation in the total number of sports sections in Romania). Secondly, a series of structural average indicators were computed, such as: the average number of registered athletes per sports section, the average number of coaches per section, the ratio between the average number of athletes and the average number of coaches (athletes per coach), and the ratio between the average number of registered athletes and sports sections. These indicators were calculated both for the Romanian Basketball Federation and for all sports clubs in Romania, allowing direct comparisons between the internal dynamics of basketball and developments in the national sports system.

Data processing involved calculating absolute and relative variations (increases or decreases compared with the base year and with certain key moments), identifying minimum and maximum values over the entire period and estimating general trends for subperiods (for example, phases of stagnation, expansion or decline). The annual series of each indicator was represented graphically in order to facilitate the observation of inflection points and changes in trend. The comparative analysis between the Romanian Basketball Federation and the whole set of sports sections in Romania examined both convergences and divergences in evolution, with an emphasis on how basketball is positioned in relation to the sports system as a whole.

The interpretation of the results was carried out by correlating the evolution of statistical indicators with the main economic, social and institutional transformations of the post-1990 period (economic transition, periods of crisis, sports development programmes, changes in funding and infrastructure). The causal analysis is therefore predominantly interpretative, starting from the numerical and structural dynamics of human resources and relating them to the broader context of Romanian sport.

The study is subject to limitations inherent in analyses based on administrative data: dependence on the way data are reported and aggregated at the level of the federation and national sports structures, possible changes in definitions and classifications over time, as well as the absence of qualitative variables (coaches' level of training, sports performance, age or gender structure of athletes). Nevertheless, the consistent time series and the synthetic indicators used make it possible to outline a robust picture of the evolution and structure of human resources in Romanian basketball and of its positioning within the sports system of Romania.

Results

Human Resources in Romanian Basketball

The data series for the period 1992-2024 shows a clearly upward overall dynamic of the network of sports sections within the Romanian Basketball Federation, both in absolute values and as a share of the total number of sports sections across all federations in Romania.

In 1992, the Romanian Basketball Federation had 146 sections, corresponding to a share of 1.22% of the total number of sports sections in Romania. Up to 2001, the number of sports sections within the Romanian Basketball Federation fluctuated within a relatively narrow range, between 137 and 146, while their share increased gradually from 1.22% to 2.55%. This combination of numerical stability and percentage growth suggests a slow but steady consolidation of basketball's position within organised sport, through an increase in relative importance even in the absence of a spectacular quantitative expansion of the network of sports sections.

The 2002-2003 interval marks a turning point, with a sharp reduction in the number of sports sections in the Romanian Basketball Federation to 81 and a decline of the share to around 1.70%. From a time-series perspective, this episode may be interpreted as a phase of structural contraction, in which the institutional infrastructure of basketball (measured by the number of sections) is compressed and the discipline's relative position within the sports system temporarily deteriorates.

From 2004 onwards, the series indicates a clear recovery. Between 2004 and 2007, the number of sports sections in the Romanian Basketball Federation increased from 114 to 174, while their share rose from 1.94% to 4.45%. The year 2007 represents the maximum, over the entire analysed period, in terms of the share of basketball sections in the total number of sports sections. This stage can be interpreted as a phase of accelerated expansion, in which basketball strengthens its role in the sports system both by extending its institutional network and by gaining a relatively higher share compared with other sports disciplines.

The period 2008-2012 is characterised by a continued increase in absolute terms (the number of sports sections in the Romanian Basketball Federation grows from 187 to 243), accompanied by a repositioning of the share, which stabilises within a range between 2.65% and 3.07%. Compared with the 2007 peak, the percentage value is lower, but the overall configuration shows a durable integration of basketball within the body of sports disciplines, with a share clearly above the early-1990s phase.

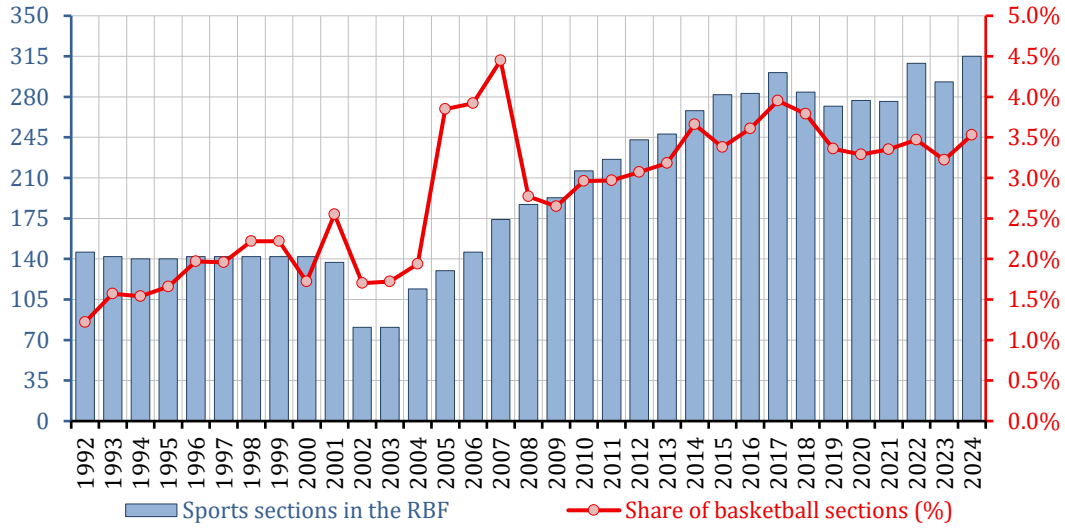

Figure 1. Sports sections in the Romanian Basketball Federation and the share of basketball sections at the national level in the period 1992-2024

In the 2013-2017 interval, the data indicate a new phase of consolidation. The number of sports sections in the Romanian Basketball Federation increases from 248 to 301, and the share remains consistently above 3%, with values between 3.18% and 3.95%. A profile of stability at a high level thus takes shape, in which basketball has already secured a well-established presence in the structure of organised sport, and annual fluctuations remain within moderate limits, without structural setbacks comparable to those of 2002-2003.

For the recent period 2018-2024, the series shows a slight oscillation around an upper plateau. The number of sports sections in the Romanian Basketball Federation remains consistently high (between 272 and 315), and the share stays above the 3% threshold, with values between 3.22% and 3.79%. The year 2024 records the highest absolute number of sections in the analysed series (315), associated with a share of 3.53%. Although this percentage does not exceed the relative maximum of 2007 (4.45%), it confirms that, in the long term, basketball maintains a high and stable share within the national sports system.

Between 1992 and 2024, the number of sections in the Romanian Basketball Federation increases from 146 to 315, while their share in the total number of sports sections rises from 1.22% to 3.53% (Figure 1). The time series captures three main features: (1) a long-term upward trend in the number of sections, with a single phase of severe contraction at the beginning of the 2000s; (2) a clear net increase in basketball's relative share within all sports disciplines, from values below 2% to values above 3%; (3) a transition from a phase of marginal presence in the early

1990s to a phase of institutional consolidation and relative stability in the last decade analysed.

Registered Athletes in the Romanian Basketball Federation

The data series for the period 1992-2024 highlights a substantial growth process in the number of athletes registered with the Romanian Basketball Federation, accompanied by a clear repositioning of basketball within the structure of organised sport, as reflected by the increase in its share of the total number of registered athletes across all sports federations in Romania.

In 1992, 5,015 registered athletes were recorded, corresponding to a share of 1.32%. Between 1993 and 2000, the number of athletes remained stable at the same level (9,825), while their share gradually increased from 3.16% to 4.41%. This combination of numerical stability and percentage growth indicates a consolidation of basketball's position: even in the absence of a quantitative expansion of the athlete base, the discipline gained relative importance compared with other sports.

The 2001-2003 interval marks a pronounced contraction phase. The number of athletes fell to about half of the previous level (5,045 and then below 2,700), and the share dropped below 2%. This sequence can be interpreted as a period of crisis or institutional restructuring, in which both the player base and the relative relevance of basketball within the sports system temporarily diminished.

From 2004 onwards, the series captures a vigorous recovery. The number of registered athletes increased rapidly, exceeding 9,000 in 2005 and 11,000 in 2006, while their share rose to around 8-9%. This stage defines a phase of accelerated expansion, in which basketball recovers and surpasses the losses from the first part of the decade, re-entering the group of disciplines with a significant share in competitive sport as a whole.

The period 2008-2011 is characterised by a moderately upward trend in absolute terms (from around 12,000 to almost 14,700 athletes), against a background of fluctuations in the share between 4 and 6%. An adjustment and stabilisation phase thus emerges, in which the growth of the athlete base is real, but the pace of relative advance may be tempered by the dynamics of other sports disciplines.

Between 2012 and 2017, the data indicate a new phase of sustained expansion. The number of registered athletes increased from over 17,000 to more than 27,000, and the share exceeded the 9-10% threshold. Basketball thus asserted itself as a heavyweight discipline in the national sports landscape, with a robust numerical base and a much higher relative relevance than in the 1990s.

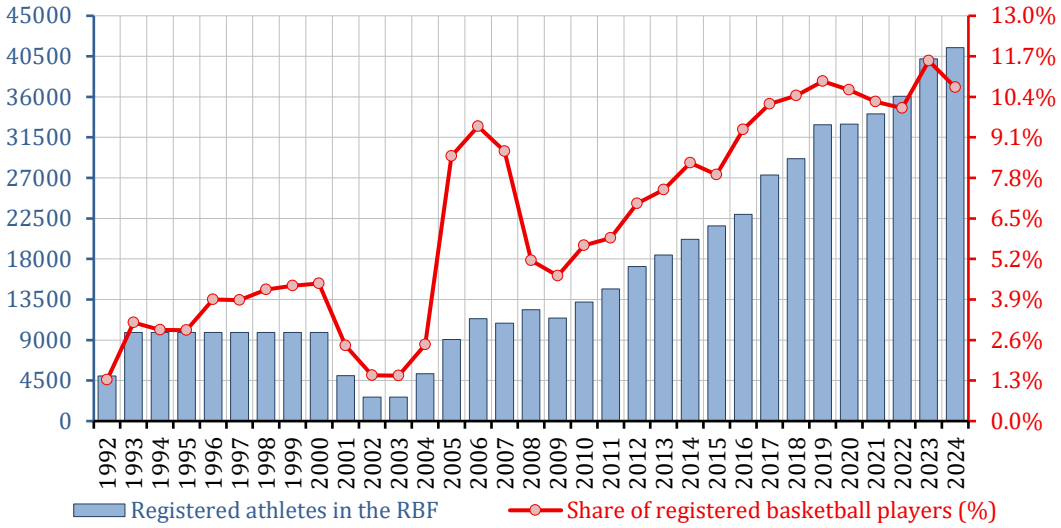

Figure 2. Registered athletes in the Romanian Basketball Federation and the share of athletes registered in basketball sports sections at the national level in the period 1992-2024

In the recent period 2018-2024, a plateau at a high level takes shape, with a continuous increase in the number of athletes (over 29,000 in 2018 and more than 41,000 in 2024) and the maintenance of the share around the 10-12% interval, with a maximum recorded in 2023. Annual fluctuations are small and do not indicate a change in trend, but rather fine adjustments within a context of structural consolidation.

In summary, between 1992 and 2024 the number of athletes registered in the Romanian Basketball Federation increased more than eightfold, while their share rose from 1.32% to over 10% (Figure 2). The time series highlights: (1) a long-term upward trend in the athlete base, with a single phase of severe contraction at the beginning of the 2000s; (2) a marked increase in the relative importance of basketball within the sports system; (3) the transition from the status of a marginal discipline at the beginning of the period to that of a sport with a consolidated position and a high share in the last decade analysed.

Coaches in Clubs Affiliated to the Romanian Basketball Federation

The data series for the period 1992-2024 highlights a long-term growth process in the number of coaches within the Romanian Basketball Federation, accompanied by significant changes in their share of the total number of registered coaches across all sports federations. From the perspective of both variables, several distinct stages can clearly be identified, marked by episodes of expansion as well as phases of contraction or relative stabilisation.

In the interval 1992-2000, the number of coaches remained within a relatively stable range. From 250 in 1992, it reached 291 in most years between 1994 and 2000, which describes a technical structure that was already formed, but without major quantitative extensions. At the same time, the share of basketball coaches in the total number of registered coaches was around 2-3%, with a slight upward trend towards the end of the period. This configuration suggests the existence of a relatively stable technical body, integrated into the sports system but without any significant repositioning in relation to other disciplines.

The period 2001-2004 marks a phase of contraction followed by recovery. The number of coaches initially fell from 291 to 230 and then to 150, while the share dropped towards values below 2%. This sequence can be interpreted as a stage of fragilisation of basketball's technical infrastructure, in which the capacity for coordinating and training athletes is temporarily reduced (see Figure 2). The resumption of growth after 2003, with a return to 204 and then 258 coaches and a share again around the 3% threshold, indicates a process of institutional reconstruction and reconfiguration of the coaching network.

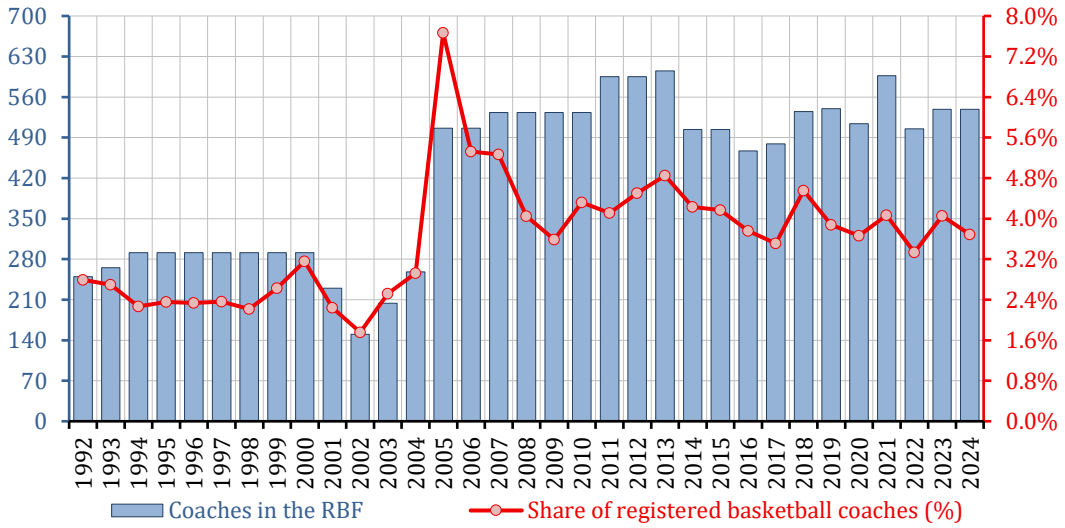

Figure 3. Coaches in the Romanian Basketball Federation and the share of basketball coaches at the national level in the period 1992-2024

The year 2005 represents a turning point in the dynamics of the series. The number of coaches practically doubled compared with the previous year, reaching 506, and the share rose sharply to 7.67%. This change cannot be interpreted as a simple annual fluctuation; it reflects a structural leap, either through the intensification of certification and registration processes or through a reorganisation of the coaching network at federation level. In the following years (2006-2008), absolute values remained at a high level, above 500 coaches, while the

share stabilised at a level higher than in the previous period, around 4-5%, even if lower than the one-off peak in 2005. This suggests the consolidation of a new stage in the development of the technical human resource.

Between 2009 and 2015, the number of coaches generally remained around the same values (between 504 and 605), and the share fluctuated between 3.5 and almost 5%. A phase of stabilisation at a high level thus takes shape, in which basketball benefits from a substantial technical body and annual variations express adjustments rather than trend shifts. The dynamics of the share show that basketball maintains a visible position in the architecture of organised sport, without setbacks comparable to those at the beginning of the 2000s.

In the more recent period, 2016-2024, a pattern of moderate fluctuation within a relatively narrow interval can be observed. The number of coaches varies between 467 and 597, and the share generally remains between 3.3 and 4.6%. Years with slightly higher values (for example 2018, 2021 or 2023) indicate moments of densification of the coaching network, while years with slightly lower values reflect either adjustments in the number of basketball coaches or changes in other sports branches that influence the relative ratio. The absence of abrupt declines and the maintenance of the share above 3% throughout the recent period confirm the stability gained by this component of human resources.

Between 1992 and 2024, the number of coaches in the Romanian Basketball Federation more than doubles, and their share moves from levels around 2-3% to a new plateau, located largely between 3 and 5%, with a distinct peak in 2005. The time series thus describes the transition from a relatively modest but stable technical infrastructure to a much more robust architecture, in which the body of basketball coaches occupies a consolidated place within the national sports system (Figure 3).

Sports Referees in the Romanian Basketball Federation

The data series for the period 1992-2024 highlights a stepwise evolution of the body of referees in the Romanian Basketball Federation, marked by phases of stability, contraction and subsequent consolidation, both in absolute terms and in their share of the total number of registered sports referees.

At the beginning of the interval, in 1992, 175 referees were registered, accounting for 1.22% of all sports referees. In the following years, up to 2000, the number of referees stabilised on a relatively constant plateau, around 120-130 persons, while their share generally fluctuated around the 1% threshold. This combination of numerical stability and low share indicates a referee body sufficient for the functioning of competitions, but with relatively limited significance in the broader architecture of sports officiating at national level.

The 2001-2004 sequence introduces a change of pace. The reduction in the number of referees to 92, followed by a renewed increase to values similar to those of the early 1990s, points to an episode of contraction and reconstruction. In percentage terms, their share initially drops below 1%, then rises again above this threshold. The dynamics suggest a period of institutional recalibration (possibly through regulatory changes, new certification criteria or internal restructuring), in which the referee base is temporarily reduced but subsequently placed back on an upward trajectory.

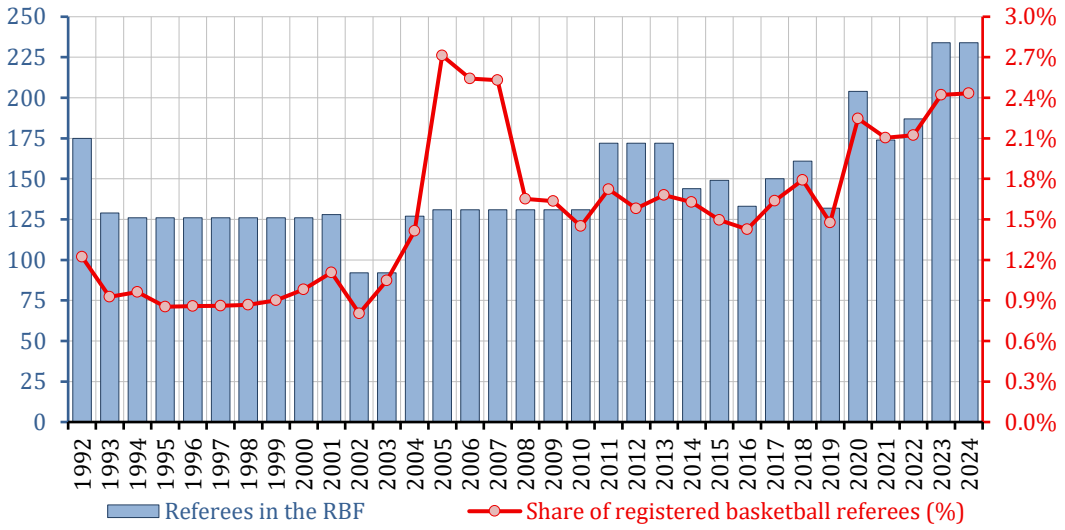

Figure 4. Referees in the Romanian Basketball Federation and the share of basketball referees at the national level in the period 1992-2024

The year 2005 marks a clear inflection point. The number of referees increases and remains at the same level for several years, while their share in the total number of sports referees practically doubles compared with previous intervals, exceeding the 2% threshold. This change does not represent a simple annual fluctuation, but a structural leap: basketball strengthens its position within the field of sports officiating, and the body of referees enters a phase of consolidation at a higher level.

In the period 2008-2017, the data outline a profile of stabilisation on an intermediate plateau. The number of referees generally remains above 130 persons, with episodes of growth (172 referees at the beginning of the decade) and moments of adjustment (moderate decreases to values of 130-150 persons). Their share consistently remains above the levels of the 1990s, situated around the 1.5-2% interval. This stage can be interpreted as a maturation phase: the corps of referees is sufficiently large to support the expansion of the competition calendar, and

basketball's position within sports officiating as a whole becomes stable, without major setbacks.

The 2018-2024 interval reveals a new upward step. The number of referees increases significantly, reaching 204 in 2020 and 234 in 2023-2024, while their share consistently exceeds the 2% level, with values around 2.4% at the end of the period. This configuration indicates a higher-level consolidation of the referee corps, in step with the expansion of the athlete base and the development of the competition network. In practical terms, basketball officiating moves from the status of a modest segment, with a subunitary share in the 1990s, to that of a well-represented component within the architecture of sports refereeing in Romania.

Between 1992 and 2024, three main developments can be observed (Figure 4): (1) an increase in the number of referees in the Romanian Basketball Federation, from an initial level of around 120-130 persons to over 230 in recent years; (2) a doubling of their share in the total number of sports referees, from values of around 1% to values approaching 2.5%; (3) a shift from a phase of relatively discreet presence to a phase of institutional consolidation, in which the body of basketball referees becomes a stable and visible element of the national sports system.

Ratio Between the Average Number of Registered Athletes and Sports Sections of the Romanian Basketball Federation

The data series for the period 1992-2024 compares the ratio between the average number of athletes per sports section for all federations in Romania and the average number of athletes per sports section in the Romanian Basketball Federation, supplemented by the percentage difference between the two values. This ratio functions as a synthetic indicator of the degree of "overloading" or "underloading" of basketball sections relative to the "average section" model in Romanian sport, and is essential for understanding the structure and distribution of human resources in Romanian basketball.

At national level, the average number of athletes per sports section remains, over the entire 1992-2024 interval, within a relatively narrow range, with values between 26.9 athletes per section (in 2000) and 43.4 athletes per section (in 2024). The series starts at 31.8 athletes per section in 1992, rises to almost 40 athletes per section in the mid-1990s, temporarily drops to the minimum of 26.9 in 2000, and then stabilises, in most years, around 30-40 athletes per section. Comparing the ends of the interval, there is an increase from 31.8 athletes per section in 1992 to 43.4 in 2024, which represents an advance of approximately 36.5% over the initial level. From a structural perspective, the utilisation model of sports sections at system level proves relatively stable: the expansion of the base of registered athletes

appears to be accompanied by a relatively proportional adjustment of the number of sections, without systemic jumps or ruptures in the mode of organisation.

Against this backdrop, the values corresponding to the Romanian Basketball Federation show a clearly distinct profile, marked by a much higher intensity of section utilisation. The average number of athletes per section in the Romanian Basketball Federation starts at 34.3 athletes per section in 1992 and reaches 131.7 athletes per section in 2024. The increase is almost fourfold (plus 97.4 athletes per section), corresponding to a rise of approximately 284% compared with the starting year. Over the interval, several phases can clearly be distinguished: in the period 1992-2000, most values are around 69.2 athletes per section (with the exception of 1992), which already in the first decade means a load almost twice as high as the national average. By contrast, the 2001-2003 interval brings a sharp setback, with values of 36.8 and 33.0 athletes per section, close to or even below the national level. Subsequently, the Romanian Basketball Federation returns to an upward trajectory: 46.0 athletes per section in 2004, over 60 athletes per section in 2005-2008 and over 70 athletes per section after 2012. In the last decade, values consistently exceed the threshold of 100 athletes per section, with a peak of 137.3 in 2023 and 131.7 in 2024, confirming a very high density of human resources within basketball sections.

The indicator "percentage difference" between the average number of athletes per section in the Romanian Basketball Federation and the average number of athletes per section at national level synthesises these trends. With the exception of the 2001-2003 period, values are consistently positive and, in many years, very high. At the beginning of the series, in 1992, the difference is modest, at 8%, meaning that basketball sections concentrate only slightly more athletes than the "average section" in the system. From 1993 onwards, however, the differences increase rapidly: 101% in 1993, 89% in 1994, 76-98% in the remaining years of the 1990s, indicating that the load of Romanian Basketball Federation sections is almost double the national average. The extreme situation is reached in 2000 when, against the background of a national minimum of 26.9 athletes per section, the Romanian Basketball Federation maintains 69.2 athletes per section, resulting in a surplus of 157%.

The only period in which the ratio is reversed is 2001-2003, when the percentage difference becomes negative: -5% in 2001, -14% in 2002 and -15% in 2003. In these years, the average number of athletes per section in the Romanian Basketball Federation (36.8 and 33.0) is slightly below or close to the national indicator (38.9 and 38.1-38.9). This change of sign coincides with the contraction phase of the Romanian Basketball Federation network identified in the series for the total number of athletes and sections, and can be interpreted as a moment of

structural recalibration: the reorganisation of sections, the temporary reduction of the athlete base and the re-arrangement of the institutional network bring, for a short time, the utilisation profile of basketball sections closer to the average model of Romanian sport.

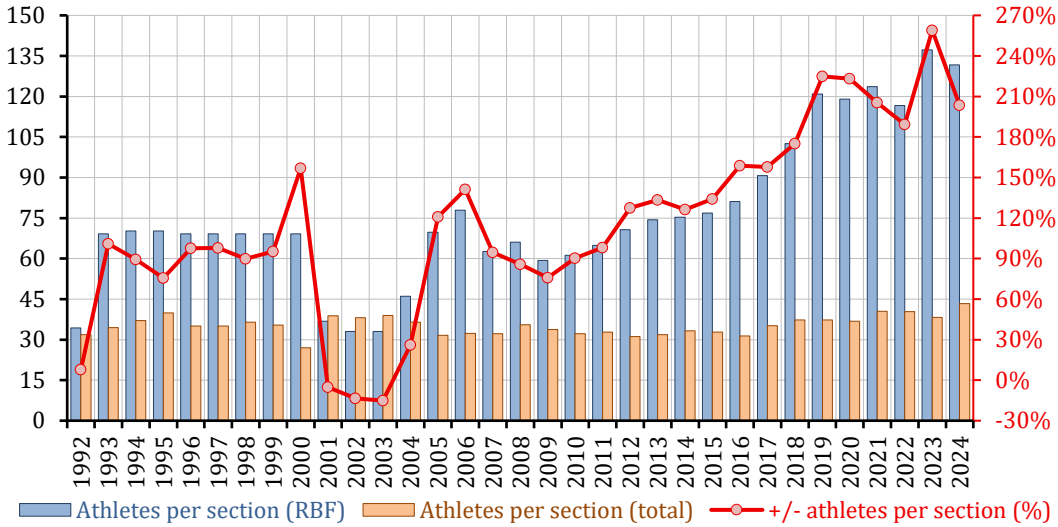

Figure 5. The average number of athletes per sports section in the Romanian Basketball Federation, the average number of athletes per sports section at the national level, and the percentage difference between the average number of athletes per sports section in the Romanian Basketball Federation and the average number of athletes per sports section at the national level in the period 1992-2024

After 2004, the percentage difference returns firmly in favour of the Romanian Basketball Federation and increases steadily. In 2004, basketball sections have 26% more athletes than the national average; in 2005 the surplus reaches 121%, in 2006 141%, and in the following years it stabilises briefly around 80-100%. From 2012 onwards, the differences become structurally very high: 127% in 2012, 133% in 2013, 126-134% in 2014-2015, 159% in 2016 and 158% in 2017, meaning that the sections of the Romanian Basketball Federation concentrate 2.3-2.6 times more athletes than the average section in the system. After 2018, the ratio intensifies even further: 175% in 2018, 225% in 2019, 223% in 2020, 205% in 2021, 189% in 2022, 259% in 2023 and 204% in 2024. In practical terms, in 2019-2023, basketball sections consistently serve more than three times as many athletes as the national average, with the maximum value reached in 2023, when the Romanian Basketball Federation / national level ratio exceeds 3.5:1 (137.3 versus 38.2 athletes per section).

From a human resources analysis perspective, these differences indicate that the growth rate of the number of registered athletes in basketball has significantly

outpaced the rate of expansion of the section network in the Romanian Basketball Federation, whereas at national level the two trends have remained closer. Basketball sections thus become organisational units with a very high athlete density, a situation that can simultaneously be interpreted as an indicator of the discipline's attractiveness and of its capacity to retain participants, but also as a signal of structural pressure on institutional infrastructure and on the body of coaches and referees.

The ratio between the average number of athletes per sports section at national level and the average number of athletes per section in the Romanian Basketball Federation highlights a pronounced particularity of basketball in the Romanian sports landscape: in the long term, Romanian Basketball Federation sections operate under a much more intensive utilisation regime than sports sections as a whole. The "normalisation" episode of 2001-2003 does not alter the general trend but represents only a recalibration moment followed by a recovery to even higher levels. This structural concentration of human resources naturally requires that data on athletes per section be integrated into any discussion on the planning, sizing and distribution of human resources in Romanian basketball.

Ratio Between the Average Number of Coaches and Sports Sections of the Romanian Basketball Federation

The data series for the period 1992-2024 makes it possible to examine comparatively the average technical capacity of sports sections in Romania by relating the average number of coaches per section at national level and within the Romanian Basketball Federation (FRB). The percentage difference between the two indicators expresses the deviation of basketball's technical structure from the "average model" of the sports system, that is, the extent to which the Romanian Basketball Federation sections are better or less well served in terms of coaching resources than sports sections at national level.

For all federations combined, the average number of coaches per sports section remains within a relatively narrow interval, with values between 0.8 coaches per section (1992) and 2.6 coaches per section (2006-2007). The series starts from 0.8 in 1992, gradually rises towards 1.7-2.1 in the second half of the 1990s, temporarily drops to 1.1 in 2000, then generally settles between 1.5 and 2.0 coaches per section. On average, over the entire period, the "typical" sports section in Romania has about 1.7 coaches. A slight increase in technical capacity is observed in the first half of the 2000s (the peak of 2.6 coaches per section), followed by a return to a more moderate plateau of around 1.6-1.8 coaches per section in the last decade. Structurally, this suggests that the organisation of coaching resources at system

level does not undergo radical transformations, but rather relatively fine adjustments around a stable model.

The profile of the Romanian Basketball Federation is, however, distinct. The average number of coaches per section in the Romanian Basketball Federation starts from 1.7 in 1992, remains around 2.0 throughout almost the entire 1990s and reaches 2.5 coaches per section in 2003. The period 2005-2007 marks a clear peak: 3.9 coaches per section in 2005, 3.5 in 2006 and 3.1 in 2007, values clearly higher than both the national average and the Romanian Basketball Federation's own earlier levels. Subsequently, the indicator gradually decreases, stabilising between 1.7 and 2.2 coaches per section in the 2014-2024 interval. Over the whole period 1992-2024, the Romanian Basketball Federation sections have, on average, about 2.2 coaches per section, therefore significantly above the national average of 1.7, even though the magnitude of this advantage varies over time.

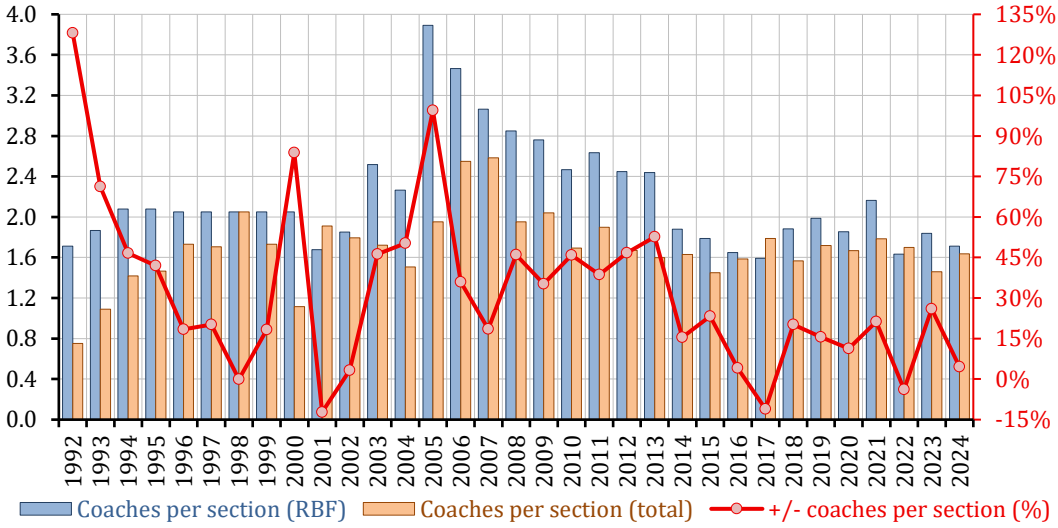

Figure 6. The average number of coaches per sports section in the Romanian Basketball Federation, the average number of coaches per sports section at the national level, and the percentage difference between the average number of coaches per sports section in the Romanian Basketball Federation and the average number of coaches per sports section at the national level in the period 1992-2024

The percentage difference between the two indicators synthesises these relationships. In the vast majority of years, the values are positive, indicating that basketball sections have more coaches than the average sports section in Romania. In 1992, the difference is very high (128%), which, combined with the absolute values (0.8 coaches per section at national level and 1.7 in the Romanian Basketball Federation), indicates more than twice as many coaches per section in basketball compared with the system average. In the following years, the difference moderates

but remains substantial: between 40% and 100% in the period 1993-2000, with a particularly notable episode in 2000, when the national average drops to 1.1 coaches per section while the Romanian Basketball Federation maintains 2.0 coaches per section, resulting in an 84% advantage.

There are also a few moments of convergence or even reversal of the ratio. In 1998, the percentage difference is zero, indicating equality between the average number of coaches per section at national level and in the Romanian Basketball Federation (2.1 and 2.0 coaches per section respectively, practically very similar values). In 2001, 2017 and 2022, the difference becomes negative (between -4% and -12%), and the absolute values confirm that, in these years, the Romanian Basketball Federation sections have slightly fewer coaches per section than the national average (for example, 1.9 coaches per section at national level and 1.7 in the Romanian Basketball Federation in 2001; 1.8 versus 1.6 in 2017). These years mark episodes of relative "underdimensioning" of the coaching workforce in basketball.

After 2003, the Romanian Basketball Federation's advantage is rapidly rebuilt and reaches a maximum in 2005, when the percentage difference climbs to 99%: with 3.9 coaches per section in the Romanian Basketball Federation compared with 2.0 at national level, basketball sections are almost twice as well provided for in technical staff. The period 2004-2013 is, overall, characterised by moderate to high positive differences (generally between 35% and 53%), which reflects a pattern in which the Romanian Basketball Federation sections consistently have more coaches than the average sections in the system. In the 2014-2024 interval, the differences decrease but remain mostly positive, ranging from values close to zero (4-5%) to episodes with a 20-26% advantage for basketball (for example in 2018, 2021 and 2023). Over the entire period 1992-2024, the average percentage difference is on the order of 30%, which means that, structurally, the Romanian Basketball Federation sections have, on average, about one third more coaches than sports sections as a whole.

In the logic of human resource analysis in Romanian basketball, these results suggest that, although the Romanian Basketball Federation has consistently benefited from a technical structure slightly superior to the national average (more coaches per section), its advantage is more modest than in the case of athletes per section. In other words, basketball sections concentrate not only a very large number of athletes, but also a relatively higher number of coaches; however, the growth rates are not perfectly synchronised. Episodes in which the Romanian Basketball Federation approaches or falls slightly below the national average signal moments of tension between the expansion of the participant base and the capacity to adjust the coaching workforce. In the long term, the ratio between the average number of coaches per sports section at national level and the average number of

coaches per section in the Romanian Basketball Federation sketches the image of a system in which basketball generally enjoys a relatively denser technical infrastructure than Romanian sport as a whole, but also of a field in which the balance between technical and competitive resources remains fragile and requires careful monitoring (Figure 6).

Ratio Between the Number of Coaches and Registered Athletes in Sports Sections of the Romanian Basketball Federation

The series for the period 1992-2024 makes it possible to analyse the relationship between the participant base and the technical resource by means of the indicator "average number of athletes per coach", calculated both for all sports federations in Romania and separately for the Romanian Basketball Federation. The percentage difference between the two indicators directly expresses the degree of workload of basketball coaches compared with coaches in the sports system as a whole.

At national level, the average number of athletes per coach decreases from 42.4 athletes/coach in 1992 to 26.5 athletes/coach in 2024, with a minimum of 12.4 athletes/coach in 2007. The mean for the entire interval is 21.78 athletes/coach. Two major developments stand out: first, a rapid reduction of the ratio in the 1990s and early 2000s, when values fall from over 40 to almost 20 athletes per coach; second, a long-term stabilisation with values generally between 19 and 26 athletes/coach after 2005. For 1992-2000, the average is 25.62 athletes/coach; between 2001 and 2004, 22.08 athletes/coach; between 2005 and 2013, 16.76 athletes/coach; and in the interval 2014-2024 the average rises to 22.65 athletes/coach. From the point of view of organising the technical resource, the national sports system thus evolves from a highly loaded model in the early 1990s towards a much more balanced model in the last two decades.

In the Romanian Basketball Federation, values are systematically higher in the long term and show a different internal dynamic. The average number of athletes per coach starts from 20.1 athletes/coach in 1992, drops to a minimum of 13.1 athletes/coach in 2003, and rises to 76.9 athletes/coach in 2024. The mean over the entire interval is 37.27 athletes/coach, that is, 15.49 athletes/coach above the national average. In the sub-period 1992-2000, the Romanian Basketball Federation records an average of 32.64 athletes/coach (versus 25.62 nationally), which means that a basketball coach works, on average, with 7.02 more athletes than an "average" coach in Romania. Between 2001 and 2004, the relationship is reversed: the Romanian Basketball Federation's average is 18.28 athletes/coach, below the national average of 22.08, an interval that also corresponds, in other indicators, to a phase of contraction and reorganisation of the basketball system. In 2005-2013, the

Romanian Basketball Federation average increases to 23.82 athletes/coach compared with 16.76 nationally, and in 2014-2024 it climbs to 58.96 athletes/coach, while the national average is 22.65. This last sub-period thus marks a change in scale: a basketball coach coordinates, on average, more than 58 athletes, compared with roughly 23 in the rest of the system.

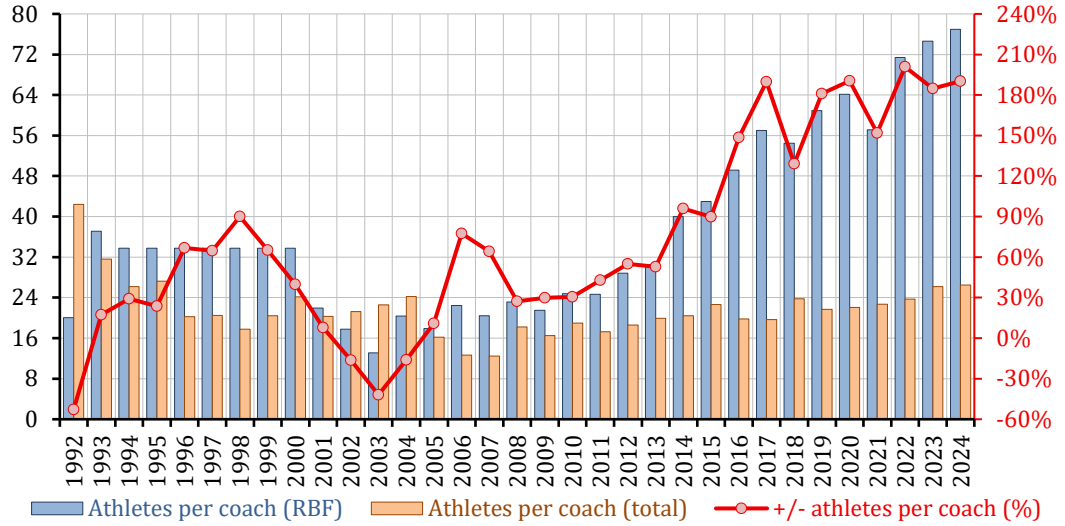

Figure 7. The average number of athletes per coach in the Romanian Basketball Federation, the average number of athletes per coach at the national level, and the percentage difference between the average number of athletes per coach in the Romanian Basketball Federation and the average number of athletes per coach at the national level in the period 1992-2024

The percentage difference between the two indicators synthesises this evolution. Over the entire 1992-2024 interval, the mean difference is 73.36%, which means that, on average, a coach in the Romanian Basketball Federation is responsible for 73.36% more athletes than a coach in the set of all federations. In 1992-2000, the mean difference is 38.22%: the Romanian Basketball Federation is already above the national level, but in a still moderate band. Between 2001 and 2004, the mean difference becomes negative, -16.50%, reflecting the fact that in those years basketball coaches are less loaded than the national average, in line with the phase of institutional contraction. In 2005-2013, the mean difference rises to 43.33%, and in 2014-2024 it reaches 159.36%. This last value corresponds to an average the Romanian Basketball Federation / national ratio of 2.60, that is, a coach in the Romanian Basketball Federation works with 2.60 athletes for every one athlete assigned to a coach in the set of all federations.

Taken together, these results show that the growth of the number of registered athletes in the Romanian Basketball Federation has clearly outpaced the expansion capacity of the coaching corps. At the beginning of the analysed interval,

basketball benefits from a relatively favourable situation, with an athletes/coach ratio below the national average, meaning more comfortable technical coverage. After the mid-1990s, as the national average decreases and the Romanian Basketball Federation maintains or increases the number of athletes per coach, basketball enters a regime in which coaches are more loaded than in the rest of the system. Following the rebalancing episode in the early 2000s, the differential gradually widens, and in the last decade basketball coaches end up working structurally with more than two and a half times as many athletes as coaches in other sports.

The ratio between the average number of athletes per coach at national level and in the Romanian Basketball Federation points to a structural tension in the technical component of human resources in basketball. Basketball sections manage to attract and retain a very large number of athletes, but the distribution and sizing of the coaching corps have not kept pace. This situation raises direct questions regarding the quality of the training process, the possibility of individualising training, and the need for policies to strengthen and expand the technical human resource in Romanian basketball (Figure 7).

Discussion

The longitudinal analysis of the period 1992-2024 shows that Romanian basketball has undergone a profound process of institutional consolidation within the national sports system. The number of sports sections in the Romanian Basketball Federation more than doubles, and their share in the total number of sections rises from a marginal level to a stable position above three percent in the last decade. This evolution is fully consistent with sport-development models that regard club density and section networks as basic indicators of organisational capacity (De Bosscher et al., 2015; Sherry et al., 2024). The temporary contraction of 2002–2003, followed by rapid recovery and stabilisation on a higher plateau, can be interpreted as a recalibration phase typical of post-transition systems in Central and Eastern Europe, where institutional restructuring and changes in funding mechanisms periodically reconfigure the club landscape (Iconomescu et al., 2014).

At the level of the playing population, the results are even more pronounced. The number of athletes registered in the RBF increases more than eightfold, and their share in the national total moves from around one percent to values above ten percent, with a maximum in the early 2020s. From the perspective of sport-development literature, this trajectory signals the successful positioning of basketball as a mass-participation team sport, comparable to the objectives formulated in development plans of other European federations, where increasing the number of registered players and teams is a central strategic priority (Basketball England, 2018; Radu, 2019). The RBF thus moves, over the three decades analysed,

from the status of a secondary discipline to that of a core component of the Romanian sports portfolio, with a robust and diversified participant base (Erdely et al., 2020).

The evolution of the technical human resource reveals a more nuanced picture. The number of coaches affiliated to the RBF more than doubles, and their share of the national coaching workforce climbs from around two–three percent to a higher plateau between three and five percent, with a clear structural leap in 2005. This expansion indicates that basketball has gradually built a substantial technical infrastructure, in line with the emphasis placed by human resource management literature on the central role of coaches in organising the training process and mediating performance outcomes (Mathis et al., 1997; Armstrong & Taylor, 2024). At the same time, the dynamics are not perfectly synchronised with those of the athlete base. While the number of registered players grows very rapidly, especially after 2004, the coaching corps expands at a slower pace, and the RBF's relative advantage in terms of coaches per section tends to diminish over the last decade. This desynchronisation suggests a gradual erosion of the "buffer" that coaches provide in managing the enlarged participant base.

The trajectory of the referee corps is marked by stepwise consolidation. Starting from a modest share of around one percent of all sports referees, the number of basketball referees and their national share roughly double over the period, with a first structural leap in the mid-2000s and a new upward step after 2018. The sequence of contraction and reconstruction at the beginning of the 2000s, followed by stabilisation and subsequent expansion, is compatible with findings from international research on basketball officials, which underline the sensitivity of this category to certification rules, development opportunities and organisational support (Ferdinand, 2019). By the end of the period, basketball officiating has moved from a relatively discreet presence to a stable and visible component of the national refereeing system, able to support an expanded competition calendar. However, the relative growth of referees remains more moderate than that of athletes, suggesting that the officiating resource, while strengthened, must be carefully monitored in relation to the volume and density of competitions.

The derived indicators clarify the internal relationships between these components of human resources and highlight the main structural tensions. At national level, the "average section" operates with approximately 30–40 athletes throughout the period, and the average number of athletes per coach decreases substantially, reflecting a long-term trend towards reducing individual workload and improving the balance between technical staff and participants. In contrast, RBF sections become organisational units with a very high athlete density: the average number of athletes per section rises from around 34 at the beginning of the period

to more than 130 at the end, and for most of the last decade basketball sections consistently manage at least twice, and often more than three times, as many athletes as the national average. From the perspective of human-resource development models in basketball (Radu, 2019; Jawad et al., 2025), such concentrations can be read simultaneously as a sign of the sport's attractiveness and of potential pressure on institutional and technical capacities.

The ratio of coaches per section reinforces this interpretation. Over the whole interval, RBF sections generally benefit from a slightly denser technical infrastructure than the "average" sports section in Romania, with an overall surplus of roughly one third more coaches per section. This relative advantage, however, is modest compared with the much sharper differences recorded for athletes per section, and it tends to narrow in the most recent decade. Isolated years in which the indicator falls to or below national levels signal episodes of under-dimensioning of the coaching resource in relation to the expansion of the competition and training network. In the language of human resource management in sport (Taylor et al., 2024), the RBF appears to have built an acceptable quantitative base of coaches, but faces increasing challenges in aligning the size and distribution of this workforce with the accelerated growth of the athlete population.

The most sensitive indicator is the athletes-to-coach ratio. While the national sports system evolves from a highly loaded model in the early 1990s towards a more balanced configuration – with the average number of athletes per coach decreasing and stabilising at relatively moderate values – the RBF follows an opposite trajectory. After a short period of rebalancing at the beginning of the 2000s, the ratio increases steadily, and in the last decade basketball coaches work, on average, with more than two and a half times as many athletes as their colleagues in other sports. From the viewpoint of long-term athlete development and training quality, such values raise legitimate concerns. The literature on coaching and youth basketball emphasises the importance of manageable group sizes and of individualised feedback in supporting technical and tactical progression (Radu, 2015, 2019). When the athlete-to-coach ratio rises to very high levels, the capacity to offer differentiated training, to monitor workload and to prevent injuries is likely to be diminished, even if the formal number of coaches appears "sufficient" at aggregate level.

Taken together, these results draw the profile of a sport that has been highly successful in expanding its institutional base and attracting participants, but in which the human infrastructure responsible for training and officiating has not fully kept pace with this expansion. In SPLISS terms, basketball in Romania has strengthened pillars related to participation and club network, while pillars associated with coaching and support staff have evolved more slowly and unevenly

(De Bosscher et al., 2015; Papp et al., 2019). From a policy perspective, the main vulnerability of the system is no longer the volume of the selection base, but the balance between this base and the technical and officiating capacities that sustain it. In line with international guidelines on coaching competences (European Commission, 2020) and with national analyses of sports-club management (Iconomescu et al., 2014), the findings suggest that the next stage in the development of Romanian basketball should prioritise the consolidation of the corps of coaches and referees – quantitatively, territorially and qualitatively – so that the internal structure of human resources becomes coherent with the size, ambitions and performance objectives of the Romanian Basketball Federation.

Conclusions

The study shows that a longitudinal, indicator-based perspective on sections, athletes, coaches and referees offers a coherent diagnosis of Romanian basketball as a system, revealing structural tensions and trajectories that cannot be captured through isolated statistics or results tables. By positioning the Romanian Basketball Federation within the wider national sports system and operationalising concepts from human resource management and sport-development models, the analysis turns abstract frameworks into a concrete tool for monitoring institutional and technical capacity in a single team sport. From a policy perspective, the findings support a reorientation from purely quantitative expansion goals towards integrated human-resource strategies that coordinate the recruitment, education and territorial distribution of coaches and referees with the scale of the participant base; future research should complement similar indicator sets with qualitative data on competence profiles, career paths and organisational practices, in order to evaluate not only the volume but also the quality and sustainability of human resources in Romanian basketball.

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