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SPIS TREŚCI

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WSTĘP

W 2025 r. periodyk „Sport i Turystyka. Środkowoeuropejskie Czasopismo Naukowe" ukazuje się ósmy rok. Jest kontynuacją tytułu „Prace Naukowe Akademii im. Jana Długosza w Częstochowie Kultura Fizyczna". W pierwszym tegorocznym numerze zostały zaprezentowane prace Autorów z różnych ośrodków naukowych w Polsce i na świecie.

W części I – *Dzieje kultury fizycznej i turystyki w Polsce i na świecie* przedstawiono artykuły dotyczące następującej problematyki:

— kto wygrał walkę o Everest? – stulecie śmierci George'a Mallory'ego i Andrew Irvine'a;
— sport w województwie opolskim w latach 1989–1998.

W części II zatytułowanej *Teoria i metodyka wychowania fizycznego i sportu* przedstawiono trzy artykuły dotyczące:

— sambo jako forma zapasów i samoobrony;
— poziom dynamicznej stabilności postawy uczniów Gimnazjum Sportowego w Nitrze;
— analiza szczytowej mocy wyjściowej, eksplozywnej siły kończyn dolnych i równowagi młodych piłkarzy w zależności od pozycji gry: badanie pilotażowe.

W części III – *Uwarunkowania zdrowia, postawy prozdrowotne, jakość życia* – ukazano artykuł odnoszący się do problematyki aktywności fizycznej a wzorca snu podczas pandemii COVID-19: wnioski z analizy klastrowej.

Część IV czasopisma dotyczy problematyki turystyki i rekreacji. W tej części przedstawiono dwa artykuły odnoszące się do następującej problematyki:

— struktura intelektualna badań intencji behawioralnych w turystyce: analiza bibliometryczna;
— czy technologie ubieralne i cyfrowe mogą zwiększyć wyniki oparte na danych przesyłanych między przedsiębiorstwami a konsumentami w branży zdrowia i fitnessu?

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Część I

Dzieje kultury fizycznej i turystyki w Polsce i na świecie

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Grzegorz ZIELIŃSKI*

WHO WON THE FIGHT FOR EVEREST? – THE CENTURY OF THE DEATH OF GEORGE MALLORY AND ANDREW IRVINE

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Kto wygrał walkę o Everest? – stulecie śmierci George'a Mallory'ego i Andrew Irvine'a

Streszczenie

W 2024 roku minęło 100 lat od wspinaczki George'a Mallory'ego i Andrew Irvine'a (8 czerwca 1924 roku). Ich atak szczytowy jest jednym z największych tajemnic Mount Everestu. Celem niniejszego artykułu jest uczczenie wyprawy z 1924 roku oraz podsumowanie dostępnej wiedzy na temat tego co mogło się stać 8 czerwca 1924 roku. George Mallory i Andrew „Sandy" Irvine na pewno dotarli na wysokość pierwszego stopnia (8564 m). Na podstawie obserwacji Odella można wnioskować, że pokonali również wysokość co najmniej drugiego stopnia (8610 m). Prawdopodobnie George Mallory i Andrew Irvine schodzili podczas zmierzchu lub w nocy. Poniżej pierwszego stopnia rozegrał się dramat, na skutek którego Mallory spadł. Prawdopodobnie przeżył upadek, a śmierć poniósł wskutek urazu głowy (od uderzenia spadającego kamienia). Ciała Irvine'a do tej pory nie znaleziono. Odell cały czas dopuszczał możliwość, że opisywany zespół zdobył szczyt. Niestety z każdym rokiem szanse na rozwikłanie tej historii maleją. Warto zaznaczyć, że George Mallory uczestniczył we wszystkich trzech brytyjskich wyprawach na Mount Everest, był jednym z pionierów himalaizmu. George Mallory był w grupie himalaistów, którzy pierwsi dotarli i przekroczyli tzw. strefę śmierci. Niestety był również pierwszą osoba, która w niej zginęła.

Słowa kluczowe: historia, Mount Everest, 1924, George Mallory, Andrew Irvine.

Abstract

The year 2024 marks the 100th anniversary of George Mallory and Andrew Irvine's climb (June 8, 1924). Their ascent remains one of the greatest mysteries of Mount Everest. The purpose of this

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article is to celebrate the 1924 expedition and to summarize the available knowledge about what may have happened on 8 June 1924. George Mallory and Andrew "Sandy" Irvine certainly reached the height of the first step (8564 m). Based on Odell's observations, it can be inferred that they have also overcome the altitude of at least the second step (8610 m). It is likely that George Mallory and Andrew Irvine descended at night. Below the first step there was a drama which resulted in Mallory falling. He probably survived the fall and died of a head injury (from the impact of a falling rock). Irvine's body has never been found. Odell always considered the possibility that the team had reached the summit. Unfortunately, with each passing year, the chances of solving this mystery diminish. It is worth noting that George Mallory participated in all three British expeditions to Mount Everest and was one of the pioneers of Himalayan climbing. George Mallory was among the group of climbers who first reached and crossed the so-called Death Zone. Unfortunately, he was also the first person to die in it.

Keywords: history, Mount Everest, 1924, George Mallory, Andrew Irvine.

Introduction

Mount Everest is the highest peak on earth at 8848.86 m above sea level. In the local language it is named Chomolungma, which can be translated as "Goddess Mother of the World"[1]. Over the years, climbing Mt. Everest has become increasingly popular.[2] The two most popular climbing routes on Mount Everest are the South-East Ridge on the Nepalese side and the North-East Ridge on the Chinese side.[3]

In 2022, it was 100 years since the first attempt to climb Mount Everest, which took place in 1922. Officially, they succeeded and safely descended from the summit on 29 May 1953, the conquerors being Edmund Hillary and Tenzing Norgay.[4] However, it is still not known whether they were the first to reach the summit. This has caused much controversy in the mountaineering community. The first to propose the theory that Edmund Hillary and Tenzing Norgay were not the first to summit Mount Everest was Tom Holzel.[5]

In 2024, it will be the 100th anniversary of the British expedition during which George Mallory and Andrew Irvine died (on June 8, 1924). They attacked the sum-

[1] M. Tannheimer, R. Lechner, *Rapid ascents of Mt Everest: normobaric hypoxic preacclimatization*, "Journal of Travel Medicine" 2020, vol. 27, no 6, pp. 1–7.

[2] E. Garrido, J.M. Soria, R. Salisbury, *Breathless and dying on Mount Everest*, "The Lancet. Respiratory Medicine" 2019, vol. 7, no 11, pp. 938–939; M. Tannheimer, R. Lechner, *Rapid ascents of Mt Everest: normobaric hypoxic preacclimatization*, "Journal of Travel Medicine" 2020, vol. 27, no 6, pp. 1–7.

[3] R. B. Huey, C. Carroll, R. Salisbury, J.-L. Wang, *Mountaineers on Mount Everest: Effects of age, sex, experience, and crowding on rates of success and death*, "PLoS ONE" 2020, vol. 15, no 8, pp. 1–16.

[4] J. Hunt, *The Ascent of Everest*, Mountaineers Boos, Seattle 1993, pp. 20–40.

[5] T. Holzel, *Investigates Mount Everest Mystery*, "Dartmouth Alumni Magazine" 1986, pp. 82–83; T. Holzel, A. Salkeld, *The mystery of Mallory and Irvine*, Seattle, WA 1999, pp. 35–85.

mit from the North-East Ridge[6] with three rock steps. The first step is at 8564 m, the second at 8610 m and the third (not distinguished in 1924) at 8710 m.[7] The first and third steps have a climbing difficulty of about II on the UIAA scale,[8] while the second step has a difficulty equivalent to V to VI- on the same scale (currently, there is a 4.6 m ladder).[9]

George Mallory was born in 1886 and brought up in Mobberley, Cheshire. He became a teacher in 1914, married Ruth Turner in 1914. They had three children, two girls and a boy. Mallory had experience in the mountains, which he gained among others in the Alps. He was the only member of all three British expeditions to Mount Everest between 1921 and 1924.[10] Mallory was one of the first people to enter the Death Zone in 1922. Unfortunately, Mallory and Irvine were also the first people to die in the Death Zone.[11] While giving a lecture (Philadelphia, 1923) to raise funds for another expedition, when asked by an anonymous reporter why he wanted to climb Mount Everest, he replied simply with words that have gone down in history:[12]

> because it is there.

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6 E.F. Norton, *The Fight for Everest 1924: Mallory, Irvine and the Quest for Everest*, Vertebrate Publishing 1925, pp. 120–225.

7 E.F. Norton, *The Fight for Everest 1924: Mallory, Irvine and the Quest for Everest*; C. Anker, D. Roberts, *The Lost Explorer : Finding Mallory On Mount Everest*, New York 10 November 1999; P. Korczak, *Dlaczego wierzę? Mallory i Irvine – Everest 1924 cz. 1*, Brytan, https://brytan.com.pl/dlaczego-wierze-mallory-i-irvine-everst-1924-roku/ (accessed: 8 February 2024).

8 N. Draper et al., *Comparative grading scales, statistical analyses, climber descriptors and ability grouping: International Rock Climbing Research Association position statement*, "Sports Technology" 2015, vol. 8, no 3–4, pp. 88–94.

9 C. Anker, D. Roberts, *The Lost Explorer: Finding Mallory On Mount Everest*, New York 1999; J. Hemmleb, *Tatort Mount Everest: Der Fall Mallory. Neue Fakten und Hintergründe*; E. Viesturs, D. Roberts, *The Mountain: My Time on Everest*, New York 2014; P. Summers, A. Dankekar, *The Mallory and Irvine Mystery: Solving the Second Step Problem*, The Wire, https://thewire.in/history/mallory-irvine-second-step-everest (accessed: 10 February 2024); J. Norton, *To See or Not To See? That is the question for Noel Odell*; J. Hemmleb, *What happened to Mallory & Irvine*, https://www.jochenhemmleb.com/english/mundi/index.php (accessed: 10 February 2024).

10 Irving, *In Memoriam George Herbert Leigh Mallory*, "Alpine Journal" 1924, vol. 36, pp. 381–385; R. Madhok, J. Lemery, G.W. Rodway, *Because It's There … The Education of George Mallory*, "Wilderness & Environmental Medicine" 2011, vol. 22, no 4, pp. 352–354; G.W. Rodway, J.S. Windsor, *Inheritors of Fate: Mountaineering, Science, and George Mallory's Legacy*, "Wilderness & Environmental Medicine" 2011, vol. 22, no 2, pp. 185–188.

11 H.V. Lankford, *The Death Zone: Lessons from History*, "Wilderness & Environmental Medicine" 2021, vol. 32, no 1, pp. 114–120.

12 R.R. Madhok, J. Lemery, G.W. Rodway, *Because It's There… The Education of George Mallory*, "Wilderness & Environmental Medicine" 2011, vol. 22, no 4, pp. 352–354; J. Rak, *Because It Is There? Mount Everest, Masculinity, and the Body of George Mallory*, "The International Journal of the History of Sport" 2021, vol. 38, no 2–3, pp. 157–183.

Andrew "Sandy" Irvine was born in Birkenhead in 1902.[13] He was also a keen sportsman, particularly good at rowing. He studied engineering at Oxford. Irvine had little mountaineering experience.[14] He was described as athletic and a talented engineer. This is probably why Mallory chose him for the summit assault. Irvine also improved oxygen masks, making them less unreliable.[15]

The purpose of this article is to celebrate the 1924 expedition and to summarize the available knowledge about what may have happened on 8 June 1924. Another aim is to describe hypotheses and theories about what happened to George Mallory and Andrew Irvine.

Problems and research methods

I employed various research methodologies to prepare this publication, including analyzing historical sources, synthesizing information, applying induction, deduction, and utilizing the comparative method. Through this process, several research problems were identified:

1. What height did George Mallory and Andrew Irvine reach during their expedition on Everest in 1924?
2. What might hypothetically have happened on June 8, 1924?
3. Did they have the opportunity to reach the summit?

Results and discussion

The day of 8 June 1924 – atmospheric conditions

On June 8, 1924, it was a Sunday. The sunrise occurred around 4:45 a.m. The morning was sunny and not too cold. Towards the end of the morning, clouds began to appear, gradually covering the mountain slopes. At 2:00 p.m., a heavy blizzard arrived, lasting for about 2 hours. Afterward, the sun came out and illuminated the mountain slopes.[16] Moore et al. suggest that during this day, there was a significant drop in barometric pressure due to atmospheric changes.[17] This drop was also associated with the arrival of the snowstorm, which could rival

[13] J. Summers, *Fearless on Everest: The Quest for Sandy Irvine*, Weidenfeld & Nicolson 2001, p. 8.

[14] R.G.C. Levens, *Merton College register, 1900–1964: with notices of some older surviving members*, Oxford 1964.

[15] C.C. Anker, D. Roberts, *The Lost Explorer: Finding Mallory On Mount Everest*, New York 1999; *First on Everest*, (2010), scs. 5–10 min.

[16] E.E.F. Norton, *The Fight for Everest 1924,* pp. 132.

[17] G.W.K. Moore, J. Semple, D. Sikka, *Mallory and Irvine on Mount Everest: Did extreme weather play a role in their disappearance?*, "Weather" 2010, vol. 65, pp. 215–218.

the strength and power of the 1996 storm (at that time, wind speeds were 30 m/s and a temperature of 32ºC).[18] In the expedition journals, the night of June 8th to 9th, 1924, was described as moonlit, and the mountain was free from fog.[19] Moore et al. believe that the decrease in barometric pressure prevented Mallory and Irvine from reaching the summit.[20]

What Mallory and Irvine wore

Mallory and Irvine wore woolen and silk underwear, woolen and flannel clothing, with silk fabric between them to provide comfort during movement. They then put on gabardine jackets.[21] Replicas of Mallory and Irvine's attire were tested on the slopes of Everest to determine whether it provided good thermal insulation and freedom of movement. One of the tests concluded at an altitude of 7000 meters with a temperature of −20ºC.[22] It was shown that if the weather and wind were stable, the attire would provide adequate protection in air temperatures down to −30°C.[23] However, it was noted that the insulation against cold was about 40% less compared to modern mountain attire.[24] The attire from 1924 was found suitable for climbing and moving but did not ensure survival during camping or long stops.

What has been found over the years

Mallory's body was found in 1999. Beside the body were found a pair of goggles hidden in a pocket, documents and letters, a watch that stopped at 5:10, an altimeter.[25] The photo of Ruth that he had promised to leave on the summit was not found[26] (Figure 1). It is a fact that Mallory's body was found with his goggles removed – suggesting this descent at sunset/at night.[27] He was familiar with the case of Norton who, at an altitude of 8382 m, began to experience significant vision problems, described as snow blindness.[28]

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[18] A. Mustain, *Mysterious 1924 Everest deaths linked to storm*, NBC News, https://www.nbcnews.com/id/wbna38639968 (accessed: 8 February 2024).

[19] E.E.F. Norton, *The Fight for Everest 1924,* p. 140.

[20] G.G.W.K. Moore, J. Semple, D. Sikka, *Mallory and Irvine on Mount Everest: Did extreme weather play a role in their disappearance?*, "Weather" 2010, vol. 65, pp. 215–218.

[21] *First on Everest*, scs. 23–28 min.

[22] *The Wildest Dream,* G.W. Rodway, *Mountain Clothing and Thermoregulation: A Look Back*, "Wilderness & Environmental Medicine" 2012, vol. 23, no 1, pp. 91–94.

[23] G.W. Rodway, *Mountain Clothing and Thermoregulation: A Look Back*, "Wilderness & Environmental Medicine" 2012, vol. 23, no 1, pp. 91–94.

[24] G.W. Rodway, *Mountain Clothing and Thermoregulation: A Look Back*, "Wilderness & Environmental Medicine" 2012, vol. 23, no 1, pp. 91–94.

[25] *The Wildest Dream*, scs. 9–10 min.

[26] *The Wildest Dream*, scs. 9–12 min.

[27] *The Wildest Dream*, scs. 9–12 min.

[28] E.E.F. Norton, *The Fight for Everest 1924,* pp. 111.

No one has ever officially announced that Irvine's body has been found. However, over the years, there have been regular reports from Chinese mountaineers claiming such a discovery. The first was Xu Jinga in 1960, who found a blackened body in a sleeping bag at an altitude of 8400 meters. Before 1960, only Mallory and Irvine were lost at this altitude.[29] Wang Fu-chou, also a member of the 1960 expedition, stated that he found the body of a European at around 8600 meters.[30] In 1979, Ryoten Hasegawa had a brief conversation with a Chinese mountaineer named Wang Hong-bao, during which Wang informed him that in 1975 he had seen the "English dead" body at an altitude of 8100 meters, lying on its side as if sleeping at the foot of a rock.[31]

No. 9 oxygen cylinder was found at 8470 m, while other cylinders and other parts of the equipment were not found.[32] A mitten was found at 8440 m and an ice axe at 8460 m[33] (Figure 1).

Mallory and Irvine left no record of when they left the camp.[34] Magnetic flares and flashlightes were found at Camp VI.[35] Odell (a member of the expedition) did not find a flashlight at that time. This suggests that Mallory and Irvine may have had a flashlight during the summit assault. However, in 1933, a flashlight was found at the camp, and to everyone's surprise, the flashlight was working,[36] raising doubts as to whether it actually belonged to the Mallory and Irvine team.[37] It is worth noting that no flashlight was found beside Mallory's body.[38] Even if Mallory had had a flashlight, he may have dropped it during the fall if they had been walking at night. There is also lack of information on whether Irvine had a flashlight. Consideration of whether they had a flashlight is one of the relevant considerations in the context of what time they set off.

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29 *First on Everest*, 4–8 min.

30 AlpKlubSPb.ru., *Альпинисты Северной столицы. 1960. Впервые на Эверест – с севера!.*, http://www.alpklubspb.ru/everest/everest52.htm (accessed: 15 February 2024); S. Edge, *Mount Everest's death zone*, Express.co.uk, https://www.express.co.uk/expressyourself/170857/Mount-Everest-s-death-zone (accessed: 15 February 2024); G. Hoyland, *Has Sandy Irvine's Body Been Found?* (*By the Chinese or Others*) – *MountEverest.info*.

31 P. Summers, A. Dandekar, *Could They Have Climbed the Everest: Part 2 of the Story of Mallory and Irvine*, The Wire, https://thewire.in/history/could-they-have-climbed-the-everest-part-2-of-the-story-of-mallory-and-irvine (accessed: 15 February 2024).

32 J. Hemmleb, L.A. Johnson, E.R. Simonson, W.E. Nothdurft, *Ghosts of Everest: The Search for Mallory & Irvine*, Seattle, WA 1999; *First on Everest*, scs. 23–26 min.

33 *First on Everest*

34 E.E.F. Norton, *The Fight for Everest 1924,* p.141.

35 Ibidem.

36 W. Davis, *Into The Silence: The Great War, Mallory and the Conquest of Everest*, Vintage, New York 2011, pp. 10–100.

37 J.P. Korczak, *Dlaczego wierzę? Mallory i Irvine – Everest 1924 cz. 1*, Brytan, https://brytan.com.pl/dlaczego-wierze-mallory-i-irvine-everst-1924-roku/ (accessed: 8 February 2024).

38 C.C. Anker, D. Roberts, *The Lost Explorer: Finding Mallory On Mount Everest*, New York 10 November 1999.

Mallory's watch, found near his body, sparks debate. Some speculate it stopped around 12:52, possibly from impact with a rock during the second step climbing. Boettcher challenges this, citing lack of dial damage. It is suggested that cold-induced shrinkage caused the plastic glass to detach,[39] possibly during the storm between 2:00 p.m. and 4:00 p.m. Mallory might have used the watch to gauge climb pace or delays, stowing it upon malfunction. Another hypothesis proposes he hid it pre-climb to prevent interference, realizing its dysfunction only post-blizzard.

The camera that Mallory was supposed to take to the summit to document his ascent was also not found.[40] We do know that Mallory was carrying a Kodak Vestpocket camera.[41] Breashears states that Irvine had the camera, because Irvine was more technically proficient and it was Mallory who was the team leader and he should have had the photo at the top.[42] Therefore, investigations and expeditions to find Irvine's body are now crucial.[43] The Eastman Kodak Company reports that it is possible to obtain images after 100 years, using the appropriate technology.[44]

Any traces of climbers' activities above the second step have never been found prior to its conquest by the Chinese expedition in 1960.[45] Consequently, accusations have emerged in the mountaineering community regarding the deliberate erasure of evidence of Mallory and Irvine's activities above 8610 m.[46] McGuinness presents the view that the bodies of both Britons were removed at some point in the first decade of the 21st century. It is worth noting that Synnott's attempt to relocate Mallory's body was unsuccessful despite having the GPS coordinates.[47] Such events raise more and more questions.

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[39] D. Boettcher, *George Mallory Watch: A Borgel na Mount Everest*, https://www.vintagewatchstraps.com/blogmalloryswatch.php (accessed: 10 February 2024).

[40] C.C. Anker, D. Roberts, *The Lost Explorer: Finding Mallory On Mount Everest*, New York 1999, p. 20.

[41] Ibidem, p. 40.

[42] Ibidem, p. 82.

[43] Ibidem; H. Howard, *Did China cover-up truth about who first made it to top of Everest?*, Mail Online, https://www.dailymail.co.uk/news/article-10808817/Book-suggests-body-1924-climber-Andrew-Sandy-Irvine-removed-Everest-camera.html (accessed: 16 February 2024).

[44] J.J. Hemmleb, L.A. Johnson, E.R. Simonson, W.E. Nothdurft, *Ghosts of Everest: The Search for Mallory & Irvine*, Seattle, WA 1999; T. Holzel, A. Salkeld, *The mystery of Mallory and Irvine*, Seattle, WA 1999 p. 320.

[45] L. Cichy, *Przedmowa*, [in:] *Zaginiony*, Warszawa 2012, p. 9 .

[46] P. Korczak, *Dlaczego wierzę? Mallory i Irvine – Everest 1924 cz. 2*, https://brytan.com.pl/dlaczego-wierze-mallory-i-irvine-everest-1924-cz-2/6/ (accessed: 15 February 2024); H. Howard, *Did China cover-up truth about who first made it to top of Everest?*, Mail Online, https://www.dailymail.co.uk/news/article-10808817/Book-suggests-body-1924-climber-Andrew-Sandy-Irvine-removed-Everest-camera.html (accessed: 16 February 2024); G. Hoyland, *Has Sandy Irvine's Body Been Found?* (*By the Chinese or Others*) – *MountEverest.info*.

[47] E. Douglas, *'It doesn't make any sense': new twist in mystery of Mount Everest and the British explorers' missing bodies*, *New Twist in Mystery of Mount Everest and the British Explorers'*

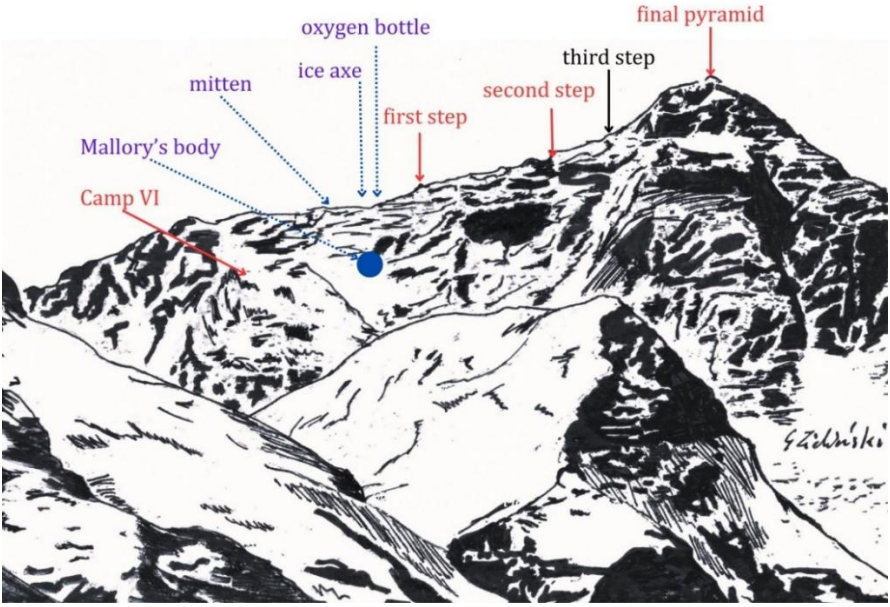

Figure 1. Traces of the expedition found. Characteristic points on the way to Mount Everest. (In black the third step not highlighted in 1924)
Source: Author's graphic created in the style of the graphic from Odell's work, i.e. N. Odell, The Mount Everest Dispatches, "The Alpine Journal" November 1924, vol. XXVI, no CXXIX, p 217.

Hour 12:50 What Odell saw

Other ambiguities concern the account of what Noel Odell (1890–1987), mountaineer, geologist, and member of the 1924 expedition, saw. Odell changed his description of his observations several times over the years. However, he ultimately stuck to his story of seeing Mallory and Irvine – not rocks, birds, and/or optical illusions[48] (Figure 2).

The first recorded observation in Odell's diary was: "At 12:50 saw M&I on ridge nearing base of final pyramide."[49] Roberts suggests, based on these words, that they may have been 500 feet (152 m) from the summit.[50]

Missing Bodies, "The Guardian'', 2024, section World news <https://www.theguardian.com/world/article/2024/jun/01/it-doesnt-make-any-sense-new-twist-in-mystery-of-mount-everest-and-the-british-explorers-missing-bodies> (accessed 9 June 2024).

48 E.J. Norton, *To See or Not To See? That is the question for Noel Odell.*

49 C.C. Anker, D. Roberts, *The Lost Explorer: Finding Mallory On Mount Everest*, New York 1999; p. 26. Korczak, *Dlaczego wierzę? Mallory i Irvine – Everest 1924 cz. 1*, Brytan, https://brytan.com.pl/dlaczego-wierze-mallory-i-irvine-everst-1924-roku/ (accessed: 8 February 2024); A. Roddie, *What happened to Mallory and Irvine in 1924? An extract from "Edmund Hillary – A Biography" by Michael Gill*.

50 C.C. Anker, D. Roberts, *The Lost Explorer: Finding Mallory On Mount Everest*, New York 1999, pp. 26.

Similar but more detailed accounts appeared in July 1924[51] and November 1924.[52] Odell describes, "The place on the ridge referred to is the prominent rock-step at a very short distance from the base of the final pyramid, and it is remarkable that they were so late in reaching this place."[53] The above descriptions may indicate the third step. It is closest to the summit pyramid (Figure 1). In none of the descriptions is there information about the "first step" or "second step." This is significant because in 1924, the third step was not distinguished. If the descriptions applied to either the first or second step, why did Odell not mention them by name?[54] If they were at the level of the third step at 12:50, it is likely (in the context of the evidence found, oxygen mask off, goggles in pocket, no photo of Ruth) that they probably reached the summit.

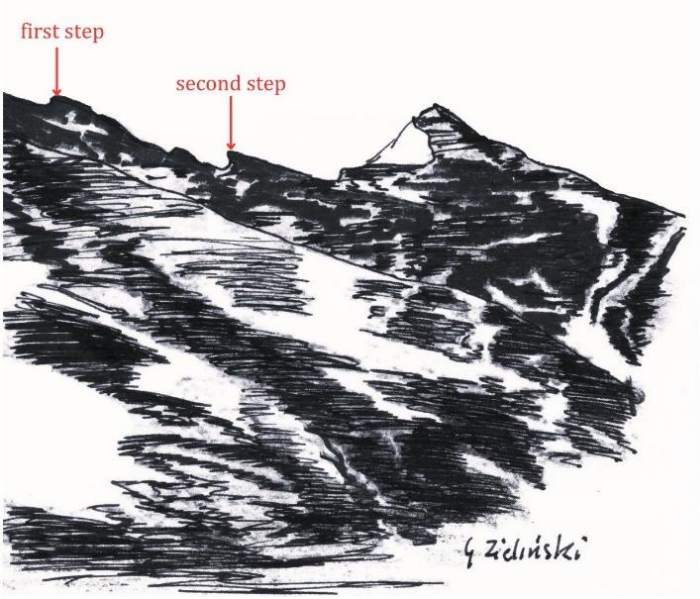

Figure 2. What Odell might have seen based on the work of Norton
Source: Author's graphic created in the style of the graphic from Odell's work. N. N. Odell, The Mount Everest Dispatches, "The Alpine Journal" 1924, vol. XXVI, no CXXIX, p. 2016.

However, Odell gave other descriptions over the years. For example, "The last point where they were seen was determined by theodolite to be 28,227 feet

[51] E.F. Norton, N. Odell, *More Light On Everest Disaster: Mr Odell's Last View Of Lost Climbers*.
[52] N.N. Odell, *The Mount Everest Dispatches*, "The Alpine Journal" 1924, vol. XXVI, no CXXIX. pp. 217.
[53] Ibidem, pp. 223.
[54] J.P. Korczak, *Dlaczego wierzę? Mallory i Irvine – Everest 1924 cz. 1*, Brytan, https://brytan.com.pl/dlaczego-wierze-mallory-i-irvine-everst-1924-roku/ (accessed: 8 February 2024).

less than 800 feet from the summit."[55] In 1925, Odell considered more broadly whether he saw two figures or one overcoming the step, and whether it was the first or second step, leaning towards the latter. He later describes that they calculated they had about "800 feet" (244 m) to climb, noting that if they encountered no difficulties, they should reach the summit in 3 to 3.30 hours.[56] Additionally, the first step is gentle and rounded, while the second step is completely different – it has a sharp character (Figure 2). Odell was a geologist and an experienced climber, even without seeing the entire ridge, he should have been able to distinguish the steps. However, was the team able to overcome the second step, i.e. the greatest difficulty on the way?

Was it possible to climb the second step?

Over the years, four climbers ascended the second step. Oscar Cadiach soloed it in 1985 without oxygen, followed by Theo Fritsche in 2001. Nickolay Totmjanin ascended in 2003, style undisclosed.[57] Conrad Anker, belayed by Leo Houlding, passed it in 2007. Cadiach and Fritsche rated it 5.7 to 5.8.[58] Anker and Houlding 5.9,[59] corresponding to UIAA difficulties V to VI. Mallory's potential ascent aligns with climbers' capabilities. Fritsche suggests Mallory may have succeeded.[60]

Odell saw two black spots, one moving rapidly towards the other in a 5 minute observation.[61] It is a 40 m formation with a more difficult end in comparison to the beginning.[62] If even Odell had seen the final climbing of the second step, then a time of 5 minutes for overcoming the key difficulties is too short.

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[55] N.N. Odell, *The Mount Everest Dispatches*, "The Alpine Journal" 1924, vol. XXVI, no CXXIX pp. 161–217.

[56] N.E. Odell, *The Last Climb of Mallory and Irvine*, "The Geographical Journal" 1924, vol. 64, no 6, pp. 455–461.

[57] J.J. Hemmleb, *What happened to Mallory & Irvine*, https://www.jochenhemmleb.com/english/mundi/index.php (accessed: 10 February 2024).

[58] P.C. Anker, D. Roberts, *The Lost Explorer : Finding Mallory On Mount Everest*, New York 10 November 1999; J. Hemmleb, *Tatort Mount Everest: Der Fall Mallory. Neue Fakten und Hintergründe*; E. Viesturs, D. Roberts, *The Mountain: My Time on Everest*, New York 29 April 2014; P. Summers, A. Dankekar, *The Mallory and Irvine Mystery: Solving the Second Step Problem*, The Wire, https://thewire.in/history/mallory-irvine-second-step-everest (accessed: 10 February 2024); J. Norton, *To See or Not To See? That is the question for Noel Odell*; J. Hemmleb, *What happened to Mallory & Irvine*, https://www.jochenhemmleb.com/english/mundi/index.php (accessed: 10 February 2024).

[59] C.C. Anker, D. Roberts, *The Lost Explorer: Finding Mallory On Mount Everest*, New York 10 November 1999; J. Hemmleb, *Tatort Mount Everest: Der Fall Mallory. Neue Fakten und Hintergründe*; E. Viesturs, D. Roberts, *The Mountain: My Time on Everest*, New York 2014.

[60] *First on Everest*, scs. 28–31 min.

[61] E.F. Norton, N. Odell, *More Light On Everest Disaster: Mr Odell's Last View Of Lost Climbers*.

[62] P.G. Philippe, *Mount Everest 8850 m, Tibet*, Philippe Gatta, https://www.philippegatta.fr/mount-everest-8850-m-tibet/ (accessed: 11 February 2024).

Unless in 1924 the second step had looked different from the current one and there had been an extra step or hold which significantly reduced the difficulty. Over the years the grip or step through progressive erosion may have fallen off.[63] This is, of course, one hypothesis.

Another method of overcoming the second step was the one used in 1960 by the Chinese Mount Everest expedition, when Liu Lianman who was a firefighter suggested a 'human ladder'.[64] Andrew Irvine was about 1.80 m, George Mallory about 1.80 m.[65] The second step is a 40 m wall but the last vertical 5 m are crucial.[66] If Mallory had climbed on Irvine's shoulders, it would have been possible to overcome the key moment. Still another possibility is that Mallory, as the more experienced climber, climbed to the second step and from the summit threw Irvine a rope by which the latter could overcome the difficulties more quickly by the facilitation method. In both cases, the final elements of this method may have coincided with Odell's observation.[67]

Another theory is that they could have overcome the difficulties below the second step by 'traversing below' to Norton Couloir or Great Couloir, as the British team did in 1933. Some researchers also believe that it may have been their return route.[68]

Messner (the first person to climb all 14 eight-thousanders) points out that the second step in 1924 was an insurmountable obstacle. Additionally, according to him, if they had climbed via the Norton Couloir, they would not have de-

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[63] D.W. Burbank, A.E. Blythe, J. Putkonen, B. Pratt-Sitaula, E. Gabet, M. Oskin, A. Barros, T.P. Ojha, *Decoupling of erosion and precipitation in the Himalayas*, "Nature" 2003, vol. 426, no 6967, pp. 652–655; K.R. Miner, P.A. Mayewski, M. Hubbard, K. Broad, H. Clifford, I. Napper, A. Gajurel, C. Jaskolski, W. Li, M. Potocki, J. Priscu, *A Perspective of the Cumulative Risks from Climate Change on Mt. Everest: Findings from the 2019 Expedition*, "International Journal of Environmental Research and Public Health" 2021, vol. 18, no 4, pp. 1928.

[64] J.P. Korczak, *Dlaczego wierzę? Mallory i Irvine – Everest 1924 cz. 1*, Brytan, https://brytan.com.pl/dlaczego-wierze-mallory-i-irvine-everst-1924-roku/ (accessed: 8 February 2024); J. Norton, *To See or Not To See? That is the question for Noel Odell.*

[65] C.C. Anker, D. Roberts, *The Lost Explorer : Finding Mallory On Mount Everest*, New York 10 November 1999; J. Norton, *To See or Not To See? That is the question for Noel Odell.*

[66] J.J. Hemmleb, *Tatort Mount Everest: Der Fall Mallory. Neue Fakten und Hintergründe*; P. Korczak, *Dlaczego wierzę? Mallory i Irvine – Everest 1924 cz. 1*, Brytan, https://brytan.com.pl/dlaczego-wierze-mallory-i-irvine-everst-1924-roku/ (accessed: 8 February 2024); *"Chinese Ladder" Retires*, https://web.archive.org/web/20191123042026/http://english.cri.cn/2886/2008/05/28/1042@362958.htm (accessed: 10 February 2024).

[67] J.E.F. Norton, *The Fight for Everest 1924: Mallory, Irvine and the Quest for Everest*; P. Korczak, *Dlaczego wierzę? Mallory i Irvine – Everest 1924 cz. 1*, Brytan, https://brytan.com.pl/dlaczego-wierze-mallory-i-irvine-everst-1924-roku/ (accessed: 8 February 2024).

[68] D. Morris, *The possible traverse*; P. Korczak, *Dlaczego wierzę? Mallory i Irvine – Everest 1924 cz. 1*, Brytan, https://brytan.com.pl/dlaczego-wierze-mallory-i-irvine-everst-1924-roku/ (accessed: 8 February 2024); R. Demarco, *The Mystery of Mallory and Irvine*, http://www.astro-udec.cl/rdemarco/RjDL/mallory_irvine/mallory_irvine.html (accessed: 20 February 2024).

scended to the location where Mallory's body was found. According to the cited mountaineer, the equipment of the time, the terrain near the summit and the location of the body all argue against the success of the 1924 expedition.[69]

When did they set out to attack the summit ?

Mallory and Irvine left, leaving no information as to what time they had left the camp.[70] The finding of the flashlight in 1933 and the attribution of its ownership to Mallory according to some indicates that they left the camp after dawn (4:45 a.m.).[71] To even hypothesise the times of departure for the summit attack, it is necessary to analyse the earlier exits into the mountains by British teams (Table 1). The time interval between 5:00. and 7:00 for the departure of the Mallory and Irvine team from the camp is given by Hemmleb.[72]

Table 1. Summary of days and times of camp departures by British expeditions

Day	Time of departure from the camp
18 August 1921	3:00 a.m. climbing start
21 May 1922	6:00 a.m. planned 8:00 a.m. climbing start
2 June 1924	6:30 a.m.
33 May 1933	5:40 a.m.

Source: D. Robertson, *George Mallory* 1999 <http://archive.org/details/georgemallory0000robe> [accessed 10 February 2024]; Bruce, *Charles Granville and Mount Everest Expedition* (*1922*)*, The Assault on Mount Everest, 1922* (*1923*) <http://archive.org/details/assaultonmountev00bruc> [accessed 9 February 2024]; E.F. Norton, *The Fight for Everest 1924: Mallory, Irvine and the Quest for Everest*, Vertebrate Publishing, Sheffield 1925; H. Ruttledge, *Everest – 1933*, Moran Press 2011.

What kind of climbing speed might Mallory and Irvine have had?

Mallory and Irvine were experienced athletes. During the 1922 attack Mallory decided to turn back from the climb when he estimated his pace at 122 m per hour, at which point they reached 8169 m.[73] Other climbing pace of British expeditions are shown in Table 2.

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[69] R. Messner, *The Second Death of George Mallory: The Enigma and Spirit of Mount Everest*, transl. T. Carruthers, New York 2001.

[70] E.E.F. Norton, *The Fight for Everest 1924: Mallory, Irvine and the Quest for Everest*, pp. 102.

[71] P. Summers, A. Dankekar, *The Mallory and Irvine Mystery: Solving the Second Step Problem*, The Wire, https://thewire.in/history/mallory-irvine-second-step-everest (accessed: 10 February 2024).

[72] J.J. Hemmleb, *What happened to Mallory & Irvine*, https://www.jochenhemmleb.com/english/mundi/index.php (accessed: 10 February 2024).

[73] C.G. Bruce, Mount Everest Expedition (1922), *The assault on Mount Everest, 1922*, pp. 206–244.

A pace of 120–160 m per hour would be most achievable especially on the first section of the climb (the difference between camp VI and step I is 426 m). This would suggest covering this section in about 2.30 – 3 hours. With the assumptions of leaving at around 6:00, this gives 8:30 – 9:00 on the first step. The author's hours assumptions are in line with those of Hemmleb[74] and Summers and Dandekar in which the authors assume reaching step I at 8:30 – 9:00.[75] This was within the sporting range of Mallory and Irvine (Table 2).

Table 2. Climbing pace

Day	Distance	Meters per hour	Additional information
21 May 1922	7620 – 8 169	122	Team with Mallory
27 May 1922	7772 – 8 321	73	Other teams
4 June 1924	6401 – 7 010	203	Mallory and Irvine
7 June 1924	7 010 – 8 138	261	Mallory and Irvine
8 June 1924	8 604 – 8848	69 – 81	Odell's assumptions about Mallory and Irvine's climbing speed
30 May 1933	8351 – 8 564	160	Other teams

Source: Bruce, Charles Granville and Mount Everest Expedition (1922), The Assault on Mount Everest, 1922 (1923) <http://archive.org/details/assaultonmountev00bruc> [accessed 9 February 2024]; T. Holzel, A. Salkeld, *The Mystery of Mallory and Irvine*, Mountaineers Books, Seattle 1999; W. Unsworth, *Everest: The Mountaineering History*, Mountaineers Books, Seattle 2000; P. Korczak, *Dlaczego Wierzę? Mallory i Irvine – Everest 1924,* Cz. 1, Brytan 2014 <https://brytan.com.pl/dlaczego-wierze-mallory-i-irvine-everst-1924-roku/> [accessed 8 February 2024].

Climbing with or without oxygen

In 1978, the first ascent of Mount Everest without supplemental oxygen took place.[76] Attempts to climb without oxygen were also made in 1924 and 1933.[77] In 1924, Norton climbed to 8572.8 meters without supplemental oxygen.[78] Mallory and Irvine used supplemental oxygen; the question is, did they use it all the

[74] J.J. Hemmleb, *What happened to Mallory & Irvine*, https://www.jochenhemmleb.com/english/mundi/index.php (accessed: 10 February 2024).

[75] P.P. Summers, A. Dankekar, *The Mallory and Irvine Mystery: Solving the Second Step Problem*, The Wire, https://thewire.in/history/mallory-irvine-second-step-everest (accessed: 10 February 2024).

[76] J. Norton, *Everest 1924: Norton & Somervell's Record Attempt*; P. D. Wagner, *Operation Everest II and the 1978 Habeler/Messner ascent of Everest without bottled O2: what might they have in common?*, "Journal of Applied Physiology (Bethesda, Md.: 1985)" 2017, vol. 123, no 6, pp. 1682–1688.

[77] E.E.F. Norton, *The Fight for Everest 1924: Mallory, Irvine and the Quest for Everest*; H. Ruttledge, *Everest – 1933*, p. 150 .

[78] E.E.F. Norton, *The Fight for Everest 1924: Mallory, Irvine and the Quest for Everest*, pp. 111–13.

time? A list with numbers and pressure of 5 oxygen cylinders was found near Mallory's body.

Analyzing the turnaround time for all expeditions until 1933, it seems that the typical turnaround time was around 1 p.m.[79] Mallory and Irvine were sighted by Odell above the second step probably around the same time. But since they were above the second step and Mallory and Irvine were likely to have 5 oxygen cylinders, they extended the turnaround time. This raises the question of why Mallory and Irvine probably decided to continue climbing? They had something that allowed them to extend the turnaround time.

Oxygen cylinder No. 9 was found (at 8470 meters).[80] This indicates that it may have run out of oxygen at this altitude. It can be suggested that they used it during the initial climb to the first step. It is assumed that no one moved it from another location. If they both had had the same oxygen flow, it should have run out at a similar altitude. So where is the second tank? Hypothetically, if the second cylinder had fallen or had been taken by someone else, and they had been left with one cylinder (assuming 2+2 cylinders), they would have had oxygen for a maximum of 4 hours. They must have known that they wouldn't have enough oxygen for the summit attempt. Oxygen would have run out around 2 p.m., at the start of the storm. On the return, they would have had to start descending while it was still daylight – so why were Mallory's goggles hidden in his pocket?

Based on the above information, it can be suggested that they climbed with a distribution of 3 and 2 cylinders. Another question is whether they used supplemental oxygen all the time. Simulations of possible oxygen use are shown in Table 3.

Table 3. Oxygen use hypotheses

Scenario	Number of cylinders	Use	Hypothetical start time for oxygen use	Hypothetical end of oxygen
1	4 cylinders	Using the cylinder from the tent exit. No flow regulation.	5:00 a.m.	1:00 p.m.
2			6:00 a.m.	2:00 p.m.
3	4 cylinders	Using the cylinder from the tent exit. Not using it when climbing to step II.	5:00 a.m.	2:00–2:30 p.m.
4			6:00 a.m.	3:00–3:30 p.m.

[79] E.E.F. Norton, *The Fight for Everest 1924: Mallory, Irvine and the Quest for Everest*; H. Ruttledge, *Everest – 1933*.

[80] J.P. Korczak, *Dlaczego wierzę? Mallory i Irvine – Everest 1924 cz. 2*, https://brytan.com.pl/dlaczego-wierze-mallory-i-irvine-everest-1924-cz-2/6/ (accessed: 15 February 2024); *Oxygen Bottle #9*, Mallory & Irvine, https://malloryandirvine.com/2017/04/26/a-possible-clue/ (accessed: 11 February 2024).

Table 3. Oxygen use hypotheses (cont.)

Sce-nario	Number of cylinders	Use	Hypothetical start time for oxygen use	Hypothetical end of oxygen
5	**4 cylinders**	**Using oxygen from step I, continuously.**	**8:30–9:00 a.m.**	**4:30–5:00 p.m.**
6	2+3 cylinders (use of 1 cylinder together for step I)	Using cylinders from the tent exit. No use while climbing to step II.	5:00 a.m.	4:30–5:00 p.m.
7			6:00 a.m.	
8	4 cylinders	Using oxygen from step II onwards. Not using it while climbing to step II.	8:30–9:00 a.m.	6:00–6:30 p.m.
9	2+3 cylinders (use of 1 cylinder together for step I)		5:00 a.m.	6:00–6:30 p.m.
10			6:00 a.m.	

Source: P. Summers, A. Dandekar, *Could They Have Climbed the Everest: Part 2 of the Story of Mallory and Irvine*, "The Wire" 2020 <https://thewire.in/history/could-they-have-climbed-the-everest-part-2-of-the-story-of-mallory-and-irvine> [accessed 15 February 2024]; P. Korczak, *Dlaczego Wierzę? Mallory i Irvine – Everest 1924 Cz. 1,* Brytan 2014 <https://brytan.com.pl/dlaczego-wierze-mallory-i-irvine-everst-1924-roku/> [accessed 8 February 2024]; P. Korczak, *Dlaczego Wierzę? Mallory i Irvine – Everest 1924 Cz. 2*, Brytan 2014 <https://brytan.com.pl/dlaczego-wierze-mallory-i-irvine-everest-1924-cz-2/6/> [accessed 15 February 2024]; 'Oxygen Bottle #9', Mallory & Irvine, 2017 <https://malloryandirvine.com/2017/04/26/a-possible-clue/> [accessed 11 February 2024].

Based on the analysis in Table 3, it can be hypothetically assumed that they had a sufficient amount of oxygen for the summit attempt. However, over the years, another significant limitation related to hydration has been noted. There are suggestions that the team had too little water, which is essential for physical exertion during a summit attempt.[81]

Cause of death

A likely dramatic situation unfolded approximately 250 m below the first step. Mallory began to fall, and in an attempt to save him, Irvine threw out his ice axe and grabbed the rope with both hands. Unfortunately, the hemp rope snapped.[82]

The arrangement of Mallory's remains and the bloodstains on the front of his jacket suggest that neither the fall nor frostbite was the direct cause of death. Bloodstains on Mallory's clothing suggest that he was attempting to move. The probable cause of death was a wound to the skull above the left eye

[81] *Curious Questions: Were Mallory and Irvine the first to reach the summit of Mount Everest?*, Country Life, https://www.countrylife.co.uk/nature/curious-questions-were-mallory-and-irvine-the-first-to-reach-the-summit-of-mount-everest-269743 (accessed: 8 June 2024).

[82] *First on Everest*, scs. 37–45 min.

socket.[83] Based on the descriptions found by Chinese climbers, Irvine likely froze, either waiting for help or resting.

Additionally, one clue is that Mallory's buttocks were pecked by birds. Birds from the crow family are most active in the early morning and evening hours. It is estimated that the temperature drop of −10 degrees Celsius was 3.6 ± 1.9 degrees Celsius per hour.[84] On Mount Everest, temperatures are significantly lower at the end of the day/night. Mallory's skin was exposed and would have frozen in less than 5 hours. Combining the potential temperature drop with the nighttime conditions and assuming sunrise at 4:45 a.m., death must have occurred after midnight (00:00). Of course, these are just hypotheses.

When could they hypothetically have reached the summit?

Contemporary ridge returns suggest a descent rate ranging from 69 to 212 meters per hour.[85] We know that Mallory and Irvine were already out of oxygen. They were certainly fatigued and experiencing the effects of the storm. Hypothetically, assuming a slow descent of 50 or 70 meters per hour seems acceptable. Finding the ice axe indicates the accident site (8460 m). Based on these two pieces of information, hypothetical scenarios were presented in Table 4. If Mallory and Irvine had turned back at 4:00 p.m., passing only the second step but not the third, and descended at a rate of 50 meters per hour, they would likely have been at the accident site by 8:00 p.m. It would have been nighttime, with 9 hours until dawn, Mallory's body would have frozen. They either had to descend more slowly, which also seems inadequate, or they must have been higher. Assuming that Mallory and Irvine descended slowly (Table 4), this would align with the assumption in all scenarios that the start of their descent was above the third step.

In summary, this means that any time after 4:00 p.m. would have been acceptable for summiting, coinciding with Mallory's set time.[86] Summers and Dandekar suggest that the earliest time Mallory could have been on the summit was 4.30p.m.[87] Korczak suggests that the latest time for summiting was 5:00 p.m.[88] Korczak points out that Mallory and Irvine had to reach the second step while

[83] *First on Everest*, scs. 39-45 min.

[84] H. Mizukami, K. Shimizu, H. Shiono, T. Uezono, M. Sasaki, *Forensic diagnosis of death from cold*, "Legal Medicine" 1999, vol. 1, no 4, pp. 204–209.

[85] I. Tate, *How Long Does It Take To Climb Mount Everest? – Everester*; A. Arnette, *Mt. Everest South Col Route Maps*, https://www.alanarnette.com/everest/everestsouthroutes.php (accessed: 16 February 2024).

[86] C.C. Anker, D. Roberts, *The Lost Explorer: Finding Mallory On Mount Everest*, New York 1999.

[87] F.P. Summers, A. Dandekar, *Could They Have Climbed the Everest: Part 2 of the Story of Mallory and Irvine*, The Wire, https://thewire.in/history/could-they-have-climbed-the-everest-part-2-of-the-story-of-mallory-and-irvine (accessed: 15 February 2024).

[88] P. Korczak, *Dlaczego wierzę? Mallory i Irvine – Everest 1924 cz. 1*, Brytan, https://brytan.com.pl/dlaczego-wierze-mallory-i-irvine-everst-1924-roku/ (accessed: 8 February 2024).

they still had daylight. Descending in nighttime conditions would have been very difficult. Demarco also opts for 4:00-5:00p.m.[89]

Table 4. Hypotheses on the return from the summit attack

Scenario	Time of attainment of altitude	Height	Accident point	Height difference	70 m/hour	50 m/hour
1	4:00 p.m.	8670 (approach in a snowstorm over the second step)	8460	210	7.00p.m.	8.00 p.m.
2	4:00 p.m.	8710	8460	250	7:30p.m.	9:00
3	4:00 p.m.	8848	8460	388	9:30p.m.	12.00a.m.
4	4:30 p.m.	8710	8460	250	8:00p.m.	9:30p.m.
5	4:30 p.m.	8848	8460	388	10:00p.m.	12:30a.m.
6	5:00 p.m.	8848	8460	388	10:30p.m.	1:00a.m.
7	5:30 p.m.	8848	8460	388	11:00p.m.	1:30a.m.
8	6:00 p.m.	8848	8460	388	11:30p.m.	2:00a.m.

Source: T. Holzel, A. Salkeld, *The Mystery of Mallory and Irvine*, Mountaineers Books, Seattle 1999; P. Summers, A. Dandekar, *Could They Have Climbed the Everest: Part 2 of the Story of Mallory and Irvine*, "The Wire" 2020 <https://thewire.in/history/could-they-have-climbed-the-everest-part-2-of-the-story-of-mallory-and-irvine> [accessed 15 February 2024]; P. Summers, A. Dankekar, *The Mallory and Irvine Mystery: Solving the Second Step Problem*, "The Wire" 2020 <https://thewire.in/history/mallory-irvine-second-step-everest> [accessed 10 February 2024]; P. Korczak, *Dlaczego Wierzę? Mallory i Irvine – Everest 1924 Cz. 1*, Brytan 2014 <https://brytan.com.pl/dlaczego-wierze-mallory-i-irvine-everst-1924-roku/> [accessed 8 February 2024]; P. Korczak, *Dlaczego Wierzę? Mallory i Irvine – Everest 1924 Cz. 2*, Brytan 2014 <https://brytan.com.pl/dlaczego-wierze-mallory-i-irvine-everest-1924-cz-2/6/> [accessed 15 February 2024]; I. Tate, How Long Does It Take To Climb Mount Everest? – Everester, 2023 <https://www.everester.org/how-long-does-it-take-to-climb-mount-everest/> [accessed 16 February 2024]

It is also worth noting that at 4:30p.m., Odell began the ascent from Camp VI to Camp IV, which he reached at 6:45 p.m.[90] Odell did not witness their potential success or failure. No one observed the summit during the potential summit attempt.

Table 4 shows some hypotheses. However, Cichy presents a different perspective on the events of 1924, suggesting that Mallory and Irvine's team reached the second step. Above it, due to fatigue and poor weather conditions, they bivouacked and began their descent after sunrise (which could explain the hidden glasses and the unfrozen tissue eaten by birds).[91] However, this raises

[89] D.R. Demarco, *The Mystery of Mallory and Irvine*, http://www.astro-udec.cl/rdemarco/RjDL/mallory_irvine/mallory_irvine.html (accessed: 20 February 2024).

[90] E.E.F. Norton, *The Fight for Everest 1924: Mallory, Irvine and the Quest for Everest*, pp. 447–449.

[91] L.L. Cichy, *Przedmowa*, [In:] *Zaginiony*, ed., Warszawa 2012.

the question about Ruth's photograph: did Mallory lose it, or did he leave it at the highest point he reached? However, there were no frostbites on Mallory's body, which would have likely occurred due to camping in unsuitable clothing.

Conclusion

Among historians, mountaineers and researchers of the subject, there are different opinions about what may have happened. The story of George Mallory and Andrew 'Sandy' Irvine has moved and divided public opinion for 100 years. Attempts to resolve it involve a desire to sort out the pages of sporting records and the pages of history. For some, it is a criminal story (in the context of the clues left to solve the mystery of whether they reached the summit),[92] for others it is a romantic story (in the context of Mallory's love for Ruth and his desire to bring a photograph of his wife where no one has gone before him).[93] Attempts to assess Mallory and Irvine's chances of climbing Everest can range from cautious optimism to skepticism.

Responding to the research problems. George Mallory and Andrew Irvine certainly contributed to reaching the first step altitude (as indicated by the artefacts found). Based on Odell's observations, they also climbed the second step. If these observations are accepted, this was a new world altitude record.

Hypothetically, the day of June 8, 1924, might have looked like this: the team set off around 6.00. Hypothetically, they could cover the distance to the first step in about 2.5-3 hours. Around 8:30–9:00, they reached the first step. Based on modern climbing times, they could have reached the base of the second step around 11:00–11:30. They had 1 hour to 1 hour and 20–50 minutes to complete the second step. Odell likely sees the final stage of overcoming the second step.[94] In the most optimistic scenarios, Odell sees them at the third step. They were probably caught by the blizzard below the third step; there is a chance they still had oxygen at that time; otherwise, they should have turned back earlier. Undoubtedly, their pace significantly slowed compared to the initial tempo. It is possible that the summit was reached between 4:30 p.m. and 5:00 p.m. Hypothetically, this is also when he left Ruth's photograph.

Another course of events is also possible. After overcoming the second step, they were caught in the blizzard. Climbing in the blizzard, exhausted, without concrete reference points (no functioning watch to determine time and poor

[92] *The Ghosts Above*

[93] J. Kelly, *Mallory and Irvine: Should we solve Everest's mystery?*; O. Clarke, *George Mallory—First To Climb Everest?*

[94] J.P. Korczak, *Dlaczego wierzę? Mallory i Irvine – Everest 1924 cz. 1*, Brytan, https://brytan.com.pl/dlaczego-wierze-mallory-i-irvine-everst-1924-roku/ (accessed: 8 February 2024).

visibility), they could have misjudged their location. A barometric altimeter was found with Mallory's body.[95] The drop in barometric pressure that occurred during the blizzard could have been interpreted as an increase in altitude.[96] Given the potential lack of the aforementioned reference points, this could have led to the assumption that they had reached the summit, and then Mallory could have left Ruth's photo near the summit. They began their descent at the end of the blizzard – before 4:00 p.m., the accident would have occurred by nightfall.

In both cases oxygen was surely running out, so Mallory took off his oxygen mask and put it in his pocket. How they traversed the second step on the way to the summit is just as mysterious as how they traversed it on the way back/or traversed under the second step. It was getting darker, so Mallory took off his goggles. The drama unfolds below the first step, Mallory begins to fall. Irvine throws the ice axe to catch the rope with both hands. Due to the low strength of the rope, it breaks. Mallory falls, trying to stop the slide along the slope. Rocks fall on him, injuring his head and killing him. The whole situation probably occurred after midnight. Irvine freezes.

However, without additional evidence of their activity above the second step, these are hypotheses. Finding Irvine's body, remaining oxygen cylinders, or the camera could shed light on this story. However, with each passing year, the chances of unraveling this story diminish. Undoubtedly, Hillary and Norgay are the first climbers who ascended and descended Everest.

George Mallory, as a person who participated in all three British expeditions to Mount Everest and the fact that he was one of the first to enter the death zone, should be described as one of the greatest pioneers of Himalayan climbing.

I will conclude with the words of Odell: [97]

> …June 8, 1924, and would still allow of the possibility I originally put forward that they may have reached the summit.

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[95] *The Wildest Dream*, scs. 9–10.

[96] G.G.W.K. Moore, J. Semple, D. Sikka, *Mallory and Irvine on Mount Everest: Did extreme weather play a role in their disappearance?*, "Weather" 2010, vol. 65, pp. 215–218.

[97] N.E. Odell, *Correspondence. The Ice Axe found on Everest.*, "Alpine Journal" 1934, no 46, pp. 447–449.

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SPORT I TURYSTYKA
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SPORT IN THE PROVINCE OF OPOLE IN THE YEARS 1989–1998. AN OUTLINE

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Sport w województwie opolskim w latach 1989–1998. Zarys problematyki

Streszczenie

Dla państwa polskiego lata 1989–1998 były czasem dynamicznych zmian i adaptacji zarówno do nowej sytuacji politycznej, jak i ekonomicznej. Okres ten kształtował rozwój kultury fizycznej i sportu na obszarze województwa opolskiego. Do głównych czynników warunkujących ten rozwój należały: wysokość środków finansowych przeznaczanych na zadania związane z kulturą fizyczną i sportem, działalność samorządów lokalnych, działalność organizacji środowiskowych, wykwalifikowane kadry trenersko-instruktorskie, działalność aktywu sportowego oraz infrastruktura sportowa. Katastrofalny wpływ na stan bazy sportowej na terenie województwa opolskiego miała powódź z 1997 r., która zniszczyła znaczącą część istniejącej i budowanej infrastruktury sportowej. W związku z powyższymi czynnikami rozwój sportu na terenie województwa opolskiego w latach 1989–1998 był nieregularny. Niestety część dyscyplin znika z prężnych ośrodków. W zakresie upowszechniania sportu na obszarze województwa opolskiego w latach 1989–1998 wymierny wpływ miała działalność Akademickiego Związku Sportowego w Opolu oraz Wojewódzkiego Zrzeszenia Ludowe Zespoły Sportowe w Opolu. Mimo wielu trudności, w latach 1989–1998 sportowcy reprezentujący kluby sportowe z województwa opolskiego osiągali znaczące sukcesy na różnych szczeblach rywalizacji krajowej. Zawodnicy tychże klubów zdobywali również medale Igrzysk Olimpijskich oraz medale mistrzostw Świata i Europy w różnych kategoriach wiekowych (indywidualnie lub drużynowo).

Słowa kluczowe: województwo opolskie, sport, okręgowy związek sportowy, judo, podnoszenie ciężarów.

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Abstract

For the Polish state, the years 1989–1998 were the times of dynamic changes and adaptation to the new political and economic situation. This period shaped the development of physical culture in the area of the province of Opole. The main factors contributing to this development were: the financial means allocated to the tasks linked with physical culture and sport, the activity of local authorities, the activity of local organisations, qualified training-instructing staff, the activity of sports activists and sports infrastructure. The flood of 1997 occurring on the territory of the province of Opole had a catastrophic impact on the state of both already existing sports infrastructure and the one under construction. Due to the abovementioned factors, the development of sport on the territory of the province of Opole in the years 1989–1998 was irregular. Unfortunately, some sports disciplines disappeared from dynamically operating centres. The activity of the Academic Sports Association in Opole and the Province Association of Folk Sports Teams in Opole in the years 1989-1998 had a tangible impact on spreading sports activity on the territory of the province of Opole. Despite many difficulties, in the years 1989–1998, athletes representing sports clubs from the province of Opole enjoyed success at various levels of sports competition. Members of these clubs were also medalists of the Olympic Games and medalists of the World and European Championships in various age categories (individually and in teams).

Keywords: Opole province, sport, sports regional association, judo, weightlifting.

Introduction

Physical culture can be defined in a broad and a narrow way. Taking the broad perspective, it encompasses physical education, sport, active recreation, rehabilitation and tourism. Its narrow definition does not include tourism.[1] Zbigniew Krawczyk listed and defined the following elements of physical culture (interpreted as a whole): physical education (at school, of children and youth), sport (for everyone, professional), physical recreation (of adults and of people in their prime) and physical rehabilitation.[2] The paper presents mostly sport, and other elements of physical culture to a lesser extent.

The aim of the paper is to present the history of sport in the province of Opole in the years 1989–1998.[3] In the years 1989–1998, sport in the province of Opole underwent significant changes that were the direct aftermath of political

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1 A. Nowakowski, *Zarządzanie kulturą fizyczną w Polsce w latach 1944–2001. Studium historyczno-porównawcze*, Rzeszów 2005, p. 13.

2 M. Kobierecki, *Kultura fizyczna a kultura – rozważania teoretyczne,* "Zeszyty Naukowe Zbliżenia Cywilizacyjne" 2016, vol. 12, pp. 116–143. See: Z. Krawczyk, *O kulturze fizycznej*. *Studia i szkice*, Warszawa 1983, p.13.

3 The act passed by the Seym of the Polish Peoples Republic (PPR) on May 28, 1975, introduced a two-degree administrative division of the country. On June 1, 1975, the division was approved and referred to the units of basic level (communes, cities, districts, cities-communes) and the units of the provincial level (49 provinces). See: Journal of Laws of the Republic of Poland (Dz. U. – Polish abbreviation) 1975 No 16, item 91.

changes in Poland. The year 1989[4] constitutes the starting point – that is when the process of political transformation began in Poland. The finishing point is the year 1998 – the aftermath of the last administrative reform that was introduced on January 1, 1999. The territorial range of the work encompasses the area of Opole province in its borders from 1989–1998. Its surface equalled 8535 km², with 1 023 700 inhabitants in 1998. In 1998, the province of Opole was divided into 29 cities and 61 communes. It neighboured 6 provinces: from the west, the province of Wałbrzych and Wrocław, from the north, the province of Kalisz and Sieradz, from the east, the province of Częstochowa and Katowice. Its southern border was the border with Czechoslovakia which became the Czech Republic on January 1, 1993.[5]

The state of the art on the history of sport in the province of Opole in the years 1989–1998 is unsatisfactory. The issued publications referred most often to the origins and activity of Folk Sports Teams and sports clubs.[6] There were also works devoted to the activity of sports organisations and associations.[7] The following disciplines received the most coverage: athletics, football, swimming,

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[4] On June 4, 1989, in accordance with the agreement of the round table, parliament elections were organised in Poland, which resulted in victory for the candidates of the "Solidarity" Citizens' Committee.

[5] https://pl.wikipedia.org/wiki/Wojew%C3%B3dztwo_opolskie_(1975%E2%80%931998) [access: 21.07.2024].

[6] B. Piksa, *Sport w województwie opolskim w latach 1975–1998* (PhD dissertation), Akademia Wychowania Fizycznego im. Jerzego Kukuczki w Katowicach 2019. S. Rosiński, *Sport w działalności Ludowych Zespołów Sportowych na Opolszczyźnie w latach 1946–2006,* [in:] L. Nowak (ed.), *Z najnowszej historii kultury fizycznej Polsce*, vol. 8, Gorzów Wlkp. 2008; Z. Jakubczyk, A. Krawczyk, *Wpływ przemian własnościowych na finansowanie i aktywność Ludowych Zespołów Sportowych w województwie opolskim w latach 1991–1995*, "Człowiek i Ruch" 2000, vol. 2, no. 2, pp. 94–98. B. Latuszkiewicz, *Zielone bractwo,* Warszawa 2000; B. Kociński, *Jubileusz 70-lecia działalności Ludowych Zespołów Sportowych na Opolszczyźnie 1946–2016*, Opole 2016; W. Czaczka, J. Stecki, *Nasze zielone lata*, Opole 1996; Z. Zielonka, *20-lecie klubu olimpijczyka w Grodkowie 1980–2000,* Wrocław 2000; J. Wac, *40-lecie LKS Technik Głubczyce,* Głubczyce 2013; J. Siekaniec, T. Brudniak, *LKS Zarzewie Prudnik. Droga do mistrzostwa*, Prudnik 2015; T. Pokusa (ed.), *Asy ze Wschodniej czyli 50 na 50 Kolejarza Opole*, Opole 2010; J. Kusidło, LKS *Jedność Rozmierka 1946–2011*, Kraków 2011; B. Kociński, *Juvenia Głuchołazy. Jubileusz 35-lecia*, Głuchołazy 2013; K. Jankowski, *Dziesięć lat działalności klubu Japońskich sztuk walki "Bushi"*, Namysłów 2004; M. Sagan, R. Stęporowski, *60 lat Opolskiego Klubu Sportowego "Odra" Opole 1945–2005,* Opole 2005; S. Bergiel, *Znani i zasłużeni niebiesko-czerwoni: 70-lecie Odry Opole,* Opole 2015.

[7] A. Banek, *Z jubileuszowych kart historii Studium Wychowania Fizycznego i Sportu WSI w Opolu*, "Zeszyty Naukowe Politechniki Opolskiej" 1997, nr 226; *Kronika 70-lecia Opolskiego Związku Piłki Nożnej*, Opole 2016; Z. Rektor, J. Żak, *Studencka piłka siatkowa w Wyższej Szkole Inżynierskiej i Politechnice Opolskiej w latach 1966–2000,* Opole 2012; *70 lat Opolskiego Związku Tenisa Stołowego*, Opole 2018; J. Stecki, *Opolski Olimp*, Opole 1995; J. Stecki, K. Stecki, *Opolski Olimp*, [in:] B. Linek, K. Tarka, U. Zajączkowska (eds.), *Opole. Dzieje i tradycja*, Opole 2011.

speedway, cycling, badminton.[8] Some publications tackled the subject matter of sport in local press.[9]

Research methods and problems

The following research methods were used to prepare the work in question: analysis of historical sources, comparative and geographical analysis, syntheses. The following research questions were formulated:

1. Which factors influenced the development of sport in the province of Opole in the years 1989–1998?
2. How did sport develop in the province of Opole in the years 1989–1998?

With regard to source research, a search for archival resources was conducted. The literature used includes contributions to the history of physical education and sport in the province of Opole in the years 1989–1998.

Results and discussion

Throughout history, the territory of the province of Opole belonged to various state organisms: the Bohemian monarchy of the Premyslid dynasty (921–990), the Polish Piast monarchy (990–1339), the Bohemian monarchy of the Luxemburgs and Jagiellons (1339–1526), the Austrian Habsburg monarchy (1526–1763), the Prussian Hohenzollern monarchy (1763–1918), the German state

[8] B. Wojnar, B. Kociński, *Lekka atletyka na Opolszczyźnie w latach 1945–2005*, „Studia i Monografie" 2006 journal 195, B. Kociński, J. Wojnar, *Najlepsi lekkoatleci Opolszczyzny dekady 1950–2009*, „Studia i Monografie" 2011, journal 286; B. Kociński, J. Wojnar, *Osiągnięcia opolskiej lekkiej atletyki w latach 1945–2000,* Opole 2002; B. Kociński, J. Wojnar, *Najlepsi lekkoatleci Opolszczyzny wszystkich kategorii wiekowych w latach 1951–2015*, Opole 2016; A. Szatan, *Historia piłką pisana*, Opole 1996; H. Malisz, *Na kolejarskim torze. Historia opolskiego żużla*, vol. I, Opole 2009; H. Malisz: *Na kolejarskim torze. Historia opolskiego żużla*, vol. II, Opole 2009; D. Bakota, *Joachim Halupczok jako legenda polskiego kolarstwa – od sukcesów do tragicznego finału kariery sportowej,* "Prace Naukowe Akademii im. Jana Długosza w Częstochowie. Kultura Fizyczna" 2015, vol. 14, no. 2; E. Wasyliszyn, *Jubileuszowe Asy,* Wydawnictwo Związkowe "Soolpress", Opole 2000; P. Świętek P, *Opolskie pływanie 1948–2008*, Opole 2008; J. Bąk, *Historia badmintona w Głubczycach. 50 lat Ludowego Klubu Sportowego "Technik" Głubczyce,* Głubczyce 2023.

[9] T. Bohdan, *Jubileusze Odry Opole na łamach "Trybuny Opolskiej" i "Nowej Trybuny Opolskiej"*, [in:] J. Kosiewicz, E. Małolepszy, T. Drozdek-Małolepsza (eds.), *Z dziejów wychowania fizycznego, sportu i turystyki w Polsce i w Europie,* Częstochowa 2016; B. Piksa, *Sport w województwie opolskim w świetle "Nowej Trybuny Opolskiej" w latach 1993–1998,* [in:] J. Kosiewicz, E. Małolepszy, T. Drozdek-Małolepsza (eds.), *Z dziejów wychowania fizycznego, sportu i turystyki w Polsce i w Europie,* Częstochowa 2016.

(1918–1945).[10] After the end of the WWII, Opole Silesia fell within the borders of the Polish state. Since the establishment of the province of Opole, i.e. since the administrative reform of the Polish state conducted in 1950, this province stands out in the country by its cultural specificity consisting in differences deriving from territorial origins of its inhabitants and cultural elements that the aforementioned inhabitants represent (customs, traditions, habits).[11] Opole Silesia, as the 1950 census reads, was inhabited by the Silesians[12] – 436 000, i.e. 54,1%; re-settlers from the east – 188 300, i.e. 23,3%; settlers from the interior of the country – 158 100, i.e. 19,5%.[13] It should be also mentioned here that till 1950, about 2 million people had been displaced from the territory of Lower and Upper Silesia.[14] The next administrative reform conducted in 1975, decreased territorially the province of Opole to a little extent. Part of Olesko administrative unit with Olesno fell within the borders of newly-established province of Częstochowa, and the administrative unit of Racibórz was incorporated into the province of Katowice.

The period of transformation that began in Poland at the end of 1980s, and lasted throughout the 1990s, was the time of profound political, economic, social and cultural changes. Political changes encompassed the transfer from the socialist to the democratic system. As for the area of economics, the centrally managed system was replaced with market economy. First and foremost, it should be mentioned that the most noticeable aspect of Opole province transformation due to the state's economic reform was the strengthening of the private sector. This sector, till the end of the administrative reform of the years 1975–1998, was one of the most important economies of the region. In 1993, this sector occupied a significant position in the number of economic entities and on the job market, and in 1998 the private sector already occupied the dom-

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[10] D. Kisielewicz, *Historyczne uwarunkowania odrębności regionu Śląska Opolskiego,* „Pogranicze. Polish Borderland Studies" 2015*,* vol. 3(1), p. 8. See: M. Lis, *Historyczne uwarunkowania odrębności Śląska Opolskiego*, "Śląsk Opolski" 1998, no. 29, pp. 5–13.

[11] M. Lis, *Śląsk Opolski w warunkach transformacji ustrojowej państwa od 1989 roku*, Opole 2013, pp. 58–60.

[12] According to confidential data of 1935, the German authorities estimated that the Polish minority in Silesia counted 400 000 people, while the Polish authorities' estimate was 750 000 people. See: J. Kokot, *Problemy narodowościowe na Śląsku od X do XX wieku,* Opole 1973, pp. 52.

[13] M. Szejma, *Starzy i nowi mieszkańcy Opolszczyzny,* Opole 1997, p. 56. See: L. Kosiński, *Pochodzenie terytorialne ludności Ziem Zachodnich*, Dokumentacja Geograficzna*,* Warszawa 1960, journal 2.

[14] S. Mizia, *Historia Śląska,* Wrocław 1997, p. 41. In the years 1945–1950, certainly the number of the Germans and German autochthones got the most depleted in Silesia. In this period of time, German identification did not completely disappear, it was even increasing. Concealing one's German identity protected against forced resettlement and hostility from the immigrant population. See: M. Czapliński, E. Kaszuba, G. Wąs, R. Żerelik, *Historia Śląska,* Wrocław 2002, p. 463.

inating position in the province of Opole.[15] The transformation also subjected the county to serious social changes. In the period of time in question, Polish society was getting open to the Western culture, which was manifested in the emergence of civic society, also on the territory of Opole province.

The period of political transformation was not favourable to developing new legal regulations concerning physical education and sport as the state authorities were busy with reforming other, more important – in their opinion – fields of social life in Poland of that time. In the years 1989–1990, the act of July 3, 1984 on physical culture[16] was still binding, and the sittings of the Round Table treated the subject matter of physical culture and sport in a rather marginal way. Only on January 25, 1991, a new act introduced a central unit of state administration, i.e. the Office of Physical Education and Tourism (UKFiT).[17] The UKFiT replaced the Committee of Youth Affairs and Physical Culture (KdSMiKF), established in 1987. In 1994, an agreement between the Ministry of Education (MEN) and the UKFiT was signed. It allowed for creating Students Sports Clubs (UKS) in form of physical culture associations. UKS were to complement the curriculum of Physical Education lessons[18] and break the monopoly of School Sports Associations within as for sport practised at school.[19] In this way, youth sport experienced free market competition. The UKFiT became the founding body for state-owned enterprises linked with the production of sports equipment and tourism. What is more, the UKFiT took over the supervision of institutions conducting research in the area of physical culture and sport, and was in charge of training physical education staff in tertiary education institutions.[20]

The first act pertaining to physical culture and sport, adjusted to new reality, was passed on January 18, 1996[21] and divided physical culture into: physical education, professional sport, physical recreation and physical rehabilitation. At the same time, it retained the organisational model based on "associations" – clubs. The aforesaid act also introduced limitations considering professional sport, which was manifested in establishing sports joint-stock companies. In accordance with the requirements of international sports federations and their

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15 Ibidem, p. 91.

16 Journal of Laws of the Republic of Poland (Dz. U. – Polish abbreviation) 1984 No 34, item 181.

17 Journal of Laws of the Republic of Poland (Dz. U. – Polish abbreviation) 1991 No 14, item 91.

18 W. Sawicki, *Szkolne stowarzyszenia kultury fizycznej. Uwarunkowania formalnoprawne,* Warszawa 1996, pp. 5-7.

19 A. Nowakowski, *Cztery tezy krytyczne o Szkolnym Związku Sportowym*, [in:] A. Nowakowski (ed.), *Z przeszłości i współczesności szkolnej kultury fizycznej. Na 50-lecie Szkolnego Związku Sportowego* (*1957–2007*), Wadowice 2008, pp. 9–27.

20 T. Dubrawski, *Zmiany w organizacji kierowania przez państwo kulturą fizyczną w Polsce w okresie od 1984 do 2000 r.,* "Zeszyty Naukowe Wyższej Szkoły Pedagogicznej. Kultura Fizyczna" 2003, vol. 5, p. 134.

21 Journal of Laws of the Republic of Poland (Dz. U. – Polish abbreviation) 1996 No 25, item 113.

statutes, the act confirmed, as an exception in the Polish Constitution, the principle on freedom of association. The principle stated that there could be only one sports association within a given sports discipline in Poland. Disabled people were an exception.[22] Unfortunately, the act preferred professional sport at the expense of the athleticism and healthiness of other citizens.[23] During the first years of the transformation, many sports clubs in the province of Opole faced a challenge of finding new sources of financing, which often resulted in limiting their activity. The funds provided by the headquarters were defined on the basis of nationwide competition of provinces (the points were granted only for events of the rank of Polish Championships in all disciplines). Unfortunately, the inflation in the years 1989–1998 was so high that the provided funds could not cater for all the needs. The turn of 1989 and 1990 and the first half of 1990s were a particularly difficult period of time.

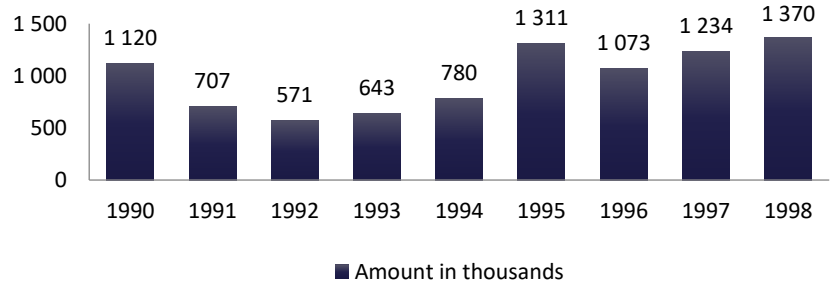

Chart 1. State budget expenditure on physical culture realised by the budget of Opole province in the years 1990–1998 (PLN)
Source: Own studies based on *Kultura Fizyczna w latach 1990–1998*, Główny Urząd Statystyczny. Warszawa 1999, p. 180.

An important contribution to the development of physical culture and sport in Opole province was the act of May 17, 1990, which introduced the division of tasks and competencies between state administration bodies and commune bodies. Communes took over the following duties:

— collaboration with physical culture associations in the area of physical culture development and providing support in executing their duties,
— creating city, regional, city-commune and commune funds of physical culture development,

[22] A. Nowakowski, *Prawo sportowe Trzeciej Rzeczypospolitej* (*1989–2010*), [in:] P. Król (ed.), *Studia i szkice w zakresie Polskiej i zagranicznej teorii oraz historii kultury fizycznej*, Rzeszów 2012, p. 251.

[23] A. Nowakowski, *Prawo w kulturze fizycznej Trzeciej Rzeczypospolitej* (*1989–2005*), [in:] T. Jurek, K. Obodyński, S. Zaborniak (eds.), *Szkice i studia z dziejów kultury fizycznej,* Rzeszów 2007, p. 440.

— disposition of field resources of physical culture development funds with regard to city, regional, commune and city-commune funds,
— executing tasks concerning the construction of physical culture facilities in rural areas.[24]

The components mentioned above made local committees of physical culture operating at the existing national councils lose their power. As a result of this reform and a further decentralisation process, at the local level, local governments began to play a greater role in sports management. New organisational structures emerged and their aim was to manage sport at the local level more efficiently.[25] Unfortunately, in the period of time in question, efficient functioning depended very often on the professionalism of people working in these structures. In the years 1990–1998, communes in Opole province had to adjust their budgets to the new economic and administrative reality. Investment in infrastructure and education was the key to local development and improving the residents' quality of life. It resulted in communes' bigger financial responsibility, which was linked with more effective management of public funds.

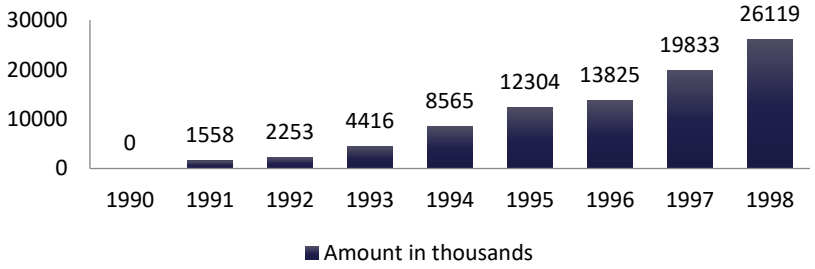

Chart 2. The expenditure of the communes' budget in Opole province on physical culture in the years 1990–1998 (PLN)
Source: Own studies based on *Kultura Fizyczna w latach 1990–1998,* Główny Urząd Statystyczny. Warszawa 1999, pp. 180–181.

In 1998, the expenditure of the communes' budget from the province of Opole on physical culture and sport equalled PLN 26 119 000. Out of this amount, PLN 8 788 000 was allocated to physical culture institutions, and PLN 2 333 000 was allocated to physical culture associations. PLN 10 937 000 was allocated to other activity. In this budget, the per capita of Opole province in the area of physical culture and sport was PLN 25.51.[26]

[24] Journal of Laws of the Republic of Poland (Dz. U. – Polish abbreviation) 1990 No 34, item 198.
[25] B. Marszałek, *Zarządzanie sprawami kultury fizycznej na szczeblu lokalnym w Polsce w latach 1973–1990*, "Prace Naukowe Wyższej Szkoły Pedagogicznej w Częstochowie. Kultura Fizyczna" 2003, vol. 5, p. 126.
[26] *Kultura Fizyczna w latach 1990–1998*, Główny Urząd Statystyczny, Warszawa 1999, p. 182.

One of the main factors influencing the development of sport in the area of Opole province was sports infrastructure. In 1989, the area in question held the following sports infrastructure facilities: 83 stadiums and pitches, 14 sports halls, 199 gyms, 41 swimming pools, including 6 indoor ones, and 3 skating rinks.[27] In 1990, the execution of investment and renovation tasks pertaining to sports infrastructure was difficult due to lack of funds, a significant increase in the cost of works and the price of materials. As a result, for example, the construction of a gym at Primary School No 17 in Opole was suspended, as well as the modernisation of "Toropol" skating rink, "Okrąglak" sports and entertainment hall, together with the renovation of an indoor swimming pool at Ozimska St. in Opole.[28] Investment projects and renovations were also suspended in many minor facilities, outside the province's capital. According to the quantitative status of the sports base reviewed by the UKFiT, in 1994, on the territory of Opole province there were: 26 stadiums, 406 football pitches, 14 halls, 257 gyms, 8 indoor swimming pools, 48 outdoor swimming pools, 2 artificial skating rinks and 98 tennis courts.[29] Due to economic improvement in the second half of 1990s, some previously suspended investment projects and renovations were completed. In the years 1990-1998, there was a gradual increase in the number of gyms in primary and secondary schools. In 1990, there were 322 of them in the province of Opole, and in 1998 – 434.[30] One of the main tasks of the Folk Sports Teams Province Association (WZ LZS) in the land of Opole was the completion of projects regarding the construction of sports facilities and infrastructure. In the years 1991-1995, the WZ LZS in the land of Opole was enriched with 68 sports facilities and in 1996 it owned 1 298 facilities.[31] This increase was due to the high activity of social activism and local authorities. On the other hand, the flood of 1997 had a catastrophic impact on the sports base on the territory of Opole province as it destroyed a significant part of already existing sports infrastructure and the one that was under construction. In 1998, sports infrastructure was in good shape (See: Table 1).

In 1989, 138 trainers and 379 instructors supervised work with athletes on the territory of Opole province.[32] In the years 1989–1993, the number of trainers and coaches decreased. In 1993, on the territory in question, there were only 61 trainers and 169 instructors. The personnel situation improved only in the second half of 1990s, when we could notice an increase in the number of trainers

[27] T. Wyspiański, *Kłopoty Salomona*, "Trybuna Opolska" 1989, no 92, p. 19.

[28] Urząd Miasta Opola, *Sprawozdanie z wykonania budżetu miasta Opole za 1990 r*., pp. 6–19.

[29] Archiwum Akt Nowych, UKFiT, sygn. 840, *Stan ilościowy bazy sportowej w latach 1945–1994*, 1995, pp. 9.

[30] *Kultura Fizyczna w latach 1990–1998,* Główny Urząd Statystyczny, Warszawa 1999, p. 171.

[31] T. Wyspiański, *Prezes nie do zastąpienia*, "Nowa Trybuna Opolska" 1996, no 78, p. 20.

[32] J. Stecki, *Pluralizm sportowy*, "Trybuna Opolska" 1989, no 46, p. 8.

and instructors working in sports clubs. In 1998, 99 trainers and 220 instructors worked with athletes from different age categories.[33]

Table 1. Sports facilities on the territory of Opole province in 1998

Type	Number
Basketball courts	37
Handball courts	33
Volleyball courts	37
Universal courts	132
Tennis courts	16
Multi-function sports halls measuring 44 × 22 m and wider	12
Sports halls measuring from 36 × 18 to 44 × 22 m	19
Universal sports halls measuring from 24 × 12 m to 36 × 18 m	117
Auxiliary sports rooms with dimensions below 24 × 12 m	162
Specialist sports halls	4
Indoor swimming pools with pools measuring less than 25 × 12,5 m	5
Indoor swimming pools with pools measuring 25 × 12,5 m	7
Outdoor swimming pools with pools measuring less than 25 × 12,5 m	8
Outdoor swimming pools with pools measuring 25 × 12,5 m	9
Outdoor swimming pools with pools measuring 50 × 20 m	24
Artificial skating rinks	1
Indoor artificial skating rinks	1
Archery tracks	1
Motorcycle and car tracks	1
Speedway	1
Equestrian track	1
Shooting ranges for pneumatic weapon	6
Shooting ranges for shooting – 25 m	10
Indoor shooting ranges for shooting – 25 m	3
Shooting ranges for shooting – 50 m	10
Indoor shooting ranges for shooting – 50 m	1
Other shooting ranges	3
Stadiums with auditoriums up to 3 000	64
Stadiums with auditoriums between 3 001 and 10 000	4
Pitches for big games with a straight raceway	41
Pitches for big games with a circular raceway	33

Source: Own studies based on *Kultura Fizyczna w latach 1990–1998*, Główny Urząd Statystyczny. Warszawa 1999, pp. 172–178.

[33] *Kultura Fizyczna w latach 1990–1998*, Główny Urząd Statystyczny, Warszawa 1999, pp. 72–74.

In 1989, the Province Sports Federation in Opole brought together 25 regional associations[34] and 61 professional clubs. Over ten thousand athletes trained in these clubs.[35] Table 2 presents the situation in the province of Opole in the years 1990–1998.

Table 2. Sports clubs on the territory of Opole province in the years 1990–1998

Year	Clubs	Club sections	Members	Athletes registered in Polish Sports Associations	Athletes training in clubs	Women	Youth under 18
1990	71	164	12 493	5967	6703	1179	4343
1991	51	130	8212	4954	6221	1281	4558
1992	63	133	8734	5091	6217	926	4194
1993	54	104	6834	4053	5031	882	3592
1994	55	106	6480	4406	5097	1028	3782
1995	70	124	7750	4563	5997	1011	4177
1996	129	502	22 961	14 775	18 750	2306	7118
1997	157	285	12 554	6768	10 257	1812	5598
1998	111	190	10 213	5960	8028	1265	4533

Source: Own studies based on: K. Teleguj (ed.), *Rocznik statystyczny województwa opolskiego 1993*, Opole 1993, p. 275; K. Teleguj (ed.), *Rocznik statystyczny województwa opolskiego 1996*, Opole 1996, p. 311; *Kultura Fizyczna w latach 1990–1998*, Główny Urząd Statystyczny, Warszawa 1999, pp. 65–71.

Sports rivalry on the territory of Opole province at all levels was administered by the following number of judges affiliated in Polish Sports Associations: 1990 – 1324; 1991 – 1161; 1992 – 887; 1993 – no data; 1994 – 1035 (apart from fishing judges); 1995 – 1072; 1996 – 1383; 199 – 1087; 1998 – 1040.[36] In the period of time in question, the largest affiliated group of judges in Opole land

[34] The following Regional Sports Associations were gathered in the Province Sports Association in Opole in 1989: the Regional Boxing Association, the Regional Sports Bridge Association, the Regional Ice Hockey Association, the Regional Field Hockey Association, the Regional Equestrian Association, the Regional Judo Association, the Regional Kayaking Association, the Regional Cycling Association, the Regional Basketball Association, the Regional Bowling Association, the Regional Figure Skating Association, the Regional Handball Association, the Regional Volleyball Association, the Regional Swimming Association, the Regional Weightlifting Association, the Regional Shooting Sports Association, the Regional Chess Association, the Regional Tennis Association, the Regional Table Tennis Association, the Regional Wrestling Association, the Regional Opole Sailing Association, the Regional Opole Badminton Association, the Regional Opole Athletics Association, the Regional Opole Archery Association, the Regional Opole Football Association.

[35] J. Stecki, *Pluralizm sportowy*, "Trybuna Opolska" 1989, nr 46, p. 8.

[36] *Kultura Fizyczna w latach 1990–1998,* Główny Urząd Statystyczny, Warszawa 1999*,* p. 118.

could be found in the Regional Opole Football Association (OOZPN). In 1989, the structures of the OOZPN hosted 473 registered judges of different classes. In the following years, the number of judges in the OOZPN grew, i.e. in 1995, there were 488 of them, and in 2000*, 578 of them.[37] R. Wójcik was one of the most famous football referees from Opole land, in the period of time in question. In September 1992, R. Wójcik led the UEFA[38] match between Real Madrid and "Politechnica" Timisoara, and in 1998 he was selected by FIFA[39] to be a referee during the Championships in France. R. Wójcik was the second referee after A. Jarguz who was also a referee during the same event. The referee from Opole land officiated one group stage match played on June 20, 1998, between the Netherlands and South Korea (group E), which ended with a score of 5:0 for the Netherlands.[40]

In the years 1989–1998, on the territory of the province in question, academic activities were developing. In 1989, on the territory of Opole province, within the framework of the Academic Sports Association (AZS), there were two clubs hosting 24 sections and 778 registered members.[41] In the academic year 1995–1996, the authorities of the Higher School of Engineering took a decision to create the study of the Institute of Physical Education and Rehabilitation, which led to further development of the academic environment. The Institute consisted of: the Department of Rehabilitation, the Department of Methodology and Pedagogy, and the Department of Physical Education and Sport.[42] The period of time in question also witnessed an increase in the number of sporting events and their participants. These events were organised on the territory of Opole province, under the auspices of the AZS: 1993 – 18 events (814 participants); 1994 – 15 events (770 participants); 1995 – 15 events (680 participants); 1996 – 49 events (1124 participants); 1997 – 122 events (4518 participants).[43] In 1998, on the territory of the province, there were already 4 academic clubs with 1 112 affiliated members.[44] The leading sections at that time were the sections of AZS Opole and AZS WSI Opole.

In the years 1989–1998, the Provincial Board of the School Sports Association (ZW SZS – Polish acronym) in Opole played the role of promoter and anima-

* The timeframe has been expanded to show a broader perspective of the OOZPN judging personnel.

37 *Kronika 70-lecia Opolskiego Związku Piłki Nożnej,* OZPN 2016, no pagination.

38 *Union of European Football Associations*.

39 Fédération Internationale de Football Association – International Federation of Association Football.

40 *Kronika 70-lecia Opolskiego Związku Piłki Nożnej*, Opole, no pagination.

41 H. Hanusz, B. Korpak, *100 lat Akademickiego Związku Sportowego*, Warszawa 2014, p. 113.

42 A. Banek, *Z jubileuszowych kart historii Studium Wychowania Fizycznego i Sportu WSI w Opolu*, „Zeszyty Naukowe Politechniki Opolskiej" 1997, nr 226, pp. 5–8.

43 K. Teleguj (ed.), *Rocznik statystyczny województwa opolskiego 1998*, Opole 1998, p. 297,

44 *Kultura Fizyczna w latach 1990–1998*, Główny Urząd Statystyczny, Warszawa 1999, pp. 31–35.

tor of physical culture and sport in the province. In the researched period of time, while organising sports events, the ZW SZS collaborated with other organisations and institutions. The ZW SZS in Opole also organised sports competitions for children and youth. Unfortunately, the period of transformation and factors linked with it led to the setback in the ZW SZS in Opole. Apart from the SZS, there were the following entities engaged in school sport in the years 1989-1998 on the territory of Opole province: sports schools, sports classes, classes with the extended PE curriculum, School Sports Clubs (SKS), Interschool Sports Clubs (MKS), Interschool Sports Centres (MOS). It should be also mentioned that the WZ LZS in Opole had a big impact on the development of school sport on the territory in question in the years 1989–1998. From 1994, the establishment of UKS contributed a lot to the process of sports education of children and youth. In the years 1995–1998, there was an increase in the number of UKS members in Opole province, which took the following shape: 1995 – 989 participants; 1996 – 1620 participants; 1997 – 2879 participants; 1998 – 3610 participants.[45]

As far as sport on the territory of Opole province in the years 1989–1998 was concerned, the WZ LZS in Opole had a significant influence. The Author would like to add that on May 16, 1946, the Sports Society "Swornica" was created at the Communal Cooperative "Samopomoc Chłopska". Later on, its name was changed into the Folk Sports Club in Czarnowąsy. Finally, the club, as the first one in Poland, took the name of the Folk Sports Club "Swornica" Czarnowąsy. The name was taken from the river flowing through that place. A. Janik (the principal of a primary school in Czarnowąsy), S. Grefling and A. Zośka established the club.[46] In 1960, W. Czaczka was elected the Chairman of the Provincial Council of the LZS Association in Opole. Thanks to his activity, the foundations of the development of professional sport were established. They encompassed the following sports disciplines: equestrianism, cycling, handball (11-person-teams), weightlifting, wrestling and athletics.[47] In 1989, on the territory of Opole province, the WZ LZS possessed 500 football pitches, 316 volleyball courts, 155 handball courts, and 37 basketball courts. In 18 places, there were communal sports and recreation centres. 110 communes were equipped with athletics gear. The WZ LZS owned 59 sports halls, 11 swimming pools and bathing facilities, 5 tourism-recreation and leisure centres and 14 stadiums. LZS cells covered 954 villages and hamlets with their activities.[48] Till 1989, one of the elements of the State Farms' (PGR) activity, with the intention of the centralised

[45] *Kultura Fizyczna w latach 1990–1998*, Główny Urząd Statystyczny, Warszawa 1999, pp. 52–55.

[46] P. Czaczka, *Z dziejów pierwszego Ludowego Klubu Sportowego w Polsce – LZS Czarnowąsy* (*województwo opolskie*) *1945–1989,* [In:] J. Dżereń (ed.), *Z dziejów kultury fizycznej Polski oraz wybranych regionów i mniejszości narodowych*, Płock 2011, p. 718.

[47] W. Czaczka, J. Stecki, *Nasze zielone lata*, Opole 1996, pp. 5–6.

[48] J. Stecki, *Równy oddech bez wyciągania rąk*, "Trybuna Opolska" 1989, pp. 16, 8.

and planned economy, was partial financing of LZS. This support was provided in the form of grants and services. The first one concerned the investment into sports equipment and remuneration of athletes who were full-time employees in workplaces. The second option concerned the maintenance of sports facilities owned by LZS, delegating employees to renovation works in facilities owned by them and giving access to means of transport.[49] The period of the 1990s, especially its first half, led to the suspension of LZS cells' activity in the region in question. It was caused by the situation in the country and reduction of subsidies for LZS Association activities. The act of January 5, 1991 which limited the role of the state support of physical culture, excluded LZS from the budget zone. As a result, 95% of WZ LZS personnel in Opole province was fired. Mainly weak LZS got liquidated due to these reasons. In order to protect themselves against liquidation, some LZS cells in Opole province made mergers among themselves.[50] In the years 1991-1995, the number of LZS centres and members in the whole country decreased by 28.9%, while in Opole province there was a noticeable increase in the number of members by 15.9%[51] despite liquidating some cells.[52] In the years 1996-1998, LZS and SZS, agricultural schools, rural schools and Volunteer Fire Departments started to cooperate. LZS activity in Opole province was also impacted by their collaboration with local authorities that started realising the provisions of the act of January 18, 1996. According to the act, commune authorities were to take care of the maintenance of sports facilities, equipment and distribution of funds for statute activity of LZS Commune Councils (RG LZS – Polish acronym). What is more, in the period of time in question, LZS in Opole land were also supported by the Department of Culture and Sport (WKiS) of the Provincial Council in Opole, sports associations, unions and organisations. Thanks to this support, at educational institutions and communal culture, sports and entertainment centres Folk Student Sports Clubs (LUKS) were established. The main sports disciplines practised there were football, handball, basketball, volleyball, table tennis and athletics. The schools in Komorno, Namysłów and

[49] Z. Jakubczyk, A. Krawczyk, *Wpływ przemian własnościowych na finansowanie i aktywność Ludowych Zespołów Sportowych w województwie opolskim w latach 1991–1995*, "Człowiek i Ruch" 2000, vol. 2, no. 2, p. 94.

[50] B. Kociński, *Jubileusz 70-lecia działalności LZS na Opolszczyźnie 1946–2016,* Opole 2016, pp. 13–14.

[51] Składnica Akt Krajowego Zrzeszenia Ludowe Zespoły Sportowe w Warszawie, Sprawozdanie na XIII Krajowy Zjazd Delegatów Zrzeszenia Ludowe Zespoły Sportowe za lata 1991–1995. Warszawa 1996, pp. 7–8. See: E. Małolepszy, D. Bakota, T. Drozdek-Małolepsza, A. Płomiński, *Z dziejów sportu i turystyki w działalności Krajowego Zrzeszenia Ludowe Zespoły Sportowe w latach 1975–2015*, Częstochowa 2016, p. 34.

[52] S. Rosiński, *Sport w działalności Ludowych Zespołów Sportowych na Opolszczyźnie w latach 1946–2006,* [in:] L. Nowak (ed.), *Z najnowszej historii kultury fizycznej w Polsce,* vol. 8, Gorzów Wlkp. 2008, pp. 511–512.

Głubczyce hosted Leading LKS (WLKS), including dormitories for athletes.[53] These activities contributed to the improvement of sports and recreational activity of the WZ LZS in Opole province in the following years.

Political and economic reforms resulted in a limited activity of sports associations. Numerous centres of the Society for the Promotion of Physical Culture (TKKF) and their activists were nor prepared for the pace of these changes. Central authorities did not agree with the demands of the TKKF Board, and even partial financing of their activity from the state budget was out of the question. It resulted in changes regarding the very nature of organised sports events and the very activity of the TKKF in the country and the province of Opole in the years 1989–1998. This period of time witnessed a decrease in the number of TKKF centres and members in Opole province. In this period of time, the TKKF mainly focused on organising smaller sports events, which gathered enthusiasts of amateur sport. This led to the decline in every area of TKKF activity in Opole province between 1989 and 1998.

The development of professional sport on the territory of Opole province in the years 1989-1009 was irregular. This was influenced by the central location of the capital city and the concentration of industry. The prevalent number of sports clubs, sections and training staff as well as athletes was concentrated in the agglomeration of the city of Opole, which gathered most of the sports potential. In the period of time in question, the following capital city clubs stood out in terms of organisation and sports: KS "Kolejarz" Opole, OKS "Odra" Opole, KS "Gwardia" Opole, SKS "Start" Opole, "Budowlani" Opole, AZS WSI Opole or AZS Opole. Outside the provincial city, the development of physical culture and sports was significantly influenced by the activity of such clubs as "Chemik" Kędzierzyn-Koźle (later "Unia" Kędzierzyn-Koźle), Kluczbork Sports Club, LKS "Zarzewie" Prudnik, "Metal" Kluczbork, "Otmęt" Krapkowice, "Pogoń" Prudnik, "Ruch" Zdzieszowice, "Stal" Brzeg, "Stal" Nysa "Stal" Zawadzkie, LKS "Technik" Głubczyce, LZS "Ziemia Opolska", ZKS "Górażdże", "Mostostal Z.A." Kędzierzyn-Koźle, Kluczbork Karate Club, "Olimp" Grodków or LKS Komprachcice.

In the years 1990–1998, athletes affiliated with sports clubs from the territory of Opole province participating in sports competition won various sports classes. Table 3 presents sports classes won by female and male athletes.

During the Olympic Games held in Barcelona in 1992, the Polish Olympic team included the following athletes from Opole province: A. Brzezińska ("Gwardia" Opole – athletics), K. Siemion, S. Wołczaniecki, A. Kozłowski (all from "Budowlani" Opole – weightlifting), B. Bąk, B. Haracz, K. Krasowska (all from "Technik" Głubczyce – badminton) and M. Kupiec ("Chemik" Kędzierzyn-Koźle – swimming). In 1996, at the Olympic Games held in Atlanta, Opole province was

[53] Ibidem, p. 512.

represented by: A. Brzezińska ("Gwardia" Opole – athletics), K. Krasowska ("Technik" Głubczyce – badminton) and M. Kupiec ("Chemik" Kędzierzyn-Koźle – swimming), A. Społowicz (LKJ Moszna – equestrianism). Among the aforesaid female and male athletes, only two representatives of Opole province won Olympic medals at that time. It happened in Barcelona, in 1992, and the medals were won by K. Siemion – silver medal in weightlifting (welterweight 82,5 kg) and S. Wołczaniecki – bronze medal in weightlifting (light heavyweight 90 kg).

Table 3. Female and male competitors from Opole province with sports classes in the years 1990–1998

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**
Total	**146**	**129**	**101**	**—**	**130**	**129**	**122**	**119**	**133**
International master class	4	4	5	—	5	7	10	16	20
Master class	31	29	19	—	40	37	22	31	37
Class I	111	96	77	—	85	85	90	72	76
Women – total	**28**	**34**	**29**	**—**	**—**	**37**	**41**	**35**	**30**
International master class	—	—	1	—	—	4	8	7	5
Master class	11	13	6	—	—	12	6	11	13
Class I	17	21	22	—	—	21	27	17	12
Female and Male Junior Athletes – total	**53**	**56**	**46**	**—**	**—**	**34**	**43**	**44**	**37**
International master class	—	—	—	—	—	1	3	4	5
Master class	6	4	4	—	—	9	8	7	7
Class I	47	52	42	—	—	24	32	33	25

Source: *Kultura Fizyczna w latach 1975–1998*, Główny Urząd Statystyczny, Warszawa 1999, pp. 137–145.

During the World and European Championships organised in the years 1989-1998, athletes from Opole province achieved significant results (individually and as a team) in various age categories (See: Table 4).

Table 4. Medalists of the World and European Championships in the years 1989–1998 representing sports clubs from Opole province

Discipline	**Male/Female Representative**	**Sports club**
Baseball	A. Kędra, M. Pawluk, Ł. Zieliński, J. Głąb, T. Polak, K. Kubik, M. Szymczakiewicz, M. Mórawski, Ł. Kuźdub, M. Świnicki, A. Cybulski,	MKB Brzeg
Equestrianism	Z. Rozpleszcz	LKJ "Moszna"
Judo	J. Wojnarowicz, B. Kucharzewska, M. Węgrzyn , I. Tokarz, A. Mróz	AZS Opole
	A. Chodakowska	AZS WSI Opole

Table 4. Medalists of the World and European Championships… (cont.)

Discipline	Male/Female Representative	Sports club
Karate	K. Neugebauer	Kluczborski Klub Karate
	A. Wolna, I. Zakowicz, P. Janiszyn, T. Juszczyk, N. Brudniak, J. Dębińska, I. Juszczyk	LKS "Zarzewie" Prudnik
	P. Gładoch	"Polonia Torakan" Biała
	W. Błoch	Obornicki Klub Karate
Basketball	A. Wojtowicz	"Stal" Brzeg
Road cycling	J. Halupczok	LZS "Ziemia Opolska"
Athletics	A. Brzezińska	"Gwardia" Opole
	R. Pewiński, A. Dyczek, P. Osiwała, T. Kszczot	"Centrum" Zdzieszowice
	I. Czut	"Technik" Komorno
Swimming	M. Kupiec	"Chemik" Kędzierzyn-Koźle
Weightlifting	M. Błoniarczyk, E. Piszczek, J. Czerwionka, D. Żagiel, A. Hawrylów, A. Gronowska, M. Kusek, D. Wojtkiewicz, K. Marszałek, K. Mazurkiewicz, K. Karaś, M. Dąbrowski, K. Siemion, S. Wołczaniecki, A. Kozłowski	"Budowlani" Opole
Ringo	M. Boguszewska, M. Domagała, M. Dora, K. Dora, S. Dora, B. Wojnarowski, A. Strózik	Opolskie Towarzystwo Ringo
Softball	M. Błoniarczyk, E. Piszczek, M. Kusek, D. Żagiel, A. Hawrylów, A. Gronowska, M. Kusek, J. Czerwionka D. Wojtkiewicz, K. Marszałek, K. Mazurkiewicz, K. Karaś.	Primary School no 6 in Brzeg
Shooting	M. Minkowski	LOK "Opolanin" Opole
Fencing	D. Gilman	"Zryw" Opole
Powerlifting	H. Bajak, I. Kodziołka, T. Grab, M. Oliwa, D. Ilów, M. Domaradzki	"Olimpia" Pokój
	M. Oliwa	"Olimpia" Pokój
Wrestling	K. Brzozowski	LKS "Orzeł" Namysłów

Source: own study based on B. Piksa, *Sport w województwie opolskim w latach 1975–1998* (PhD dissertation), Jerzy Kukuczka Academy of Physical Education in Katowice 2019.

In the years 1990–1998, athletes from Opole province achieved a lot of success both in the country and abroad in several sports disciplines. These are some of the most important results: gymnastics – in 1995, at the Team Polish Championships, master class, organised in Łódź, the athletes of NTG "Nysa" won the championship title, and in Class III they won a bronze medal;[54] equestrianism –

[54] "Nowa Trybuna Opolska" 1995, no 275, p. 16.

A. Sałacki (LKJ "Lewada" Zakrzów) won five medals at the Polish Senior Championships (1991 – gold one; 1992 – bronze one; 1993 – bronze one; 1995 – silver one; 1996 – bronze one);[55] track cycling – in 1992, H. Kołaczek (LKS "Ziemia Opolska") won the title of vice-champion of Poland in track cycling, in the 50 km distance race.[56] In 1995, W. Świrydowicz (LKS "Ziemia Opolska") won the second place in sprint during the track championships of Poland;[57] athletics – in the years 1989-1994, I. Czut ("Technik" Komorno) in the national competition achieved the following results: Ostrów Wielkopolski Polish Championships 1989 – gold medal for the 6km distance run, Olsztyn Polish Championships 1990 – gold medal for the 7km distance run, Skarżysko-Kamienna Polish Championships 1991 – bronze medal for the 6km distance run, Kędzierzyn-Koźle Polish Championships 1992 – gold medal for the 6km distance run, Płock Polish Championships 1993 – gold medal for the 6km distance run, Bydgoszcz Polish Championships 1994 – silver medal for the 5km distance run. The medals won put I. Czut on the 6th place in the classification of the best female cross-country runners in the history of the Polish Championships;[58] weightlifting – competitors representing "Budowlani" Opole club, in the years 1992, 1994, 1995, 1997 won Polish Team Championship;[59] badminton – female and male athletes from "Technik" Głubczyce, in the years 1989-1998, won 33 gold, 15 silver and 15 bronze medals of Polish Championships in men's single game, women's single game, men's double game, women's double game and mixed game;[60] field hockey – in the years 1989-1994, the teams of LKS "Rolnik" Nysa (6 times) and LKS "Plon" Skoroszyce (7 times) stood on the podium of Polish Senior Championships, competing on outdoor pitches and indoor sports halls.[61] Indoor football – in 1992, the team of "Novomex" Opole won the title of indoor football Polish champion;[62] male volleyball – a volleyball team from Nysa enjoyed their greatest success in the 1990s, under the names of KS "Stal" Nysa (1990), "Stal-Hochland" Nysa (1993), and Citroën "Stal-Hochland" Nysa. In this period of time, the club won 2 vice-championships of Poland (1994, 1995), and two bronze medals of Polish championships (1992, 1995). The club was also successful in the Polish Cup: a silver medal in

[55] https://www.kjlewada.pl/index.php/o-nas/osiagniecia-klubu [access 27.10.2024]

[56] "Trybuna Opolska" 1992, no 202, p. 8.

[57] "Nowa Trybuna Opolska" 1994, no 199, p. 13. See: R. Stęporowski, *Wygrywać jak Mario*, "Nowa Trybuna Opolska" 1996, no 217, p. 24.

[58] "Nowa Trybuna Opolska" 1994, no 51, p. 12. See: www.wikiwand.com/pl/Medalistki_mistrzostw_Polski_senior%C3%B3w_w_biegu_prze%C5%82ajowym [access 28.10.2024].

[59] http://budowlaniopole.pl/o-nas/osiagniecia [access 28.10.2024].

[60] B. Haracz, *Historia sekcji badmintona LKS „Technik" Głubczyce w latach 1966–2004* (M.A. thesis), Opole University of Technology 2004, „Badminton Polska" 1997, nr 10, pp. 18–28, https://pl.wikipedia.org/wiki/Mistrzostwa_Polski_w_badmintonie [access 28.10.2024].

[61] https://pl.wikipedia.org/wiki/Mistrzostwa_Polski_w_hokeju_na_trawie_kobiet [access 28.10.2024].

[62] *Kronika 70-lecia Opolskiego Związku Piłki Nożnej*, Opole 2016, no pagination

1995, a gold medal in 1996.[63] In the season of 1996–1997, the runner-up title was won by the team of "Mostostal Z.A." Kędzierzyn-Koźle.[64] In 1998, volleyball teams from Opole province enjoyed the best season in the history of that discipline in the land of Opole. The volleyball players of "Mostostal" Azoty Kędzierzyn-Koźle won the Polish championship for the first time, while the team of "Stal-Hochland" Nysa won the third place;[65] table tennis – in the years 1991–1997, D. Djaczyńska-Nowacka ("Stal" Zawadzkie) won five medals of Polish Championships: in singles, doubles and mixed games;[66] tennis – in 1994, A. Żarska (TKS Kędzierzyn-Koźle)[67] became the Polish senior women's champion; kayaking – in 1996, Gorzów Wielkopolski organised the Polish Championships in kayaking marathon. A. Guzek and A. Zyzik, in K-2 junior competition won a gold medal at a distance of 30km, and their club mate, J. Owczarczyk, won a silver medal for the same distance in K-1 competition. All the athletes represented OTK Opole – former "Kolejarz". During this championship, representatives of other clubs from Opole also won their medals. A. Jeziorański ("Zryw" Opole)[68] won a silver medal in the junior classification in C-1 15km-distance competition, while A. Madej ("Zryw" Opole)[69] won a bronze medal in K-1 30km-distance competition. In 1995, A. Madej ("Zryw" Opole) won a silver medal in K-1 42km-distance competition, during the Polish Championships in kayaking marathon;[70] swimming – at the beginning of 1990s, the biggest swimming talent in the land of Opole was M. Kupiec from "Chemik" Kędzierzyn-Koźle. This female athlete represented the club in the years 1988-1995, and she was trained by J. Kocjan. M. Kupiec was a seven-time Polish champion (in the 50m[71] and 25m swimming pool[72]). Judo – in October 1990, the athletes of "Gwardia" Opole won a bronze medal of the Team Polish Championships held in Wrocław.[73] In October 1992, Wrocław was the host of the Team Polish Championships during which AZS Opole female judokas won a team gold medal.[74] In the years 1993–1997, the female judokas of AZS Opole won the title of team Polish champions five times

[63] P. Mazur, *Historia piłki siatkowej w Nysie* (M.A. thesis), Opole University of Technology 2007, pp. 66–76.
[64] "Nowa Trybuna Opolska" 1997, no 68, p. 19.
[65] "Nowa Trybuna Opolska" 1998, no 270, p. 26.
[66] "Nowa Trybuna Opolska" 1997, no 88, p. 20.
[67] "Nowa Trybuna Opolska" 1994, no 73, p. 13.
[68] "Nowa Trybuna Opolska" 1996, no 128, p. 20.
[69] "Nowa Trybuna Opolska" 1996, no 128, p. 20.
[70] "Nowa trybuna Opolska" 1995, no 207, p. 12.
[71] 50 m breaststroke (1992,1993); 100 m breaststroke (1991, 1992, 1993, 1995); 200 m breaststroke (1993).
[72] 200 m breaststroke (1993).
[73] "Trybuna Opolska" 1990, nr 242, p. 8.
[74] "Trybuna Opolska" 1992, nr 254, p. 8.

in a row.[75] On the other hand, Gdańsk organised the "Tournament of Champions" ending the struggle for the 1998 Polish Team Championship. During this competition, the female judokas of AZS Opole won the runner-up title.[76] In the years 1989-1998, the female judokas of AZS WSI Opole and AZS Opole and male judokas of "Gwardia" Opole won numerous individual medals in all age categories; karate – in the period of time in question, the most successful karateka from Opole was K. Neugebauer (Kluczbork Karate Club). A multimedalist of Polish, European and World championships in individual and team kumite; fencing – in the years

1989–1996, D. Gilman (player of "Zryw" Opole 1983–1994, player of TSSZ Opole 1995–1996) was Opole's leading sabre player. In 1995, during the Polish Championships, D. Gilman won a bronze medal in épée fencing;[77] wrestling – in July 1992, Zegrze held Polish Championships in freestyle wrestling. K. Pawlak of LKS „Orzeł" Namysłów won the champion title in 57kg category,[78] and a bronze medal in 52kg category was won by

W. Chwaszcz (ZKS "Górażdże");[79] archery – "Obuwnik" Prudnik club hosted Polish Championships in 1989. Then, J. Pawlik-Helbin won two silver and one bronze medal.[80] In 1997, M. Jania ("Obuwnik" Prudnik) won the vice-championship of Poland in archery;[81] rallying and motor racing – in 1990, the title of Polish Champions in navigation rallies went to J. Makowski and M. Pańka (Automobilklub Kędzierzyńsko-Kozielski), and J. Morel and A. Morel (Automobilklub Opolski) were vice-champions. In the team classification, the title of Polish champion was granted to the racers of AKK, the third place went to the representatives of AMO. In the regional classification run by the Polish Motorcyclist Association (PZMot), the region of Opole won the first place.[82] During "Karlik 1992" Opole car rally, which ended up the navigation Polish Championships, the team from Opole, J. Morel and A. Morel, won the title of individual national champions. In the club classification, the second place went to OSA competitors.[83] In the season of 1993 and 1994, OSA won the titles of Club Champion of Poland in the Polish Navigation Car Championships.[84] In Wrocław, in 1994, there was a navigation rally "Ślęża 94". During this event, the fifth and the sixth quali-

[75] A. Szatan, *Brązowy puchar*, "Nowa Trybuna Opolska" 1997, nr 258, p. 24.
[76] "Nowa Trybuna Opolska" 1998, no 280, p. 26.
[77] "Nowa Trybuna Opolska" 1995, no 132, p. 16.
[78] "Trybuna Opolska" 1992, no 158, p. 8.
[79] K. Juźwin, *Historia Zakładowego Klubu Sportowego "Górażdże"* (M.A. thesis), Opole University of Technology 2004, pp. 93–100.
[80] "Trybuna Opolska" 1989, no 188, p. 8.
[81] "Nowa Trybuna Opolska" 1997, no 213, p. 18.
[82] T. Wyspiański, *Motorowe notowania*, "Trybuna Opolska" 1991, no 1, p. 8.
[83] "Trybuna Opolska" 1992, no 248, p. 8.
[84] www.agropin.opole.pl/osaopole/wyniki_2000.pdf [access 15.09.2024].

fiers of the Polish Navigational Car Championships were held. In the general classification, the first place went to the team of J. Herbeć and M. Herbeć (OSA);[85] motorcycle racing – in the years 1995-1998 the drivers from Auto Moto Klub "Tortex" Grodków won championship titles in various motocross and enduro classes; triathlon – in 1993, K. Gwizdoń (TKKF Prudnik) won a bronze medal in short distance Duathlon Polish Championships in Głogów;[86] powerlifting – in November 1993, in Bielsko-Biała, the Second Polish Championships in barbell bench press of the Polish Bodybuilding and Powerlifting Association took place. During this event, the contestants from "Skarabeusz" Opole won three medals.[87] In Dobrzeń Wielki, in 1994, the Fourth Polish Championships in barbell bench press took place. The contestants from "Olimpia" Pokój did very well in these championships. They won three titles of Polish champions.[88] During Polish Championships in barbell bench press organised in Nowy Sącz in 1997, the contestants from "Olimpia" Pokój won three gold and two bronze medals.[89]

Summary

The years 1989–1998 were a very dynamic period of changes and adaptation to new political and economic circumstances, influencing the development of physical culture and sport on the territory of Opole province. Sport in Opole province developed despite numerous challenges. Legal regulations concerning physical culture and sport, introduced by state authorities had an impact on the process of sports development on the aforesaid territory. During the first years after the transformation, many sports clubs in Opole province faced the challenge of finding new sources of financing, which often led to the reduction of their activity and the number of their athletes. At the local level, territorial authorities started to play a bigger role in sports and sports infrastructure management. As far as popularisation of physical culture, sport and tourism on the territory of Opole province in the years 1989–1998 was concerned, the activity of environmental organisations, i.e. AZS in Opole and the WZ LZS in Opole had a measurable impact. Unfortunately, the reforms of the transformation time led to a regression of operations of the TKKF and the ZW SZS on the territory of Opole province. Moreover, the number of trainers, instructors and sports judges also contributed to the development of sport in Opole province. The condition of sports infrastructure and social activism had a measurable impact on the de-

[85] "Nowa Trybuna Opolska" 1994, no 112, p. 16.
[86] "Nowa Trybuna Opolska" 1993, no 48, p. 14. (7.3-km-run, 30-km-cycling, 3.65-km-swimming)
[87] "Nowa Trybuna Opolska" 1993, no 190, p. 16.
[88] "Nowa Trybuna Opolska" 1994, no 117, p.14.
[89] "Nowa Trybuna Opolska" 1997, no 66, p. 20.

velopment of sport on the territory of the region in question. Due to the aforementioned factors, in the first half of the 1990s, some sports centres representing such sports disciplines as figure skating, ice hockey, track cycling, acrobatics, speedway limited their activity. The period of time in question witnessed the change of leading sports disciplines. The athletes and clubs from Opole province triumphed in badminton, baseball, weightlifting, field hockey, female and male judo, karate, male volleyball. Despite many difficulties, sportspeople representing clubs from the area of Opole province achieved significant results at various levels of sports competition.

DECLARATION OF CONFLICTING INTERESTS

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Część II

TEORIA I METODYKA WYCHOWANIA FIZYCZNEGO I SPORTU

SPORT I TURYSTYKA
Środkowoeuropejskie Czasopismo Naukowe

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SAMBO AS A FORM OF WRESTLING AND SELF-DEFENCE

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Sambo jako forma zapasów i samoobrony

Streszczenie

Rzecz dotyczy *sambo* – sztuki walki usytuowanej pomiędzy samoobroną a sportem. Czy jest to bardziej forma zapasów? Czy jest to sztuka walki, system walki, czy sport? Na ile *sambo* jest podobne do *jujutsu* lub *judo*? Jak należy tę sztukę walki dookreślić? Autor uwzględnienia wypowiedzi różnych specjalistów i szuka wyjaśnień w drodze dowodu logicznego. Metodą badań jest tu więc analiza treści literatury przedmiotu, wywiady bezpośrednie, oraz analiza dokumentów. Jako źródła potraktowano też starsze publikacje (podręczniki i inne książki). Następnie zaś przeprowadzono proces logicznej dedukcji.

Sambo nie jest jednorodne – *sambo* sportowe i *sambo* bojowe są jakby osobnymi sztukami walki. Sportowe *sambo* jest walką zapaśniczą, bazującą głównie na japońskich wzorach techniczno-taktycznych. Jest to jakby połączenie zapasów w stylu wolnym i *judo*. Natomiast inne postaci *sambo* są formą samoobrony, systemem wojskowej walki wręcz lub eklektyczną mieszanką różnych technik walki. *Sambo* nie spełnia kryteriów dla kategorii sztuki walki i drogi walki. Jest zatem formą sztuki walki jako sport walki lub program treningowy dla MMA, eklektyczną samoobroną lub systemem walki.

Słowa kluczowe: *sambo*, samoobrona, system walki, zapasy, klasyfikacja.

Abstract

The thing is about *sambo* – a fighting art between self-defence and sport. Or is it more of a form of wrestling? Is it a martial art, a combat system, or a sport? How similar is *sambo* to *jujutsu* or *judo*? How should this fighting art be defined? The author takes into account the statements of

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various specialists and seeks explanations by logical proof. Therefore, the method of research here is the analysis of the content of the literature on the subject, direct interviews, and the analysis of documents. Older publications (textbooks and other books) were also treated as sources. Then the process of logical deduction was carried out.

Sambo is not homogeneous – sport *sambo* and combat *sambo* are like separate fighting arts. Sport *sambo* is a wrestling fight based mainly on Japanese technical and tactical patterns. It is like a combination of freestyle wrestling and *judo*. In contrast, other forms of *sambo* are a form of self-defence, a system of military hand-to-hand combat, or an eclectic mix of different fighting techniques. *Sambo* does not meet the criteria for martial art and martial way. It is therefore a form of fighting art, as a combat sport or training program for MMA, eclectic self-defence or combat system.

Keywords: *sambo*, self-defence, combat system, wrestling, classification

Introduction

On July 20, 2021, the International Olympic Committee (IOC) fully recognized the International Federation of Amateur Sambo (FIAS), thus accepting sambo into the family of Olympic sports. We know that *sambo* is both a self-defence/hand-to-hand combat system and a combat sport. *Sambo* – is an abbreviation of the words in Russian (*SAMozaszczita Biez Oružia*) – Self-defence without weapon (Błach, W., Cynarski, & Błach, Ł., 2006). It is a genetically Soviet and now de facto Russian version of hand-to-hand combat in the area between self-defence and sport. Is it more of a form of wrestling or how should it be defined? Does it meet the definition of a martial art?: "Martial arts are a historic category of flawless methods of unarmed combat fighting and the use of weapons, combined with spiritual elements (both personal development and in the transcendental sphere)" (Cynarski & Skowron, 2014).

The reflection will be based on the General Theory of Fighting Arts (GTFA) (Cynarski, 2019) and a more specialized theory of self-defence (*cf*. Ambroży, 2001: 5–140, 2002–2003; Raczkowski, 2008; Cynarski, 2009, Cynarski, 2016), taking into account the statements of various specialists and by logical proof.

The research **method** here is content analysis of the subject literature, direct interviews, and document analysis. Older publications (textbooks and other books) were also treated as sources. Then, a process of logical deduction was carried out. It is like a monographic study, referring to various sources – existing and evoked.

A few words about the history of *sambo*

Establishment and institutionalization

The self-defence combat system was developed within the Soviet Union's secret services in the 1920s. The concept of "self-defence without weapons" was introduced by Viktor A. Spiridonov in his book "Guide to self-defence with-

out weapons in the ju-jitsu system" in 1927. It was intended for NKVD employees. The following year, his second textbook, i.e. "Self-defense without weapons. Training and competition" was published and it was also marked "For internal use". However, in 1938, the All-Union Committee for Physical Culture and Sports in Order No. 633: "On the development of freestyle wrestling (*sambo*)" used the name "freestyle wrestling sambo". It was only in 1946 that the name was changed to "sambo" in the central sports institutions of the USSR (Cynarski, 2021a: 138–139).

The author of the above-mentioned books was a participant in the Russo-Japanese War in Manchuria in 1905 and the First World War in 1914. During the war he was wounded and transferred to the reserve. In 1921, Spirydonov created the foundations of a new system consisting of the most effective (in his opinion) methods and tricks of various martial arts used at that time (Rudman, 2003), but essentially based on jujutsu and classical Greco-Roman wrestling. He emphasized the fact that the art of self-defense helps to achieve victory by all available means. Therefore, he recommended using a rich repertoire of techniques useful in real combat. Moreover, Spirydonov was the first to classify holds and give them names (Rudman, 2003). The introduction of a new combat system was caused by the need to train new personnel for the uniformed services of the Soviet Union.

After years of searching for optimal solutions to combat operations, Spirydonov came to the conclusion that *jujutsu* holds are a bit too complicated to use. He stated that due to specific climatic and cultural conditions, foreign self-defense systems are of little use in Russia. Therefore, in the book "Self-defense without weapons. Training and Competition" (1928), in which he presents the basic principles of his self-defense system, he no longer uses the name *jujutsu*. The main slogan of this book is "Everything is good that leads to victory", which is quite commonly accepted in various self-defense schools. Spirydonov also emphasized the principle that the best results should be achieved with the least possible energy loss. But this is the principle of *Seiryoku zen'yo* known in *jujutsu*.

In February 1929, Spirydonov organized the first self-defense championship of the Moscow "Dynamo" (Rudman, 2003). Then, in 1933, he published his third book on *sambo*, also For Internal Use. In it, he described, among other things, the principles of organizing self-defence competitions. In his book, the author is considering naming his new combat system. Here he also introduced the justification for the name *sambo* as the most accurate.

His work was continued by his students, including Viktor Volkov. He also wrote a book titled "Unarmed self-defense course: Sambo. Manual for NKVD schools" (1940). This manual describes the basic combat techniques necessary in operational work. The techniques were classified into seven groups: immobilization and incapacitation, locks, twists, off-balance and throws, compressions

and choking, strikes and combinations. In addition, the training system, special-purpose holds were described: fighting with knives, defense against an opponent armed with firearms, holds and counter-attacks, as well as the teaching methodology and organization of competitions (Błach, W., Cynarski, & Błach, Ł., 2006). This and previous manuals were not available outside the USSR's power ministries.

The second great co-creator of *sambo* was Vasiliy Oshchepkov. He came to Moscow in 1930. He already had 2nd dan *judo*, for which he passed the examination at the *Kodokan* Institute in 1917. In the years 1918-1926, he was a resident of the main intelligence directorate in Japan. In Moscow, Oshchepkov worked at the Institute of Physical Culture as a *judo* teacher. He supplemented his judo with technical elements taken from various wrestling styles of the nations that were part of the Soviet state, especially Central Asia and the Caucasus (*cf*. Tumanian, 1997). However, despite his merits, in 1937 the NKVD arrested Oshchepkov on charges of alleged cooperation with the Japanese and in 1938 he was murdered.

Anatoliy Kharlampiyev was Oshchepkov's student, who significantly promoted *sambo*. In order to gain the support of the communist authorities, he spread the highly dubious thesis that it was an original Russian sport enriched with the techniques of traditional wrestling of the peoples of the USSR. However, for his contribution to the development of a sport similar to *judo*, Kharlampiyev received an honorary 8th dan *judo* from Japan (Dawidowicz, 2019: 64).

Only after the end of World War II was "unarmed self-defense" divided into two types: combat *sambo* and sports *sambo*. The former remained a secret system until the collapse of the USSR, while sports *sambo* became a massively practised and quite popular sport. Further institutional development was facilitated by its entry into sports. The next steps were:

1938 – the first friendly competition in "free style fighting" with the participation of teams from five cities;
1939 – the first championship of the Soviet Union in this new sport;
1946 – the competition was resumed, but under a new name, as the sambo championship;
1966 – at the congress of the International Amateur Wrestling Federation (FILA) in the United States, the topic of "*sambo*" was discussed, and then a commission was established within FILA to deal with the development of sambo in the world (Enigmas, 1997);
1967 – the first international *sambo* competition organized in Riga (today's Latvia);
1968 – FILA (International Federation of Amateur Wrestling) recognized *sambo* as a wrestling sport;
1972 – the 1st European Championships were held;
1980 – *sambo* was presented during the Olympic Games in Moscow;

1985 – the International Federation of Amateur Sambo (FIAS) was established;
2000 – the “sambo combat” competition was introduced.

Sports sambo

Kharlampiyev introduced a new cut of sweatshirt (*samboyka*), additional shoes (*bortsovki*) for fighting players, and also modified the rules of duels. This is how a new type of sport was created, which was then called "freestyle fighting". It was a type of fighting that supplemented the rich heritage of judo with elements of moves from other types of self-defense. These include, for example, levers on the leg joints, which are not allowed in sports *judo*.

The pioneers of this sport, in addition to those previously mentioned, included: Nikolai Galkovskiy, Ivan Vasiliev, Roman Shkolnikov, Lev Turin and Evgeniy Chumakov. However, among the most important figures in the history of sambo, four names should be mentioned. These are: Viktor Spiridonov (1882–1944) and Alexey A. Kadochnikov (Systema), who continued his thought, and Vasili S. Oshchepkov (1893–1938) and his student Anatoly Kharlampiev (1906–1979). Spiridonov, a pioneer of Soviet *sambo*, is considered the creator of Systema (*sistiema*), an undefined Russian style of self-defence (Cynarski, 2021a: 154). However, the sport of *sambo* was a global success, given its international reach.

The World Cup has been held cyclically since 1969, and the World Championships since 1973. In 1985, the International Federation of Amateur Sambo (FIAS) was founded in Bilbao (Spain). The first president of the FIAS was elected; it was a Spaniard, Fernando Comte. In the same year, the FIAS was admitted as a member of the World Association of Non-Olympic Sports (GAISF), and sambo was included as a sport in the program of the World Games for Non-Olympic Sports.

Sport *sambo* is a hand-to-hand fight in which fighting takes place in a standing position (vertical position) and on the ground (horizontal position), which is typical of a wrestling fight. Only throws and catches are allowed. Throws are divided (as in *judo*) into foot throws, hand throws, hip throws and the so-called “sacrifice” throws, i.e. with one’s own fall. The grips are: holds and levers – used on the upper and lower limbs. The variety of ways to defeat an opponent places great demands on the trainees’ psychomotor preparation. *Sambo* players face high demands in terms of psychophysical fitness. A sports fight in sambo lasts 5 minutes of real, effective fighting time, which does not include breaks in the fight. This applies to both men and women. In younger age categories (from junior to junior), the duration of the duel is correspondingly shorter (junior – 4 minutes, junior – 3 minutes). *Sambo* fighting is an effort of variable intensity and different durations of its individual sequences (Błach, W. *et al*., 2005).

The Russian film Combat *Sambo* (1993) presents a bit of history, a bit of a fictionalized legend of the origins of sambo, and, above all, technical and tac-

tical solutions. According to Lothar Sieber (2023), the techniques of this combat sambo look almost identical to those in *jujutsu*. The author thinks similarly.

The multi-form nature of *sambo*

The classification of this form of fighting art causes some difficulties. Originally it was possible to distinguish:

— military *sambo* – the Soviet equivalent of *jujutsu* (according to Spiridonov's teaching);
— sports *sambo* – the Soviet equivalent of *judo* (according to Oshchepkov's teaching).

Its other characteristics are also highlighted. For example, Zeziulin (2005) states that the entire self-defense system is divided into: combat *sambo*, sports *sambo*, and self-defence outside sports. In turn, the Polish Sambo Association / *Polski Związek Sambo* (PZ Sambo) distinguishes three types:

— Sports *sambo*;
— Combat *sambo* (combat, Russian: *Boyevoye Sambo*);
— Military *sambo* (*systema*) (Polish Sambo Association, 2022).

Sports competition was also introduced in combat *sambo*. Here, fighting forms such as throws, holds, hand strikes and kicks are allowed. One of the most famous graduates of the martial *sambo* school was Fyodor Emielianenko, a multiple world champion in MMA, in the years 2003-2010, considered one of the strongest players in this sport. Oleg Taktarov, Alexander Emielianenko and several other fighters also joined the world's MMA leaders.

The *sambo* self-defence system was popularized especially in the armed forces and police until the mid-20th century (Błach, W., Cynarski, & Błach, Ł., 2006). This was probably due to the political situation in the world and Europe at that time. With the "political thaw" in international relations, a more visible commercial trend appeared – self-defence courses with an emphasis on the utilitarian value of this system. At the same time, sports were becoming more and more important. The element of sports competition in *sambo* ceased to be marginal and became one of the main goals of training.

The author asked for a statement from the coach and activist of the International Sambo Federation (FIAS) and the European Sambo Federation, Prof. Dr Patrik Drid from Serbia.

> You are an activist of the International Sambo Federation. I would like to write an essay on *sambo*. I would like you to answer my 3 questions:
> 1. How did you get into *sambo*?
> 2. What is *sambo* for you?
> 3. Do you think *sambo* is closer to wrestling, *judo, jujutsu* or something else (compared to similar martial arts, combat sports, self-defence systems and hand-to-hand combat)?"

I performed as a competitor for the first time in 1993 at the World Championship in Kstovo (Russia). I was lucky that my coach (Svetozar Mihailovic) was one of the founders of the World Sambo Federation (FIAS), and he introduced me to this sport.

After the first competition, two top *sambo* competitors (Nikolaj Igrushkin and Aleksandar Dunavev), multiple world champions, with their coach Kuljkov, came to Novi Sad. The competitors trained with us for three months while the coach stayed for a year.

After my competitive career, I continued working as a coach and referee on the international level. I managed the organization of two European and four world *sambo* championships. I want to emphasize the World Championship in 2020, which we organized in a sanitary "bubble" during Covid-19, which is my most outstanding achievement. I am currently the vice president of the European Sambo Federation.

For me, *sambo* represents the most complex combat sport. The movements are simple yet very demanding and effective. I especially emphasize the beauty of combat *sambo*, which cannot be said to resemble any other combat sport. Sports *sambo* contains the best elements from many combat sports. It is much more physically demanding than judo and more attractive than wrestling (Drid, 2023).

Sambo in Poland

In Poland, the sport of *sambo* is not very popular and unknown to a wider group of people. However, Polish judokas and wrestlers have successfully participated in *sambo* competitions several times. This fact is exemplified by the success of Joanna Majdan (gold medal) and Radosław Laskowski (silver) in the European Championships in Kaliningrad in 1993. In turn, in 2005, the first sambo championships of European Union countries were held in Milovice (Czech Republic), in which the Polish women's national team and men took the second place in the team classification. The coach of the Polish national team was Wiesław Błach (7th dan *judo*), and the manager of the national team was Jarosław Bojarski.

The Polish Sambo Association (*Polski Związek Sambo* / PZ Sambo) has been operating since 2011, the first president of which was Marek Porycki. Since 2014, this function has been held by Oleksandr Gorbatiuk (born 1961, *sambo* trainer from Ukraine). He is a well-known person in the Polish jujutsu community because he has been mixing and operating in Kraków for many years. Gorbatiuk is a trainer of sports *sambo* and a new type of sports and combat *sambo: unifight*. He also holds an honorary 8th dan in *jujutsu*. Its players have been taking part in sports *sambo*, combat and *unifight* competitions since 2007. The leader of Polish *sambo* also deals with manual therapy (chiropractice), which is quite common among teachers of *jujutsu* and various, especially Asian, martial arts.

Sports competitions are organized regularly. There are 14 sports clubs/associations registered in PZ Sambo. Polish representatives also participate in international competitions. The author tried to interview Oleksandr Gorbatiuk, president of PZ Sambo. However, the president did not respond to the invitation. Unfortunately, the new president of this Association, Iwo Czerniawski, who was elected to this function on February 3, 2024, behaved similarly.

Discussion

According to Dawidowicz (2019: 57), *sambo* was created on the basis of *jujutsu* and *judo*. This thesis in terms of genesis is true, taking into account the previously mentioned figures of co-creators and pioneers: Spirydonov (*jujutsu* and wrestling) and Oshchepkov (*judo*). However, it applies only to the technical and tactical sphere. Moreover, sports *sambo* resembles fighting in sports *jujutsu* and is described as a specific form of sports *jujutsu* (*cf*. Kisiel *et al*., 2022: 47-52).

Judo, broadly understood (as "ways of flexibility"), as in the teaching of the *Idokan Yoshin-ryu* school (Swider, 2018), includes various derivative and similar varieties. Such *judo* includes the *Kodokan* and *Idokan* methods (Cynarski, 2021b), *Butokukai* (*Dai Nippon Butokukai*) and Mikonosuke Kawaishi's method, but also *judo-do* (Klinger von Klingerstorff, 1951), some varieties of self-defence (*cf*. van Haesendonck, 1961; Glucker, 1963; Skut, 1967a, b, c; Ambroży, 2001; Cynarski, 2008), but also, for example, *Nihon jujutsu*, where the ideas of master Jigoro Kano were supplemented by classic *jujutsu* techniques (Sato, 1998), which, incidentally, J. Kano himself had previously rejected. When *judoka*s teach *jujutsu* or *goshinjutsu* (the art of self-defence), it is relatively easy to draw parallels in the selection and execution of techniques with Master Kano's "gentle way" (*judo*). Sports *sambo* fits in here as well. But is *sambo* an educational system and a martial art?

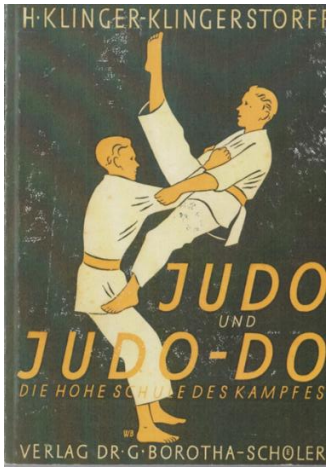

Fig. 1. Hubert Klinger von Klingerstorff (1951), *Judo und Judo-Do* – book cover. *Hängegarten* throw (Cynarski 2021a: 80)

Judo-do is a development of *judo* towards new throws (Fig. 1) and counter-techniques. It also develops the sphere of philosophical, humanistic justifications ("widening of the road") (Klinger von Klingerstorff, 1951: 5-9, 87-92). Meanwhile, *sambo* is developing *judo*, adding interesting counterattacks, throw

variants and new joint levers (*cf*. Gulevich & Zviagincev, 1968, fig. 2; Andreyev & Tschumakov, 1976; Zeziulin, 2005). However, it cuts itself off from the spheres of spirit, ethics and values. Therefore, it is only (*tai*)*jutsu* – a fighting technique (hand-to-hand, without weapons). In terms of fighting tactics, it is similar to *judo* and *jujutsu*, but without a religious or philosophical foundation it becomes just a fighting technique and a combat sport. According to the definition adopted in the GTFA, ***sambo* is not a martial art** in the traditional sense. There are no "spiritual elements" here because there cannot be any; the doctrine of communism rejects everything that is incompatible with Marxist-Leninist materialism.

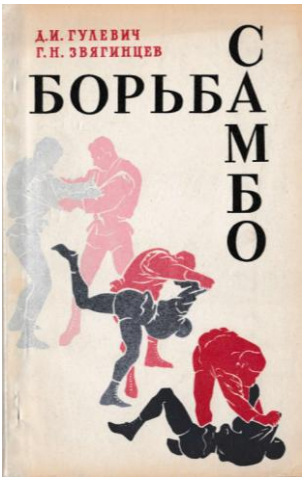

Fig. 2. A.I. Gulevich and G.N. Zviagincev (1968), *Bor'ba Sambo* – book cover: wrestling takedown technique

Spirydonov studied "European" *jujutsu*, taught in Europe at the beginning of the 20th century and popularized in numerous books – manuals, instructions, tutorials. There was a kind of fashion for learning this way of fighting, where the appropriate technique allows you to defeat a physically stronger opponent. It was learning new tricks for their situational use. According to the author, the random knowledge and skills in *jujutsu* need to be supplemented in some way by adding elements of wrestling or other fighting techniques. From a *jujutsu* perspective, some technical or techno-tactical elements are interesting, while others are wrong.

Since historically (according to its origins) the co-creator of *sambo,* Spirydonov, also based his technique on wrestling, and patterns were sought and references were made to the traditional wrestling of nations from the USSR (Caucasus and Central Asia), techniques borrowed directly from wrestling fights are present here. Moreover, *jujutsu* and *judo* are also wrestling fighting systems. In Dulin's study (2008), both Spirydonov and Oshchepkov are shown next to famous wrestlers of the turn of the 19th and 20th centuries. So ***sambo* (sport) is clearly a wrestling sport**, which was also confirmed by the FILA. However, it is

not a sport based on any Russian tradition, but mainly on using Japanese patterns. Although wrestling was probably practised by the Slavs in ancient times, the original technique has not been preserved (Cynarski, 2020).

In this competitive combat sport practised today, there is a pathology that plagues many types of extremely commercialized sport. This is, in particular, prohibited doping (Cynarski, 2017; Mytskan *et al*., 2022). On the other hand, sports *sambo* finds a loyal audience, fans and supporters, also outside Russia (*cf*. Matic *et al*., 2020). Events are organized to promote this sport internationally (Kubala, 2017; Cynarski, 2018; Kubala, Cynarski, & Swider, 2019).

In contrast, combat or military variants of *sambo* are more similar to eclectic self-defence and combat systems. According to GM V. Pilat (2022), Kadochnikov reached for the traditions of Cossack/Ukrainian martial arts when creating his style of *sistema*. However, his style is today promoted as "Kadochnikov System Russian Martial Art". The competitive combat variant of *sambo* is similar to the competition in *unifight* and MMA. In these varieties, it is difficult to determine what is the original invention of *sambo* masters, because there is neither a long tradition nor a single established canon of teaching. Training specialists in uniformed services are constantly looking for better ways of teaching and more effective techniques of fighting or intervening and incapacitating or neutralizing the enemy (*cf*. Secours, Jacques, & Anderson, 2016; Renden, Savelsbergh, & Oudejans, 2017; Maczuga & Cynarski, 2021).

Summary

Sports *sambo* is a wrestling match based mainly on Japanese technical and tactical patterns. It is like a combination of freestyle wrestling and *judo*, and the players fight in shorts and sweatshirts.

In contrast, other forms of *sambo* are a form of self-defence, a system of military hand-to-hand combat, or an eclectic mix of different fighting techniques. It does not meet the criteria for martial art and martial way. It is therefore a form of fighting art, as a combat sport or a training program for MMA, eclectic self-defensc or combat system.

DECLARATION OF CONFLICTING INTERESTS

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LEVEL OF DYNAMIC POSTURAL STABILITY OF STUDENTS AT SPORTS MID-SCHOOL IN NITRA

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Poziom dynamicznej stabilności postawy uczniów Gimnazjum Sportowego w Nitrze

Streszczenie

W pracy odwołujemy się do poziomu dynamicznej stabilności postawy (DPS) u uczniów Gimnazjum Sportowego w Nitrze. Zespół badawczy składał się ze sportowców z gimnazjum sportowego w Nitrze (dziewczęta n = 21, wzrost M = 166,37, SD = 5,36; chłopcy n = 19, wzrost M = 179,05, SD = 7,57). Dynamiczną stabilność postawy mierzono za pomocą testu równowagi Star Excursion Balance Test (SEBT) przeprowadzanego w ośmiu kierunkach. Poziom dynamicznej stabilności postawy (DPS) scharakteryzowano za pomocą statystyk opisowych. Boczność między prawą i lewą stopą stojącą oceniano za pomocą testu t i „d" Cohena. Istotność statystyczną różnic oszacowano na poziomie istotności 5%.

Wyniki nie wykazały różnic w lateralności dynamicznej stabilności postawy (DPS) i złożonej stabilności postawy (CPS) u chłopców i dziewcząt pomiędzy stopą dominującą (DLS) i niedominującą (NLS) pod względem wartości średnich, maksymalnych, a nawet względnych (p = n.s). Największe zakresy ruchu pod względem wartości średnich zaobserwowano u chłopców i dziewcząt w obu stojących nogach w kierunku grzbietowym, tylno-przyśrodkowym, tylnym, tylno-bocznym, bocznym w kierunku przyśrodkowym i przednio-przyśrodkowym.

Artykuł stanowi część zadania badawczego VEGA 1/0460/23 Zdrowie postawy ciała u dzieci i młodzieży oraz możliwości wpływania na nie.

Słowa kluczowe: stabilność postawy, lateralność, chłopcy, dziewczęta, gimnastyczna sala sportowa.

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Abstract

At work, we refer to the level of dynamic postural stability (DPS) in students at the Sports Mid-school in Nitra. The research sample consisted of athletes from the sports mid-school in Nitra (girls n = 21, height M = 166.37, SD = 5.36; boys n = 19, height M = 179.05, SD = 7.57). Their dynamic postural stability was measured using the Star Excursion Balance Test (SEBT) carried out in eight directions. The level of dynamic postural stability (DPS) was characterized by descriptive statistics. The laterality between the right and left standing foot was assessed by a t-test and a Cohen's "d". The statistical significance of the differences was assessed at a 5% significance level.

The results did not show differences in the laterality of dynamic postural stability (DPS) and complex postural stability (CPS) in boys and girls between dominant (DLS) and non-dominant (NLS) standing foot in terms of mean, maximum and even relative values (p = n. s). The largest movement ranges in terms of average values were seen in boys and girls in both standing legs in the dorsal direction in the posteromedial, posterior, posterolateral, lateral in the medial direction and in the anteromedial front direction.

The contribution is part of the research task VEGA 1 / 0460 / 23 Postural health in children and adolescents and the possibility of influencing it.

Keywords: postural stability, laterality, boys, girls, sports mid-school.

Introduction

The students of the Sports Mid-school receive between 4 and 8 training units each in their respective fields of study. The different nature of the load, together with the uneven load due to the specific needs for sports performance in sport, may result in changes in posture and posture which may also have an impact on dynamic postural stability.

The approach chosen can be viewed from two different perspectives: balance and stability. It is important to bear in mind the correct definition of the aforementioned two concepts. Balance is the act of putting something into balance, stability is the ability to maintain balance by resisting external forces and tensions. A balanced and stable attitude, therefore, enables perfect balance to be maintained in various positions in many sports sectors, minimising the fluctuations naturally produced by our bodies and thus making it easier to make all the movements without any changes in the position itself. In addition, it increases the chance of shortening the activation time of the muscle chains involved in the technical gesture and consequently also improves the control of rebound. The ability to maintain equilibrium is crucial to everyday life. It involves complex coordination of the muscles, bones and nervous system so that the body can adapt to various internal and external influences.

Dynamic postural stability focuses on this capability in motion, with different activities and terrain inequalities. Posterior stability is the ability to ensure upright posture and to react to changes in external and internal forces in such a way that there is no unintended or uncontrolled fall (Vařeka, 2002), or even

the ability to maintain the centre of gravity (COG) projection of the support base (Lee & Lin, 2008) and to maintain stability over time (Lee & Lin, 2008). The central nervous system concentrates and selects sensory inputs from the environment to provide the most functionally useful information for maintaining stability. This ability to select important sensory stimuli is essential for the proper functioning of postural stability (Brumagne et al., 2008). Visual, vestibular and somatosensory information is important for maintaining stability. The visual system provides information about the environment, the vestibular head and body positions, and the somatosensory system includes input from proprioreceptors, thermoreceptors and nociceptors (Page et al., 2010).

In all activities, that is to say, in sport, when sportspeople come into contact with the surface, the preservation of structural stability is of crucial importance in order to achieve a successful outcome, and a high level of control is also necessary in order to ensure that movement is accurately carried out. The control unit in the form of the central nervous system concentrates primarily on maintaining equilibrium and subsequently on other activities associated with motor activity. Developing the capacity to control balance thus becomes one of the important objectives of the training process in most sports.

Methods

The research was carried out on a set of athletes from the sports mid-school in Nitra in the age range from 16 to 19 years. The sports specializations of individual probands are athletics, basketball, dance, football, handball, table tennis, floorball, hockey and fitness (girls n = 21, height M = 166.37, SD = 5.36; boys n = 19, height M = 179.05, SD = 7.57). Dynamic postural stability was measured using the eight-point Star Excursion Balance Test (SEBT). The SEBT test was performed in eight directions, i.e. posterior, posterior medial, medial, anterior medial, anterior, anterior lateral, lateral, posterior lateral on a dominant and non-dominant standing leg (Figure 1).

The output measurements of the dominant and non-dominant leg shall be assessed with respect to the maximum measured value (cm), the average of 3 attempts (cm) and the relative value (Relative – normalized distance in each direction (%) = Average distance in each direction / length of the lower limb * 100). Complex postural stability (CPS) for both legs = mean with mean values from 3 attempts of SEBT (Composit Scores) (Garrett et al., 2012; Calatayud et al., 2017).

The level of DPS was characterized by descriptive statistics (M, SD, Max, Min). The statistical significance of the differences between the dominant and the non-dominant leg was assessed by a t-test ($p < 0.05$) and the material significance of the differences was assessed by Cohen's „d" (low effect = 0.20, medium effect = 0.50, high effect = 0.80).

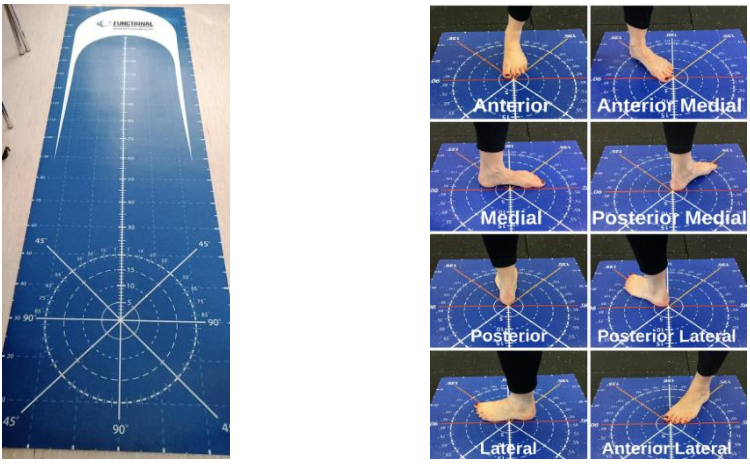


Figure 1
Eight-way Star Excursion Balance Test (SEBT)

Results

By comparing the dynamic postural stability of the students at sports mid-school, the dominant (DSL) and the non-dominant standing leg (NSL), no differentiation in the boys' lateral laterality was observed (Tab. 1 and 3) for average values t (19) = 1.59, p = 0.13, d = 0.22, maximum values t (19) = 1.49, p = 0.15, d = 0.22 and for relative values t (19) = 1.59, p = 0.13, d = 0.24.

No significant differentiation in the dominant leg (DSL) and the non-dominant standing leg (NSL) in laterality was observed in girls (Table 2 and 3) for average values t (19) = 1.71 p = 0.10, d = 0.22, maximum values t (19) = 1.48, p = 0.15, d = 0.10 and relative values t (19) = 1.59, p = 0.13, d = 0.13.

In complex postural stability (CPS), no significant differences were noted in boys between the dominant (DSL) and non-dominant standing leg (NSL) in terms of average values t (19) = 0.80, p = 0.44, maximum values t (19) = 0.51 p = 0.62 and relative values t(19) = 0.77, p = 0.45 nor for girls from the point of view of average values t (19) = 1.33, p = 0.2, maximal values t (19) = 1.04, p = 0.31 and relative values t (19) = 1.37, p = 0.18.

In terms of average values, we recorded the largest range of motion in boys and girls for both standing legs in the dorsal (spinal plane) in the posterior medial direction (M_{dsl} = 95.18, SD = 13.22 <> M_{nsl} = 92.53, SD = 11.04), in the posterior direction (M_{dsl} = 93.07, SD = 12.28 <> M_{nsl} = 92.75, SD = 12.32), in the posterior lateral direction (M_{dsl} = 90.95, SD = 10.79 <> M_{nsl} = 90.74, SD = 12.40) and laterally in the medial direction (M_{dsl} = 93.37, SD = 12.65 <> M_{nsl} = 92.09, SD = 12.02). From the perspective of the frontal plane, the greatest range of motion was in the anterior medial direction (M_{dsl} = 79.44, SD = 8.48 <> M_{nsl} = 78.39, SD = 8.50).

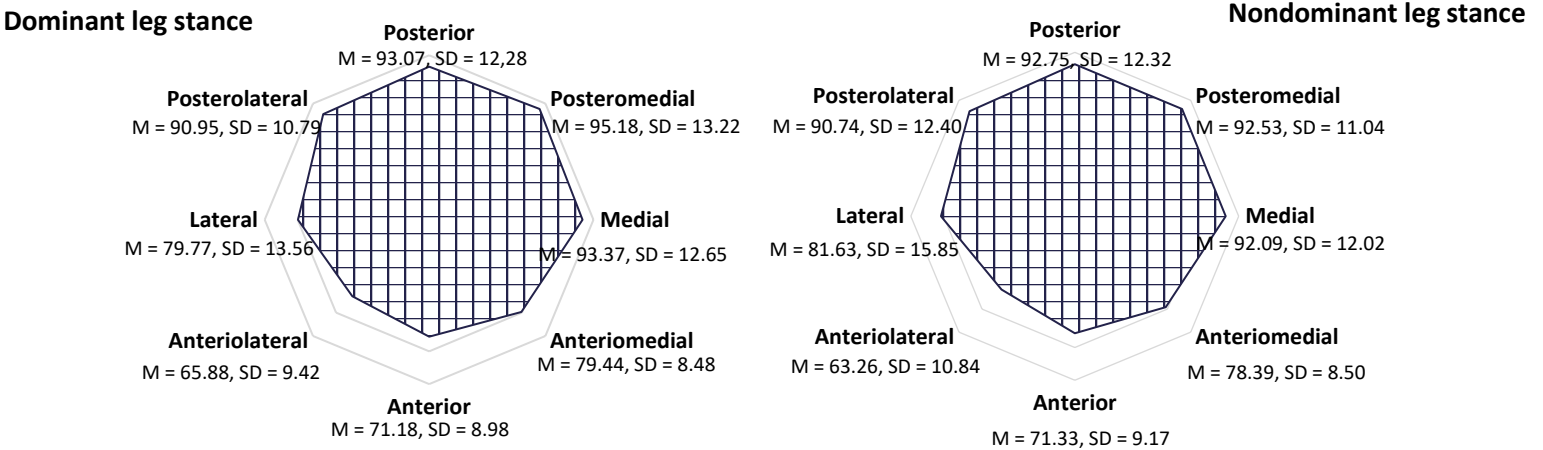


Figure 1

Postural stability of the dominant and non-dominant leg of girls and boys (Mean values)

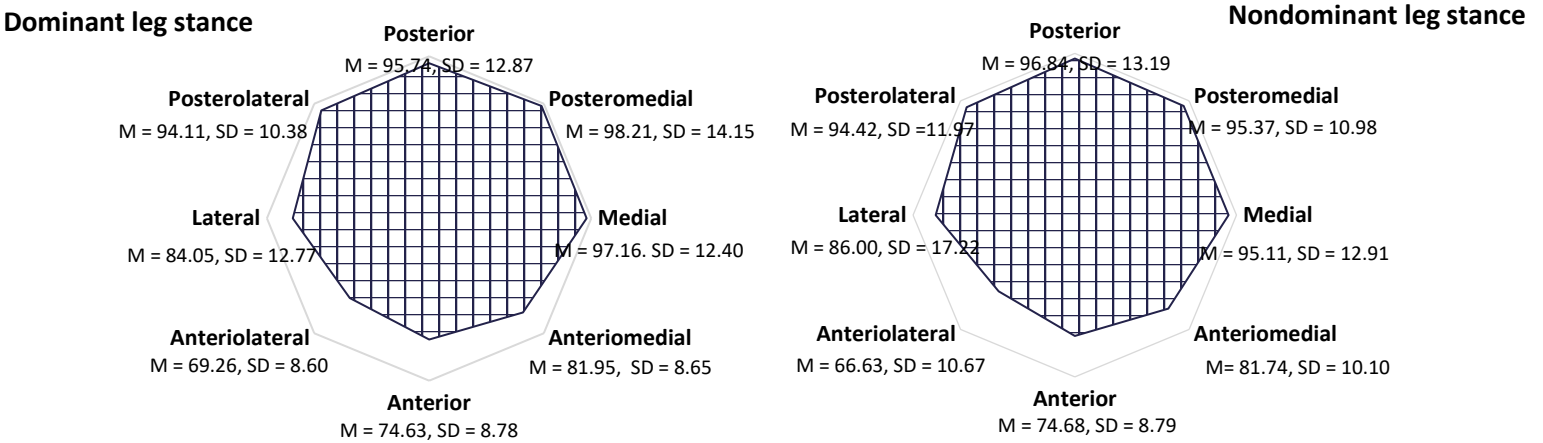


Figure 2
Postural stability of the dominant and non-dominant leg of girls and boys (Maximum values)

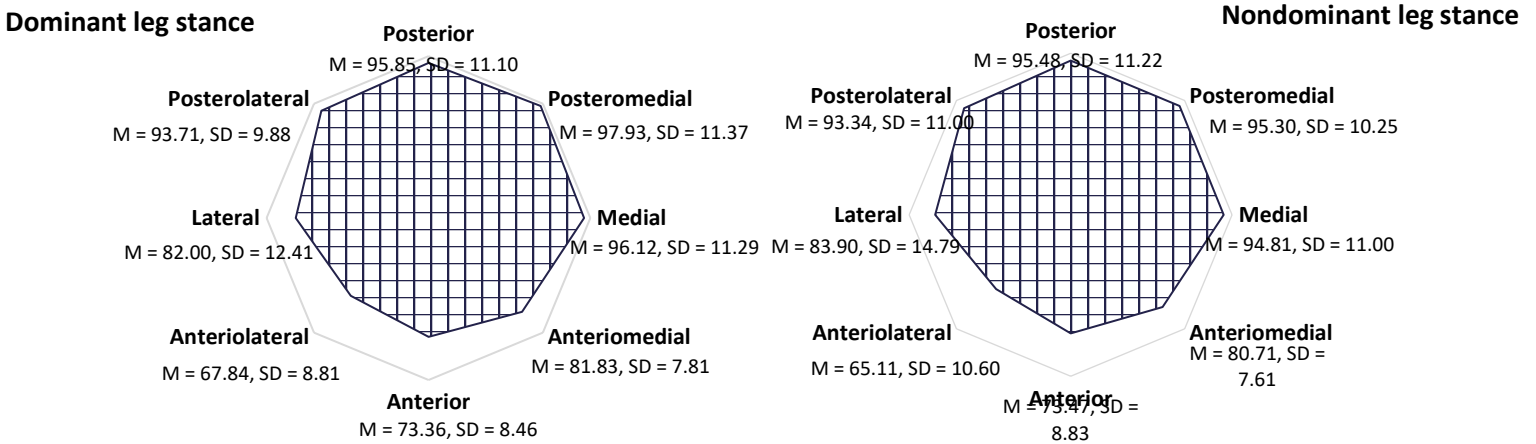


Figure 3
Postural stability of the dominant and non-dominant leg of boys (Relative values)

Table 1

Postural stability of the dominant and non-dominant leg of boys from the point of view of maximum, average and relative values

	Average values				Maximum values				Relative values			
	Dominant		Nondomimant		Dominant		Nondomimant		Dominant		Nondomimant	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Anterior (cm)	93.07	12.28	92.75	12.32	95.74	12.87	96.84	13.19	95.85	11.10	95.48	11.22
AnteroLateral (cm)	95.18	13.22	92.53	11.04	98.21	14.15	95.37	10.98	97.93	11.37	95.30	10.25
Lateral (cm)	93.37	12.65	92.09	12.02	97.16	12.40	95.11	12.91	96.12	11.29	94.81	11.00
PosteroLateral (cm)	79.44	8.84	78.39	8.50	81.95	8.65	81.74	10.10	81.83	7.81	80.71	7.61
Posterior (cm)	71.18	8.98	71.33	9.17	74.63	8.78	74.68	8.79	73.36	8.46	73.47	8.83
PosteroMedial (cm)	65.88	9.42	63.26	10.84	69.26	8.60	66.63	10.67	67.84	8.81	65.11	10.60
Medial (cm)	79.77	13.56	81.63	15.85	84.05	12.77	86.00	17.22	82.00	12.41	83.90	14.79
Anteromedial (cm)	90.95	10.79	90.74	12.40	94.11	10.38	94.42	11.97	93.71	9.88	93.34	11.00

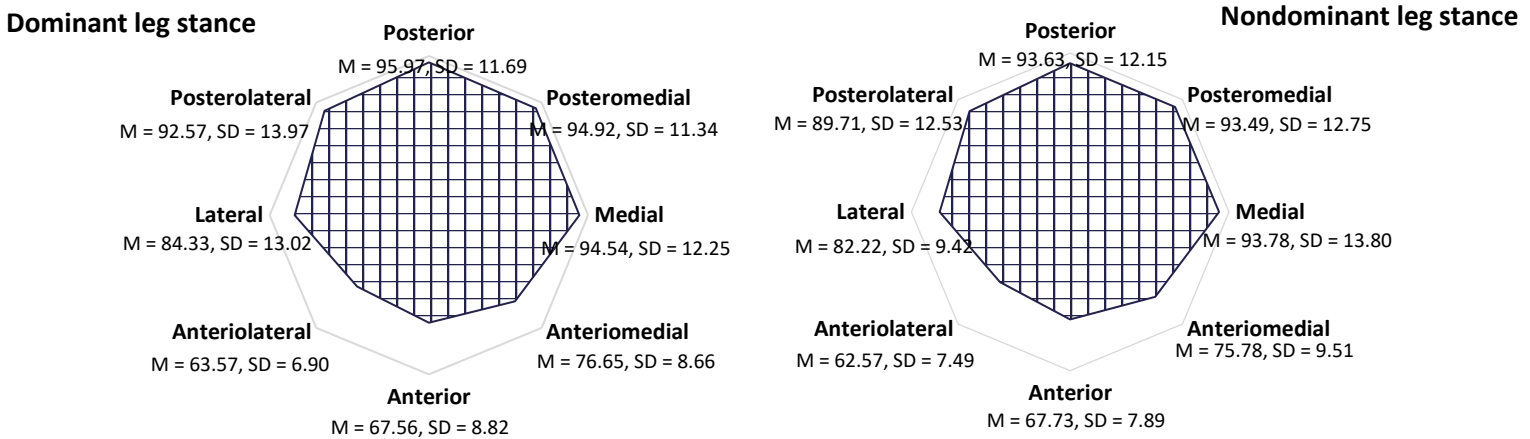


Figure 4
Postural stability of the dominant and non-dominant leg of girls (Average values)

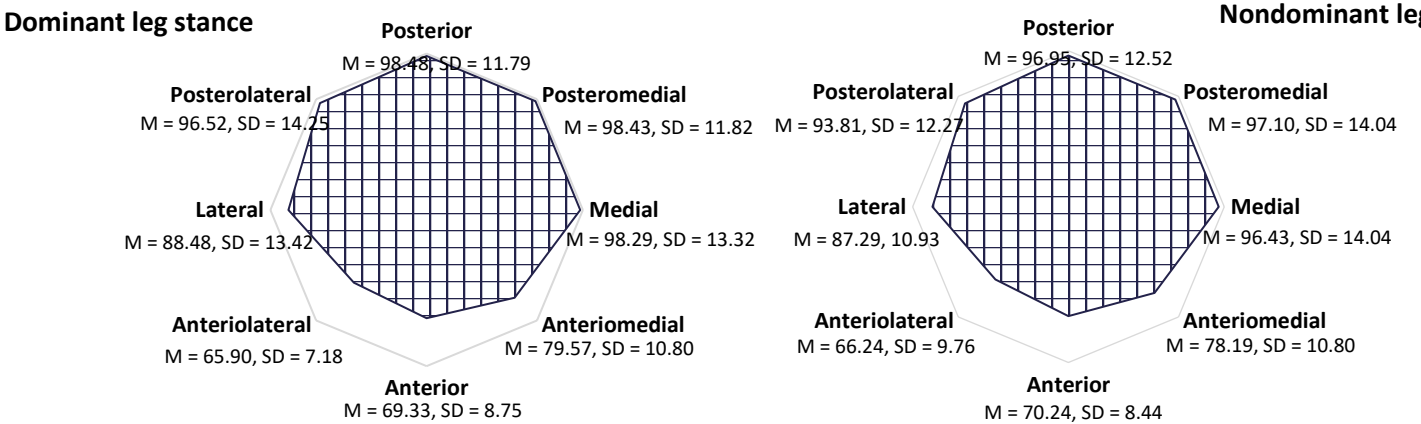
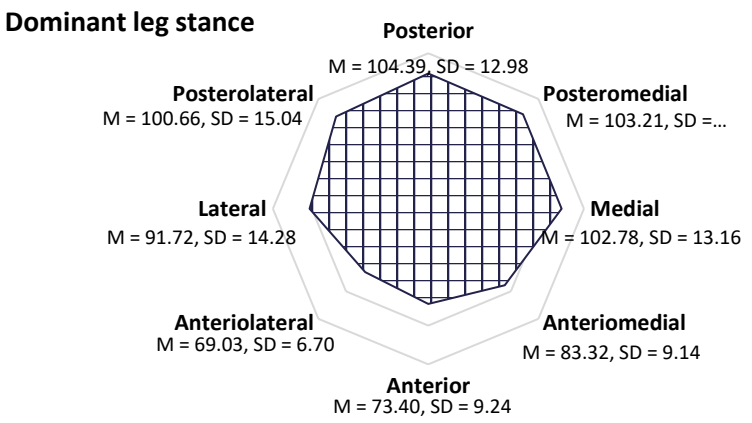


Figure 5
Postural stability of the dominant and non-dominant leg of girls (Maximum values)



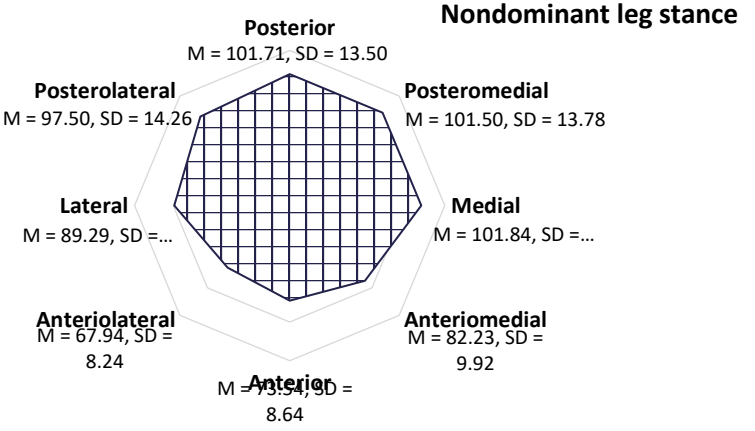


Figure 6
Postural stability of the dominant and non-dominant leg of girls (Relative values)

Table 2

Postural stability of the dominant and non-dominant leg of girls from the point of view of maximum, average and relative values

	Average values				Maximum values				Relative values			
	Dominant		Nondomimant		Dominant		Nondomimant		Dominant		Nondomimant	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Anterior (cm)	95.97	11.69	93.63	12.15	98.48	11.79	96.95	12.52	104.39	12.98	101.71	13.50
AnteroLateral (cm)	94.92	11.34	93.49	12.75	98.43	11.82	97.10	14.04	103.21	12.14	101.50	13.78
Lateral (cm)	94.54	12.25	93.78	13.80	98.29	13.32	96.43	14.04	102.78	13.16	101.84	15.07
PosteroLateral (cm)	76.65	8.66	75.78	9.51	79.57	10.80	78.19	10.80	83.32	9.14	82.23	9.92
Posterior (cm)	67.56	8.82	67.73	7.89	69.33	8.75	70.24	8.44	73.40	9.24	73.54	8.64
PosteroMedial (cm)	63.57	6.90	62.57	7.49	65.90	7.18	66.24	9.76	69.03	6.70	67.94	8.24
Medial (cm)	84.33	13.02	82.22	9.42	88.48	13.42	87.29	10.93	91.72	14.28	89.29	10.32
Anteromedial (cm)	92.57	13.97	89.71	12.53	96.52	14.25	93.81	12.27	100.66	15.04	97.50	14.26

Table 3

Differences in postural stability between the dominant and non-dominant leg of boys and girls

	Average values						Maximum values						Relative values					
	boys			girls			boys			girls			boys			girls		
	t	p	d	t	p	d	t	p	d	t	p	d	t	p	d	t	p	d
Anterior	0.08	0.94	0.02	0.16	0.88	0.02	0.03	0.98	0.01	0.03	0.98	0.11	0.05	0.96	0.01	0.05	0.96	0.02
AnteroLateral	1.31	0.21	0.26	0.95	0.35	0.14	1.24	0.23	0.27	1.24	0.23	0.04	1.29	0.21	0.28	1.29	0.21	0.15
Lateral	0.80	0.43	0.13	0.98	0.34	0.19	0.80	0.43	0.13	0.80	0.43	0.10	0.77	0.45	0.14	0.77	0.45	0.20
PosteroLateral	0.17	0.86	0.02	1.71	0.10	0.22	0.21	0.83	0.03	0.21	0.83	0.20	0.30	0.77	0.04	0.29	0.77	0.22
Posterior	0.23	0.82	0.03	1.45	0.16	0.20	0.80	0.43	0.08	0.80	0.43	0.13	0.27	0.79	0.03	0.27	0.79	0.20
PosteroMedial	1.59	0.13	0.22	0.84	0.41	0.12	1.49	0.15	0.22	1.48	0.15	0.10	1.59	0.13	0.24	1.59	0.13	0.13
Medial	0.61	0.55	0.10	0.55	0.59	0.06	0.93	0.36	0.16	0.93	0.36	0.14	0.62	0.55	0.12	0.62	0.55	0.07
Anteromedial	0.71	0.48	0.12	0.44	0.67	0.10	0.13	0.90	0.02	0.13	0.90	0.13	0.72	0.48	0.15	0.72	0.48	0.11

Labels: t-test, p – value, Cohens “d”

Table 4

Complex PS in boys and girls from the point of view of maximum, average and relative values

		Boys				Girls			
		M	**SD**	**Max**	**Min**	**M**	**SD**	**Max**	**Min**
Dominant	**Average (cm)**	83.603	8.534	97.667	67.542	84.329	8.840	103.542	70.958
	Maximum (cm)	86.888	8.273	99.875	70.250	87.500	9.200	107.125	74.375
	Relatively (cm)	86.078	6.828	98.653	72.279	91.967	9.113	111.335	78.843
Non dominant	**Average (cm)**	82.840	9.424	98.083	68.208	83.090	8.275	100.792	68.792
	Maximum (cm)	86.349	9.747	104.875	72.125	86.632	8.809	105.000	71.750
	Relatively (cm)	85.263	8.192	100.085	74.262	90.495	8.832	108.378	72.412

Table 5

Differences in CPS in boys and girls between their dominant and non-dominant leg

		Diference Boys				Diference Girls			
		d	t	p	d	d	t	p	d
CPS	**Average**	0.76	0.80	0.44	0.084	1.24	1.33	0.20	0.143
	Maximum	0.54	0.51	0.62	0.059	0.87	1.04	0.31	0.095
	Relatively	0.81	0.77	0.45	0.107	1.47	1.37	0.18	0.162

Discussion

In our research, comparing the dynamic postural stability of sports mid-school students with the dominant (DSL) and non-dominant standing leg (NSL), we did not find any differences in the laterality of the boys. Similarly, in girls, no significant differences of dominant (DSL) and non-dominant standing leg (NSL) in laterality were found.

In the level of complex postural stability (CPS), no significant differences were recorded in boys between the dominant (DSL) and non-dominant standing leg (NSL) in terms of average values t (19) = 0.80, p = 0.44, maximum values t (19) = 0.51 p = 0.62 and relative values t (19) = 0.77, p = 0.45 even in girls from the point of view of average values t (19) = 1.33, p = 0.2, maximum values t (19) = 1.04, p = 0.31 and relative values t (19) = 1.37, p = 0.18.

In terms of average values, we recorded the largest range of motion in boys and girls in both standing legs in the dorsal (spinal plane) direction in the posteromedial direction, in the posterior direction, in the posterolateral direction and in the lateral direction in the medial direction. From the perspective of the frontal plane, the greatest range of motion was in the anteromedial direction.

Hrysomallis (2011) executed a complex study, consisting of several researches, dealing with the impact of postural stability in individual areas of sport, where he found that postural stability has a significant impact on the performance of athletes in various disciplines. The results showed, for example, that the proportionality of postural stability to an athlete's performance can best be observed primarily in accuracy in shooting disciplines, for example, when shooting with a rifle or a bow. The research revealed that gymnasts showed the best balance skills, followed by soccer players, swimmers and basketball players. In sports such as shooting, football and golf, athletes have better balance than athletes in alpine skiing, surfing or judo. The author also points out that adding a balance component to the activities led to improved performance in high jump or downhill skiing. The results demonstrate a very close connection and influence of the ability to maintain balance on a range of performance indicators of athletes and support the idea that stability training can be a very useful addition to the regular training of athletes to improve some motor skills.

Postural stability can be disturbed by internal influences such as heartbeat and respiratory muscle activity (Zemková & Hamar, 2005). Molnárová (2023) states that in sport shooting, in the discipline of TRAP, one of the causes may be insufficient cardiorespiratory adaptation due to the need to hold one's breath when shooting. This statement is also confirmed by the research of Konttinen et al. (1998) who demonstrated that heart rate decreased during the launch phase in all probands, with heart rate variation greater in non-elite shooters compared to elite shooters. Applying the lower extremity dynamic balance test (SEBT) ap-

pears to us to be an interesting parameter for detecting changes when introducing an experimental factor.

In the work of the authors Pal et al. (2021) we find the effect of plyometrics and pilates on the dynamic balance of lower limbs and the strength of the center of the body of karate athletes. The authors applied 8-week experimental stimuli in two experimental and one control group. When presenting the final results, they found statistically significant positive changes in the dynamic balance of lower limbs at the 1% level of significance. The results of the authors were also supported by research conducted by Czaková (2022), who applied SEBT as a test battery, with the same (1%) level of statistical significance, after an 8-week speed-strength stimulus in karate athletes.

The study of Bakhsis (2023), Behm et al. (2005) and Chauhan et al. (2023) investigated ice hockey players in the context of the interaction between selected performance parameters and postural stability. Hockey players can develop high speed by skating, and actions during the game are characterized by sudden accelerations, decelerations and changes of direction. The observed positive interactions of agility and DPS in hockey players are also confirmed by the research of Arboix-Alió and Aguilera-Castells (2021), as hockey skating performance is significantly related to balance and sprint tests, which points to the important role of postural stability in players' skating speed.

In the work of Blanár et al. (2020), the authors investigated the dependence of skating and running performance on explosive lower limb strength and dynamic balance in ice hockey players. They used the Y-Balance Test to determine the level of dynamic balance. A significant relationship was measured between the 5-10-5 running test and Y-Balance of the left leg ($p<0.01$) and also Y-Balance of the right leg ($p<0.01$), as well as in the study of Bayraktar (2017).

Dynamic postural stability also greatly affects the health of humans. In the study of Zemkova et al. (2022), the authors examined the differences between the sexes in the strength of torso rotation at different loads in a group of gymnastics and dance sports. The force produced during torso rotation was evaluated using the FiTRO torso Premium apparatus. The results showed significantly higher average performance in the acceleration phase of the torso in men than in women at 10.5 kg (206.8 ± 22.0 W and 165.4 ± 17.8 W, $p = 0.033$), 15.5 kg (231.8 ± 27.5 W and 155.6 ± 24.4 W, $p = 0.001$) and 20 kg (196.9 ± 25.3 W and 111.4 W). Similar significant gender differences were also observed at angular velocity of ≥ 10.5 kg. Alternatively, performance and strength were greater at lower rates in men than in women. However, some women were able to produce slightly more power and strength at higher speeds, despite their lower values at lower speeds than men. This can be attributed both to genetic predispositions and to the specificities of their acrobatic and dance elements, including torso rotation at different speeds under different load conditions.

Studies by Brumagne et al. (2008), which involved 21 probands with low back pain (LBP) and 24 healthy probands with a mean age of 24.6 years, investigated the effect of different surface types (firm and unstable foam) on postural stability. On both types of surfaces, a bipedal stance was first performed with eyes open, with vision included, and the following three situations, all with eyes closed: ballistic bilateral abduction of the shoulder joint, bilateral vibration stimulus on the m. triceps surface, bilateral vibration stimulus on m. multifidus lumborum and bilateral vibration stimulus on m. tibialis anterior. All tests lasted 60 seconds. No statistically significant differences between groups were found in bipedal standing on a firm surface. However, when standing on an unstable foam surface and excluding vision, persons with LBP showed significantly greater deviations of the place of action of the resulting reaction force – center of pressure (COP) than healthy persons. The authors further highlight the fact that young adults suffering from LPB are likely to prefer the same type of postural strategy in different situations, even in those when it is not entirely appropriate (e.g., standing on an unstable surface). People with LBP appear to prefer the ankle strategy, but this is appropriate when standing on a firm, level surface. It is not as effective as other types of postural strategies on an unstable surface.

The above studies by different authors and their research show that dynamic postural stability can affect different sports sectors, age categories and individual health.

Conclusions

The aim of this paper was to evaluate the level of dynamic postural stability of the students of the Sports Mid-school in Nitra using the SEBT test. This test is easy to use in measuring dynamic postural stability, injury assessment, screening and rehabilitation.

Postural stability is one of the basic building blocks of sports performance. Athletes who have a high level of postural stability can better control their body during sports performance and handle the tense situations that sport brings with it.

However, the level of postural stability is not only related to sports performance, but also has a close connection with the health aspect of the athlete. Athletes with properly strengthened and balanced muscle fibers are less prone to back injuries, joint injuries or other problems related to posture (improper body posture).

The unrecorded significant differences in boys and girls between the dominant (DSL) and non-dominant standing leg (NSL) show us the importance of a stable and balanced stance for both legs in all directions of movement, even with the diversity of sports specialization of sports mid-school students. We be-

lieve that a stable and balanced attitude forms the basis for sports performance in young athletes, which will be necessary in their next sports specialization.

STATEMENT OF ETHICS

This study was conducted in accordance with the World Medical Association Declaration of Helsinki. The study protocol was reviewed and approved by the University of Constantine the Philosopher in Nitra, UKF/197/2024/191013:001, Nitra, Slovakia. All participants provided written informed consent to participate in this study.

DECLARATION OF CONFLICTING INTERESTS

The authors declared no potential conflicts of interests with respect to the research, authorship, and/or publication of the article *Level of Dynamic Postural Stability of Students at Sports Mid-school in Nitra.*

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SPORT I TURYSTYKA
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ANALYSIS OF PEAK POWER OUTPUT, LOWER LIMB EXPLOSIVE STRENGTH AND BALANCE PERFORMANCE OF YOUNG FOOTBALL PLAYERS ACCORDING TO THEIR PLAYING POSITION: A PILOT STUDY

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Analiza szczytowej mocy wyjściowej, eksplozywnej siły kończyn dolnych i równowagi młodych piłkarzy w zależności od pozycji gry: badanie pilotażowe

Streszczenie

Promowanie wysokiego poziomu siły, mocy i kontroli postawy w określonych pozycjach gry ma kluczowe znaczenie w całej fazie dojrzewania u młodych piłkarzy. W badaniu tym zbadano moc szczytową, siłę eksplozywną kończyn dolnych i zachowanie równowagi wśród młodych piłkarzy na różnych pozycjach gry. W badaniu wzięło udział czterdziestu trzech młodych piłkarzy (wiek: 15,81 ±1,33 lat), podzielonych na cztery pozycje: 5 bramkarzy, 12 obrońców, 20 pomocników i 6 napastników. Zaobserwowano istotne różnice w szczytowej mocy wyjściowej pomiędzy grającymi na pozycjach ($p = 0,003$, $\eta^2 = 0,226$), z przewagą napastników nad pomocnikami ($p = 0,011$). Jednakże nie stwierdzono żadnych znaczących rozbieżności w charakterystyce skoku pionowego. Stwierdzono różnice w charakterystyce równowagi statycznej średniej prędkości środkowo-bocznej (AAPS) dla nogi niedominującej i dominującej ($p = 0,025$, $\eta^2 = 0,211$; $p = 0,033$, $\eta^2 = 0,198$),

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przy niższej prędkości kołysania u bramkarzy (p = 0,022) w porównaniu z napastnikami (p = 0,040). Jednakże badanie nie wykazało znaczących różnic w innych charakterystykach działania wagi statycznej ani równowagi dynamicznej. Podsumowując, badanie podkreśla znaczące różnice w szczytowej mocy wyjściowej w zależności od pozycji gracza, ale nie w przypadku siły eksplozywnej kończyn dolnych i zachowania równowagi pomiędzy grupami.

Słowa kluczowe: moc szczytowa, skok pionowy, równowaga statyczna i dynamiczna, piłka nożna.

Abstract

Promoting a high level of strength, power, and postural control in specific playing positions is crucial throughout the puberty phase in young football players. This study explored peak power, lower limb explosive strength, and balance performance among youth football players across their playing positions. Forty-three young male football players (age: 15.81±1.33 years) participated, categorized into four positions: 5 goalkeepers, 12 defenders, 20 midfielders, and 6 forwards. Significant differences were observed in peak power output among playing positions (p=0.003, η^2=0.226), with forwards superior over midfielders (p=0.011). However, no meaningful disparities were found in vertical jump characteristics. Variations in center of body pressure sway speed medial-lateral direction were identified for nondominant and dominant leg (p=0.025, η^2=0.211; p=0.033, η^2=0.198), with the lower sway speed in goalkeepers (p=0.022) in comparison with forwards (p=0.040). However, the study found no significant differences in the other characteristics of static balance performance, nor in the dynamic balance. In conclusion, the study emphasizes significant variations in peak power output across player positions but not for lower limb explosive strength and balance performance among groups.

Keywords: peak power, vertical jump, static and dynamic balance, football.

Introduction

Strength, power, and endurance play a significant role in performing sprinting, passing, shooting, jumping, and changing direction throughout a football game (Helgerud et al., 2011; Malina et al., 2024; Martinho et al., 2024). Power and strength development are important for improving the physical performance of young footballers (Barbalho et al., 2018; França et al., 2024). Moreover, enhancing youth football players' physical and physiological performance is emphasized according to their playing position (Joo & Seo, 2016; Toselli et al., 2022).

The evaluation of anaerobic performance has been extensively used to assess short-term power action (Cossio-Bolaños et al., 2021; Gross & Lüthy, 2020; Haugen et al., 2013; Ostojić et al., 2010). It contributed to repeated sprinting, jumping, shooting, and dueling against the opponent, known as short-burst activity. Development of power for a short period of time is a fundamental aspect of the young's physical capacity that increases during growth and maturation (Baker & Davies, 2002). The vertical jump is a test frequently employed for estimating the strength and power of the inferior limb (Rodríguez-Rosell et al., 2017; Chamari et al., 2004) and impulsive ability. It has also been used to evaluate

physical performance in young football players (Petridis et al., 2019; Rodríguez-Rosell et al., 2017). The cycling ergometer test evaluated peak power output by the six-second peak power test (Herbert et al., 2015; Wehbe et al., 2015), and the Wingate test investigated the short-term strength endurance of young players' leg muscles (Nikolaidis & Knechtle, 2021; Nikolaidis et al., 2016).

Balance performance is the capacity to maintain a support base with restricted movement while doing tasks in a steady postural stance (Bressel et al., 2007). In football, balance plays a crucial role in enhancing the technical skills of players (Evangelos et al., 2012; Teixeira et al., 2011) and injury prevention, particularly in adolescent football players (Bressel et al., 2007; Malliou et al., 2004; Teixeira et al., 2011). Paillard et al. (2019), Pau and Attene (2014) confirmed that football players' balance ability is strongly linked to maturation and the level of playing experience.

A great number of research articles on football players' playing positions (AlTaweel et al., 2022a; Bortnik et al., 2024; Harry et al., 2018; Jadczak et al., 2019; Mahmoudi et al., 2023) have been examined to analyze physiological performance and motor skills in football players. However, peak power production, lower body explosive strength, and static and dynamic balance performance characteristics have not been investigated on a wide scale in adolescent unmatured footballers playing in different positions. Therefore, the objective of this study was to examine the differences in anaerobic power production, explosive strength of the lower body, and static and dynamic balance based on player position. We hypothesized that young players would have smaller peak power production, explosive strength, and balance variations based on their playing position than adult footballers.

Methods and Materials

Subjects

Forty-three young male football players (age = 15.81±1.33 years) from various football clubs, who attended regular training sessions and competitions at the weekends, were selected for this study. The players had less than eight years of experience in football training. The maturation of the adolescent players was estimated using the Tanner method (Beunen et al., 1992) by the physician, only participants classified as Tanner stage 3 – 4 were included in the investigation. The players were classified into four groups according to playing positions: Goalkeepers (GK) (N=5, body height 185.42±2.20, body mass=76.20±9.85), Defenders (D) (N=12, body height 182.48±2.20, body mass=73.70±4.73), Midfielders (MD) (N=20, body height 174.89±5.03, body mass=63.77±6.92), Forwards (F)

(N=6, body height 184.00±3.69, body mass=75.28±12.25). None of the participants has experienced injury in the previous six months. Parents and participants were briefed on the study's protocols, risks, and advantages. The parents submitted the informed consent form to allow their sons to participate in the study. The research that pertains to human use has followed all pertinent national regulations and institutional policies, adhered to the principles of the Declaration of Helsinki, and was approved by the Ethics Committee of the Latvian Academy of Sport Education (Meeting Protocol No. 6, decision No. 1/51813 of February 24, 2023).

Data Collection

Before the tests, the participants engaged in warm-up sets for approximately 30 minutes, involving jogging and dynamic stretching. Anthropometric assessments of young football players wearing briefs were performed using SECA 220 for height measurement with an accuracy of up to 1 mm and SECA 874 for weight measurement with an accuracy of up to 0.05 kg (SECA, Hamburg, Germany). Body mass index (BMI) was calculated as weight in kilograms (kg) divided by the square of height in meters (m^2).

All devices and platforms used in this research have demonstrated validity and reliability in measuring peak power output on bicycle ergometer (Herbert et al., 2015; Wehbe et al., 2015), short-term strength endurance on bicycle ergometer (Nikolaidis & Knechtle, 2021; Nikolaidis et al., 2016), vertical jump for muscle strength and power investigation (Bellicha et al., 2022; Attia et al., 2017) and static and dynamic balance (Srishti et al., 2023). With a flying start, the six-second peak power test was performed using a cycling ergometer (Wattbike Pro, Nottingham, UK). The Wattbike was 'zeroed' before the testing to ensure reliability by the manufacturer's recommendations. Initially, the players selected saddle height and handlebar position based on their preferences. The Wattbike test guide recommended body mass-based resistance levels. The WattBike Pro cycle ergometer's performance computer calculated power via a load cell located next to the chain. As force is exerted through the cranks, the load cell calculates power by the sum of all forces applied during one complete pedal revolution. After completing the test, the power output in Watts (W) shown on the WattBike monitor is calculated using the following equation: P(W)=(F[N]*1[m])/T[s], where F -the forces applied in N multiplied by the distance covered in meters (m) and divided by the time T in seconds (s). Peak power (W), mean power (W), relative peak power (W/kg), and distance completed (m) throughout the six-second WattBike test were recorded. Before starting the test, the participants could pedal for 20 to 30 seconds without any load. Subsequently, an investigator raised the resistance to the chosen level, then the sub-

jects pedaled as strong as possible during six-seconds. The participants were encouraged verbally to exert maximal effort. Throughout testing, the investigator stabilized the Wattbike to prevent ergometer shifting (Herbert et al., 2015; Hopker et al., 2010).

The vertical jump was widely used in health care and athletes to measure lower limb muscle strength and power (Vanegas et al., 2021). The subjects' arms were allowed to move freely during the vertical jump assessment (Petrigna et al., 2019). The players start a countermovement and jump maximally in one motion after a verbal command. The best jump test result (the highest jump) was used for analysis after three jump trials, one minute of passive recovery was given between each trial of jumps. An **Optojump (Microgate, Srl., Bolzano, Italy)** measured jump height and time flight, and a force plate **BTSP-6000 (BTS Bioengineering, Garbagnate Milanese, Italy)** measured the peak force.

The subjects stood on the balance platform **ProKin 252 stabilometry platform (TecnoBody, Dalmine, Italy),** accurately measuring pressure sway in all directions. The participants were instructed to keep balance in a one-leg stance, concentrate on a screen for thirty seconds, set hands on their hips and the opposite leg at a 45-degree knee flexion. A smaller perimeter length of the center of pressure movements' area indicated better static balance (Donath et al., 2012). The body center of pressure which sways an ellipse area (mm^2) is a well-defined elliptical form encompassing at least 90% or 95% of the chaotic sway lines. Smaller ellipse areas indicated better balance (Asseman et al., 2004). The ProKin 252 stabilometric platform also assessed the dynamic balance ability as a total stability index and the trunk deviation angle in degrees**.** The total stability index was categorized as normative for trained subjects with a value of 0 – 0.83, normal for nonathletes between 0.84 and 2.32, and poor postural control if it exceeded 2.33. A greater score of the total stability index and the trunk deviation angle meant a worse sense of trunk position (Toprak Celenay et al., 2019).

Statistical Analysis

The statistical analyses were performed using SPSS version 26.0 for Windows, developed by SPSS Inc. in Chicago, IL, USA. Shapiro-Wilk's and Levene's test of equality of error variances ($p > 0.05$) verified that the data was normal and homogent. The variable did not follow a normal distribution; the Kruskal-Wallis H test was performed to compare peak power output, explosive strength of the lower limb, and balance characteristics based on the subjects' playing position. Multiple comparisons used Post hoc Dunn's tests when groups were significantly different. Eta-squared (η^2) was used to calculate the effect sizes: 0.01 small, 0.06 medium, and 0.14 large (Richardson, 2011).

Results

Table 1 shows that the goalkeepers were the tallest among all outfield positions compared to the other groups (185.42 ± 2.20 cm, p=0.00). Furthermore, the forwards demonstrated greater body mass (76.20 ± 9.85 kg) compared to the defenders (63.77 ± 6.92 kg), the midfielders (63.77 ± 6.92 kg), and the strikers (75.28 ± 12.25 kg), p = 0.000. Nevertheless, there were no disparities in BMI and age among all outfield positions, as indicated by p-values of 0.263 and 0.203, respectively.

Table 1
Anthropometric characteristics of the football players based on their playing positions

Parameters	Players	Mean	Std. Deviation	95% confidence interval for mean		p-value	eta-square (η^2)
				Lower Bound	Upper Bound		
Height (cm)	GK	185.42	2.20	182.69	188.15	0.000*	0.523
	D	182.48	4.12	179.86	185.09		
	MD	174.89	5.03	172.53	177.24		
	F	184.00	3.69	180.13	187.87		
Weight (kg)	GK	76.20	9.85	63.97	88.43	0.000*	0.373
	D	73.70	4.73	70.70	76.70		
	MD	63.77	6.92	60.54	67.01		
	F	75.28	12.25	63.43	89.14		
BMI (kg/m^2)	GK	22.17	2.89	18.59	25.75	0.263	0.096
	D	22.14	1.19	21.39	22.89		
	MD	20.85	2.15	19.85	21.86		
	F	22.54	3.64	18.72	26.35		
Age (years)	GK	16.40	1.14	14.98	17.82	0.203	0.110
	D	16.33	1.61	15.31	17.36		
	MD	15.45	1.19	14.89	16.01		
	F	15.50	1.05	14.40	16.60		

Abbreviation: BMI = Body Mass Index, GK (Goal Keeper), D (Defender), MD (Midfielder), F (Forward).
Notes: * Significant difference among the players' positions (p= < 0.05)

Table 2 exhibits a significant comparison of anaerobic peak power production based on the subjects' playing positions (p=0.018, η^2=0.226). However, cadence peak and time to peak did not differ significantly among the groups. The post hoc Dunn test demonstrated considerable disparities in peak power characteristics between the forwards and the midfielders (p=0.011). However, no distinctions were observed among the other groups regarding peak power output. Moreover, Table 2

indicates no statistically significant differences in jump height, flight time, and peak force in vertical jump performance among the players in different positions.

Table 2
The six-second peak power output and explosive strength of lower limbs determined by a counter-movement jump in young football players

6s cycling sprint	**Position**	**Mean**	**Std. Deviation**	**95% confidence interval for mean**		**p- value**	**Eta- square (η²)**
				Lower Bound	Upper Bound		
PPO (W)	GK	855	46.24	797.57	912.42	0.003*	0.226
	D	816.75	109.65	747.08	886.41		
	MD	690.54	198.97	597.42	783.66		
	F	885.83	77.18	804.82	966.83		
CP(Rpm)	GK	151.6	14.94	133.04	170.15	0.904	0.009
	D	150.91	10.16	144.45	157.37		
	MD	152.55	14.54	145.74	159.35		
	F	154.83	14.51	139.6	170.06		
TP(s)	GK	1.59	0.99	0.35	2.83	0.782	0.053
	D	1.34	0.65	0.93	1.76		
	MD	1.33	0.6	1.05	1.61		
	F	1.78	1	0.72	2.84		
Vertical jump	Position	Mean	Std. Deviation	95% confidence interval for mean		P value	Eta- square(η²)
				Lower Bound	Upper Bound		
JH (cm)	GK	42.84	2.56	39.66	46.02	0.316	0.055
	D	40.27	5.19	36.97	43.56		
	MD	39.37	5.98	36.57	42.17		
	F	38.63	2.81	35.68	41.58		
TF (s)	GK	0.59	0.02	0.57	0.61	0.272	0.070
	D	0.57	0.04	0.55	0.6		
	MD	0.57	0.04	0.55	0.59		
	F	0.56	0.02	0.53	0.58		
PF (N)	GK	1850.14	222.01	1574.48	2125.8	0.111	0.175
	D	1824.36	270.82	1652.29	1996.43		
	MD	1571.48	270.38	1444.93	1698.02		
	F	1819.3	439.45	1358.12	2280.48		

Abbreviation: PPO (Peak power output), CP (cadence peak), TP (Time to peak), W (watt), Rpm (Revolution per minutes, JH (Jump height), TF (Time flight), PF (Peak force), cm (centimeters), s (Seconds), N (Newton). Notes: * Significant difference among the players' positions (p= < 0.05)

Table 3 shows that a minor difference was observed in the average medial-lateral speed parameter (AMLS) between the nondominant leg (p=0.025, η^2=0.211) and the dominant leg (p=0.033, η^2=0.198) based on the players' positions. In addition, Dunn's posthoc test identified disparities between the goalkeepers and the forwards in their non-dominant leg (p=0.022) and dominant average medial-lateral speed (p=0.040). However, characteristics of static balance: a center of body pressure deviations ellipse area (EA), perimeter (P), and average Anterior – Posterior speed (AAPS) exhibited no significant differences among the players across playing positions. No statistical significance was identified in assessing the dynamic balance of the young football players in unipedal stances based on their positions.

Table 3
Static and dynamic balance characteristics in unipedal stance among the groups of football players

Static Balance	Position	Mean	Std. Deviation	95% confidence interval for mean		P value	Eta-square (η^2)
				Lower Bound	Upper Bound		
EA (mm^2) ND	GK	860.4	214.96	593.49	1127.3	0.324	0.109
	D	743.22	320.5	539.58	946.85		
	MD	847.02	401.06	659.32	1034.72		
	F	1172.82	593.81	549.65	1795.99		
EA (mm^2) D	GK	985.62	331.99	573.4	1397.84	0.456	0.042
	D	823.11	221.02	682.68	963.53		
	MD	896.3	432.26	694	1098.6		
	F	1034.64	254.33	767.73	1301.54		
P (mm) ND	GK	1215.62	190.36	979.26	1451.99	0.171	0.171
	D	1476.71	369.31	1242.06	1711.35		
	MD	1596.23	520.65	1352.56	1839.91		
	F	2036.29	793.06	1204.02	2868.56		
P (mm) D	GK	1369.26	235.62	1076.7	1661.82	0.423	0.089
	D	1639.68	509.22	1316.14	1963.22		
	MD	1584.23	454.16	1371.68	1796.78		
	F	1923.35	666.94	1223.44	2623.26		
AAPS (mm/s) ND	GK	24.18	3.24	20.16	28.2	0.406	0.09
	D	29.33	8.06	24.21	34.45		
	MD	31.89	11.9	26.33	37.46		
	F	36.87	17.25	18.76	54.98		
AAPS (mm/s) D	GK	26.24	5.34	19.61	32.87	0.307	0.102
	D	32.34	9.25	26.46	38.22		
	MD	29.46	9.46	25.03	33.88		
	F	37.32	13.7	22.94	51.69		

Table 3
Static and dynamic balance characteristics (*cont.*)

Static Balance	**Position**	**Mean**	**Std. Deviation**	**95% confidence interval for mean**		**P value**	**Eta-square (η^2)**
				Lower Bound	Upper Bound		
AMLS (mm/s) ND	GK	27.29	5.34	20.66	33.92	0.025*	0.211
	D	32.94	9.05	27.19	38.69		
	MD	35.43	10.65	30.44	40.41		
	F	47.21	17.02	29.34	65.08		
AMLS (mm/s) D	GK	31.37	5.94	23.99	38.75	0.033*	0.198
	D	36.77	13.11	28.44	45.1		
	MD	36.77	9.97	32.11	41.44		
	F	52.29	20.5	30.78	73.81		
Dynamic Balance	Position	Mean	Std. Deviation	95% confidence interval for mean		p value	Eta-square (η^2)
				Lower Bound	Upper Bound		
TSI (^{0}) ND	GK	2.57	0.87	1.5	3.65	0.571	0.047
	D	2.18	0.73	1.72	2.64		
	MD	2.33	0.83	1.94	2.72		
	F	2.67	0.66	1.98	3.36		
TSI (^{0}) D	GK	2.7	1.25	1.14	4.25	0.619	0.027
	D	2.37	1.01	1.73	3.01		
	MD	2.23	0.91	1.81	2.66		
	F	2.4	0.43	1.95	2.85		
TTD (^{0}) ND	GK	2.01	0.8	1.02	3.01	0.168	0.12
	D	3.43	2.61	1.77	5.09		
	MD	2.31	1.35	1.68	2.94		
	F	3.86	2.47	1.27	6.45		
TTD(^{0}) D	GK	3.29	2.53	0.15	6.43	0.483	0.06
	D	3.03	2.43	1.49	4.57		
	MD	2.28	1.85	1.41	3.14		
	F	3.62	2.04	1.48	5.76		

Abbreviation: EA (Ellipse area), P (Perimeter), AAPS (Average Anterior – Posterior speed), AMLS (Average Medial – Lateral speed), TSI (Total Stability Index), TTD (Trunk Total Deviation), (0) (Degree). ND (Nondominant leg), D (Dominant leg)
Notes: *. Significant difference among the players' positions (p= < 0.05)

Discussion

The study purposed to compare peak power output, explosive strength of the lower limb, and balance performance across football player positions. Prior research has emphasized variations in anthropometric characteristics among football players depending on their specific positions (Slimani & Nikolaidis, 2019; Towlson et al., 2017). Our data research indicated that the goalkeepers had the highest average height and body mass in comparison to other groups' positions (AlTaweel et al., 2022; Bujnovsky et al., 2019; Leão et al., 2019). Nevertheless, the adolescent football players presented significant differences in body composition and physique compared to adult players. Effect size revealed that age and body mass index had a small effect on alactic anaerobic profile for all groups, confirming no significant differences among football players in all positions (Nikolaidis et al., 2014; Nikolaidis et al., 2021).

The peak power output was based on the maximum force value and its rate of production, which were influenced by the growth and maturation of adolescent athletes (Armstrong et al., 2001; Bar-Or & Rowland, 2004; Nobari et al., 2023). Our findings revealed that the forwards exhibited the highest, but the midfielders had the lowest peak power production (AlTaweel et al., 2022). The forwards and the midfielders demonstrated a difference in large effect size. Former studies have argued about the highest peak power between defenders and goalkeepers (AlTaweel et al., 2022; Joo & Seo, 2016; Nikolaïdis, 2014), but the midfielders had the lowest peak power output.

Vertical jump tests were commonly used to assess athletes' lower body explosive strength by measuring jump height and mechanical power (Hübner et al., 2013). The study reported no statistically significant differences in jump height, flight time, or peak force among different players' positions. These results consistently agreed with previous studies on elite Slovak football players (Pivovarnicek et al., 2015), national collegiate athletic association (NCAA) (Harry et al., 2018), and young football players in five groups (Silva et al., 2022). Our findings indicated a trend in which jump height is a result of force production during vertical jump. In line with this, Miller et al. (2022) found that peak reaction force development is a significant predictor of vertical jump height.

The medial-lateral sway speeds of the nondominant and dominant legs are significantly different across the playing positions, but there was no difference for another variable of static balance. This finding is consistent with earlier research that reported the assessment of static balance based on the body center of pressure (COP) displacement (Teixeira et al., 2013), 95% COP elliptical area, standard deviation (King & Wang, 2017), total path length area, and deviation speed in anterior-posterior/mediolateral directions (Huurnink et al., 2014). Regarding dynamic balance, no significant differences were identified among the

players' positions in TSI and TTD parameters. Previous studies have also found no differences in dynamic balance performance with different platforms of balance tests and sports disciplines (Sinulingga et al., 2024; Ateş, 2019; Cuğ et al., 2016). Balance performance is influenced by environmental and experimental conditions, as well as intrinsic factors. Additionally, balance is organized by individual factors like body somatotype, muscle strength, awareness of body position, and brain hemisphere dominance (Paillard & Noé, 2020).

The study's limitations should be acknowledged. The participation number was limited and the distribution of players across different playing positions was unequal. Full defenders (right and left) and wide midfielders (right and left) should be included to provide a more comprehensive analysis. Nevertheless, the data collected from the individuals provided a valuable insight into the future endeavors of young footballers.

The hypothesis that young players' peak power production, explosive strength of the lower limbs, and balance variations according to their playing position would be smaller in comparison with adult footballers is confirmed. This is possible to explain by a large amount of conditioning exercises in young athletes training sessions which are the same for players of different positions, and with smaller training experience in particular positions.

Conclusion

The study manifested significantly higher peak power output of the six-second peak power test on bicycle ergometer in the forwards than in the midfielders. Static and dynamic balance characteristics did not exhibit differences (with one exception: average medial-lateral speed was significantly lower in the goalkeepers in comparison with the forwards), as well as a countermovement vertical jump based on the group's playing position.

Directions for future research

Considering the age groups, puberty's effects are critical factors characterized by substantial physical and physiological changes, growth spurts, and hormonal fluctuations, needing investigation in future studies. The findings could be useful for coaches and trainers in identifying adolescent football players' strengths and weaknesses, enabling the development of specific training programs for individuals and groups.

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STATEMENT OF ETHICS

The research that pertains to human use has followed all pertinent national regulations and institutional policies, adhered to the principles of the Declaration of Helsinki, and has been approved by the Ethics Committee of the Latvian Academy of Sport Education (Meeting Protocol No. 6, Decision No. 1/51813 of February 24, 2023).

DECLARATION OF CONFLICTING INTERESTS

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Część III

Uwarunkowania zdrowia, postawy prozdrowotne, jakość życia

SPORT I TURYSTYKA
Środkowoeuropejskie Czasopismo Naukowe

UNIWERSYTET JANA DŁUGOSZA
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PHYSICAL ACTIVITY AND SLEEP PATTERNS DURING THE COVID-19 PANDEMIC: INSIGHTS FROM A CLUSTER ANALYSIS

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Aktywność fizyczna a wzorce snu podczas pandemii COVID-19: wnioski z analizy klastrowej

Streszczenie

Celem badania była analiza związku między poziomem aktywności fizycznej a jakością snu wśród studentów podczas pandemii COVID-19, z identyfikacją wzorców za pomocą analizy skupień. W badaniu uczestniczyło 1600 studentów Uniwersytetu Medycznego we Wrocławiu, a dane zbierano w dwóch etapach: Etap I (n = 845) po sześciu miesiącach oraz Etap II (n = 755) po roku pandemii. Poziomy aktywności fizycznej, mierzone skróconą wersją Międzynarodowego Kwestionariusza Aktywności Fizycznej (IPAQ-S), sklasyfikowano jako niskie, umiarkowane lub wysokie w minutach MET na tydzień, a jakość snu oceniono za pomocą Pittsburgh Sleep Quality Index (PSQI), klasyfikując uczestników jako „dobrych" lub „złych" śpiących. Wyniki MET dla chodzenia wzrosły z 2020 na 2021 rok, przy czym u kobiet odnotowano wzrost całkowitego MET, a u mężczyzn stabilizację wyników. Hierarchiczne grupowanie aglomeracyjne (HAC) na danych z 2021 roku wyłoniło cztery skupienia. Skupienie 1 i 2, o wysokiej aktywności chodzenia i intensywnej lub umiarkowanej aktywności dodatkowej, miały krótszy czas snu, co sugeruje, że wyższa aktywność

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wspiera lepszą jakość snu. Skupienie o niskiej aktywności, charakteryzowało się dłuższym snem, a z kolei ostatnie skupienie, z nieregularną aktywnością, miało najdłuższy czas snu, co może wskazywać na wyższe zapotrzebowanie na sen przy nieregularnym ruchu. Podsumowując, regularna i zróżnicowana aktywność fizyczna może wspierać optymalne wzorce snu wśród studentów.

Słowa kluczowe: zdrowie studentów; intensywność ćwiczeń; długość snu; analiza klastrów; wpływ edukacji zdalnej.

Abstract

This study examined the relationship between physical activity levels and sleep quality among students during the COVID-19 pandemic, identifying patterns through clustering analysis. A longitudinal cohort of 1,600 students from Wroclaw Medical University, Poland participated from October 2020 to March 2021, with data collected in two stages: Stage I (n = 845) after six months and Stage II (n = 755) after one year. Physical activity levels, measured by the International Physical Activity Questionnaire-Short Form (IPAQ-S), were categorized as low, moderate, or high in metabolic equivalent of task (MET) minutes per week, while sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), classifying participants as "good" or "poor" sleepers. Clustering analysis applied hierarchical agglomerative clustering (HAC) on 2021 data. Walking MET scores increased for both genders from 2020 to 2021, with significant gender differences. Females showed increased total MET, while male scores remained stable. Four clusters emerged: Clusters 1 and 2, with high walking plus vigorous or moderate activity, had shorter sleep durations, suggesting higher activity supports better sleep. Cluster 3, with low vigorous and moderate activity, had longer sleep duration, while Cluster 4, with irregular activity, showed the longest sleep duration, indicating inconsistent activity may increase sleep needs. Overall, consistent and varied physical activity may support optimal sleep patterns among students.

Keywords: student health; exercise intensity; sleep duration; cluster analysis; remote education impact.

Introduction

Nowadays, physical activity is an important component of a healthy lifestyle (Park, 2014; Lathia et al., 2017; Kilpatrick et al., 2005; World Health Organization [WHO], 2020). It is carried out at every stage of human life and, what is important, it can be practised in the place of residence or outside it. In the literature on the subject, it is repeatedly emphasized in scientific studies that physical activity affects the quality of sleep (Kilpatrick et al., 2005; WHO, 2020). Nowadays, care for health is an element of lifestyle, especially for young people. Alejziak (2011) indicated that the development of awareness in this regard at all levels of school education is an important aspect. It is the state of health that depends on the individual themselves, because the knowledge that it is a person's own actions, their style, can determine the quality of functioning, and also indicates that health should be properly taken care of. Human awareness related to health plays a key role. Many researchers (Alejziak, 2015; Hanna et al.,

2019; Demeter & Brătucu, 2014; Cini & Passafaro, 2019; Cini et al., 2015; Koseniak, et al., 2023; Castañeda-Babarro, et al., 2020; Pinto, et al., 2020) notice that currently a young person functioning in the 21st century strives to make physical activity present in their life. In addition to physical activity, the quality of sleep also plays an important role in promoting health. Numerous studies conducted over the last decade confirm that sleep disorders affect the risk of many civilization diseases, including cardiovascular diseases, cancer, mental disorders and depression.

The amount and quality of sleep affect a person's health. Sleep is a physiological phenomenon, and its disturbances lead to the deterioration of a given individual's health. Studies confirm that academic requirements, use of electronic media, poor diet, lack of physical activity can lead to sleep quality disorders. That is why it is so important to build awareness of a healthy lifestyle by highlighting the role and importance of physical activity in human life. It is physical activity among university students that can be an excellent factor improving concentration, metabolism and the quality of their sleep.

Appropriate physical activity is an excellent way to maintain health, energy for action, and well-being. It is an important and yet still underestimated element of a healthy lifestyle. In the literature, many researchers indicate that lifestyle, including physical activity, proper nutrition, avoiding stimulants and psycho-emotional overload, undoubtedly has an impact on human health (Centers for Disease Control and Prevention [CDC], 2023; Tremblay et al., 2007; Castiglione-Fontanellaz et al., 2022; Stutz et al., 2019; Hallal et al., 2006). Nowadays, more and more research centers are involved in research on physical activity, which expands the range of methods used in these studies, thus indicating new directions of research (Lang et al., 2016). At the same time, many scientists emphasize the importance of sleep and its quality (Schred &Hoffman, 2003). This means that sleep undoubtedly affects the state of the human body. Moreover, analyzing the philosophical perspective, dreaming is associated with having subjective experiences, and sleep is a specific pattern of subjective experience (Revonsuo et al., 2016; Sikka et al., 2018). There are theories that emphasize the autonomous role of deeper brain structures and see dreams as an epiphenomenon of REM sleep (Givrad, 2016). In the literature on the subject, the phenomenon of sleep and dreaming was first studied in the 19th century by Calkins (1893), who presented his results and argued that some aspects of dream content could be quantified. In subsequent years, the phenomenon of dreaming and sleep was further studied so that the research results could be used by psychologists, psychiatrists, and other scientists.

The aim of the research presented in this article was to examine the relationship between physical activity and sleep quality among Polish students. The study focused on two key research questions: first, how physical activity influ-

ences students' sleep quality, and second, whether engaging in physical activity positively impacts their overall health.

Materials and Methods

Study design and participants

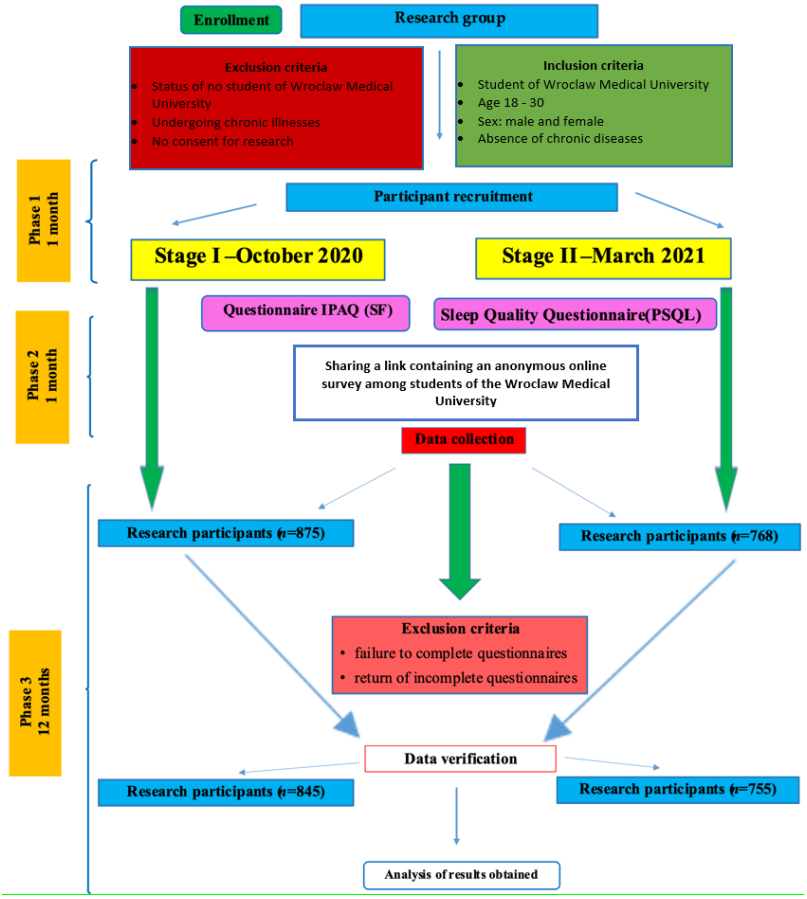

Figure 1
Overview of the research experiment design
Note: Adapted from Kosendiak et al. (2023). Physical activity and sleep quality among students of the Medical University of Wrocław. *Medycyna Ogólna i Nauki o Zdrowiu, 29*(4), 309–315; https://doi.org/10.26444/monz/172587.

This study was designed as a longitudinal cohort study and was conducted among a randomly selected group of students at Wroclaw Medical University

between October 2020 and March 2021. A total of 1,600 adult students participated in the study, all of whom were enrolled in mandatory remote physical education classes during the 2020/2021 academic year. As presented in Figure 1, the study was divided into two stages:

— Stage I (n = 845): Conducted after six months of the COVID-19 pandemic (October 2020).
— Stage II (n = 755): Conducted after one year of the COVID-19 pandemic (March 2021).

The same cohort of students completed the survey questionnaire at both intervals (Stage I and Stage II). However, differences in sample size across the two stages resulted from some students not completing the questionnaire each time, with 89.3% of the initial group participating in Stage II. The student recruitment process remained consistent throughout the study period.

Outcome measures

An analysis of physical activity was conducted using the short version of the International Physical Activity Questionnaire (IPAQ-S), which monitors health risks and assesses physical activity levels. This version includes seven questions covering a one-week period, addressing moderate and vigorous intensity exercise, walking, and sitting. Data from the IPAQ-S allowed for the classification of the participants into three physical activity levels: inactive (low level), moderately active (medium level), and very active (high level), based on the classification system by López-Moreno et al. (2020). Physical activity levels were categorized into three groups—low (LPAL), moderate (MPAL), and high (HPAL)—following the IPAQ scoring guidelines and measured in metabolic equivalent of task (MET) minutes per week.

Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), a self-administered questionnaire developed by Daniel J. Buysse. The PSQI evaluates sleep quality and disturbances over the past month, comprising 19 items organized into seven subscales: (1) sleep quality (1 item), (2) sleep latency (2 items), (3) sleep duration (1 item), (4) sleep efficiency (3 items), (5) sleep disturbances (9 items), (6) use of sleep medications (1 item), and (7) daytime dysfunction (2 items). Each component is scored from 0 to 3, with the sum providing a global PSQI score ranging from 0 to 21. Respondents with a score greater than 5 are classified as "poor sleepers," while those scoring 5 or less are classified as "good sleepers." The original PSQI demonstrated an internal consistency of 0.83 (Wang & Boros, 2021).

Data analysis

The clustering analysis was conducted using R software (4.4.1). Hierarchical agglomerative clustering (HAC), a widely-used clustering algorithm in academic rese-

arch, was employed in this study. The objective of the clustering analysis was to group objects into clusters based on the similarity of selected variables. For this analysis, only records from the year 2021 were used, focusing on the following variables:

— X1: vigorous_days – Average number of days with vigorous activity
— X2: moderate_days – Average number of days with moderate activity
— X3: walking_days – Average number of days with walking activity

Prior to clustering, the variables were standardized to ensure comparability and prevent any one variable from disproportionately influencing the clustering outcome. Standardization was applied using the formula:

$$z_i = \frac{x_i - \bar{x}}{S_x}$$

where x represents the mean of the variable within the sample, and S_x is the standard deviation of that variable within the sample. This transformation standardized each variable to a mean of zero and a standard deviation of one, enabling fair comparison across variables with different scales.

A key step in clustering analysis is determining the optimal number of clusters. To identify this, several indices (KL, CH, Hartigan, CCC, Scott, Marriot, TrCovW, TraceW, Friedman, Rubin, C, DB, Silhouette, Duda, PseudoT2, Beale, Ratkowsky, Ball, PtBiserial, Frey, McClain, Dunn, Hubert, SDindex, Dindex, and SDbw) were calculated for varying numbers of clusters. The optimal number of clusters was determined through a voting mechanism based on these indices (Mishra et al., 2022). The results of this clustering process are presented as a dendrogram (Figure 2) (Wang & Boros, 2021).

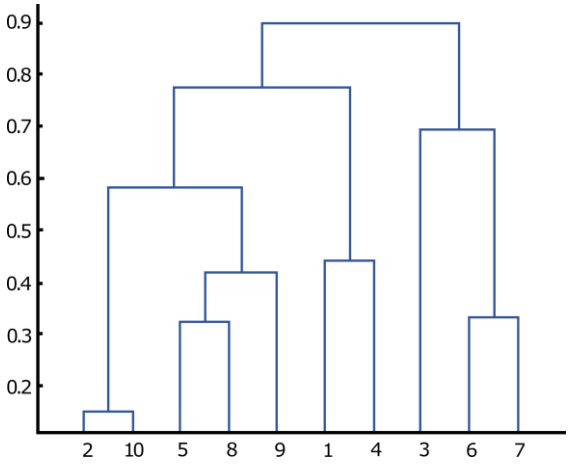

Figure 2
Example of a dendrogram for hierarchical agglomerative clustering
Note: Adapted from Gostkowski et al. (2021). Clustering Analysis of Energy Consumption in the Countries of the Visegrad Group. *Energies*, *14*(18), 5612; https://doi.org/10.3390/en14185612.

Results

Participants Characteristics

Table 1 presents the relationship between gender and MET m/w scores for two time periods. MET m/w for walking increased for both females and males. The decrease for women was smaller compared to that for men. It is worth noting that the difference between genders was statistically significant in both 2020 and 2021. In summary, the total MET m/w for females increased between 2020 and 2021, while for males, it remained at the same level. Additionally, the subjective sleep quality index for females increased between 2020 and 2021, whereas for males, it slightly decreased.

Table 1
Comparison of mean physical activity levels between genders

Variables	2020 (n = 845)	2021 (n = 755)
Walking MET, m/w		
Female	868.36	1208.10
Male	971.25	1032.22
p-Value	$p = 0.27$	$p = 0.12$
Moderate MET, m/w		
Female	132.16	129.75
Male	147.69	162.71
p-Value	$p = 0.25$	$p = 0.07$
Vigorous MET, m/w		
Female	580.8	511.19
Male	799.39	797.74
p-Value	$p = 0.004$	$p = 0.001$
Total MET, m/w		
Female	1582.67	1849.05
Male	1918.35	1992.68
p-Value	$p = 0.012$	$p = 0.351$
Sleep quality		
Female	1.905	1.959
Male	1.962	1.957
p-Value	$p = 0.29$	$p = 0.97$

MET: metabolic equivalent of task; m/w: minutes per week.

The relationships between the study year and MET m/w scores are presented below. For MET m/w related to walking, an increase was observed in almost

every year. Similar to the details in the previous table, moderate physical activity levels in 2021 were comparable to those in 2020. Regarding MET m/w for vigorous physical activity, an increase was observed only in the third year; for the remaining years, either a constant level or a decrease was observed. Changes in the sleep quality index were variable: an increase was noted in the first, fourth, and fifth years, while a decrease was observed in the second and third years. Notably, the difference between years in 2021 was statistically significant.

Table 2
Comparison of mean physical activity levels across study years

Variables	**2020 (n = 845)**	**2021 (n = 755)**
Walking MET, m/w1		
First year	898.67	1024.93
Second year	904.64	1546.40
Third year	677.08	1081.23
Fourth year	1318.21	1153.09
Fifth year	814.50	1534.86
p-Value	$p = 0.90$	$p = 0.002$
Moderate MET, m/w		
First year	139.36	135.78
Second year	140.31	141.80
Third year	112.14	140.00
Fourth year	107.56	62.30
Fifth year	210.90	168.44
p-Value	$p = 0.37$	$p = 0.88$
Vigorous MET, m/w		
First year	583.88	538.67
Second year	706.60	588.35
Third year	645.23	1200.00
Fourth year	668.10	353.84
Fifth year	1112.72	752.00
p-Value	$p = 0.08$	$p = 0.17$
Total MET, m/w		
First year	1623.66	1699.39
Second year	1751.56	2276.55
Third year	1434.47	2421.23
Fourth year	2093.89	1569.25
Fifth year	2138.13	2455.31
p-Value	$p = 0.32$	$p = 0.001$

Table 2
Comparison of mean physical activity levels across study years (*cont.*)

Variables	2020 (n = 845)	2021 (n = 755)
Sleep quality		
First year	1.902	2.004
Second year	1.976	1.885
Third year	1.933	1.785
Fourth year	1.888	2.080
Fifth year	1.600	1.700
p-Value	$p = 0.59$	$p = 0.01$

MET: metabolic equivalent of task; m/w: minutes per week.

Clustering Results

For the analyzed variables, the values of selected indices were calculated. Based on these index values, four clusters were identified as the optimal number of clusters. The results of the clustering analysis are presented below (Figure 3 and Figure 4). The largest cluster is Cluster Three.

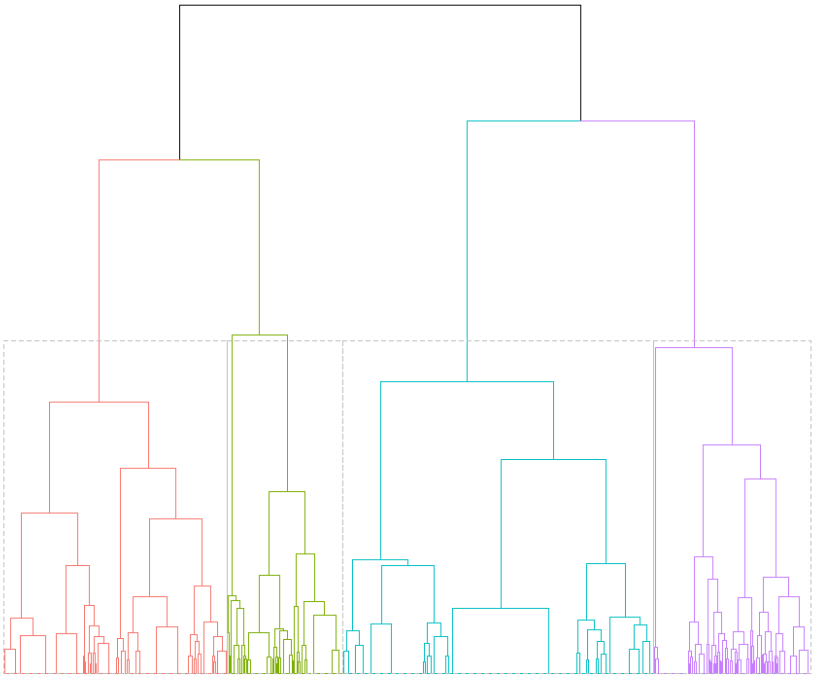

Figure 3
The dendrogram of hierarchical clustering using Ward's method
Source: own preparation.

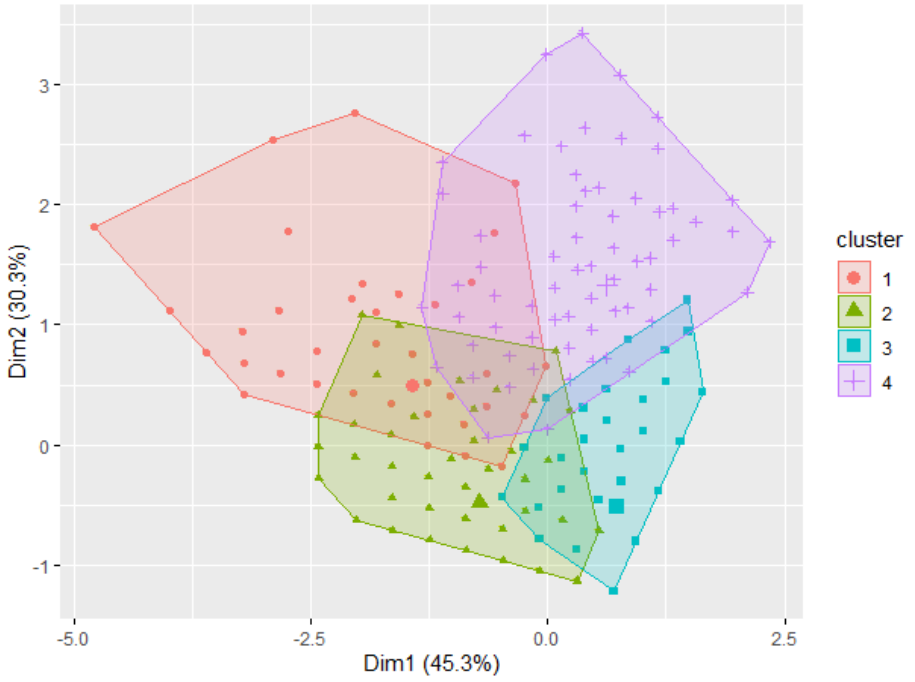

Figure 4
Results of hierarchical clustering after PCA, providing a visual representation of the clusters in relation to the principal components

Table 3
The mean values of analyzed variables for each cluster

Cluster	Sleep duration	Sleep quality	Vigorous days	Moderate days	Walking days	n
1	7.07	1.93	3.83	1.89	6.46	108
2	6.98	1.98	0.880	3.02	6.58	209
3	7.14	1.99	0.421	0.259	5.71	290
4	7.31	1.88	1.50	1.45	2.41	147
p-value	0.052	0.608	<0.001	<0.001	<0.001	

Based on the clustering analysis, the first and second clusters contain the students with the highest values for walking days compared to the other groups. The students in the second cluster show relatively high values for moderate days, while the students in the first cluster have relatively high values for vigorous days. At the same time, the students in the first and second clusters have the shortest sleep duration, which may indicate that engaging in physical activity (e.g., walking combined with gym or fitness exercises) enhances sleep quality, allowing these students to sleep for shorter durations compared to other groups.

The third cluster contains the students with the lowest values in vigorous and moderate days but moderate values in walking days. Compared to the first and second clusters, the students in the third cluster have longer sleep duration. This may suggest that physical activity limited to walking alone does not guarantee high sleep quality, leading these students to require more sleep than those in the first and second clusters.

The students in the last cluster have the lowest values for walking days and moderate values for vigorous and moderate days, suggesting that this cluster includes the students who engage in physical exercise but in a very irregular pattern. This irregularity results in the highest sleep duration in this group (CDC, 2023).

Discussion

The research conducted by the authors of this study confirms that physical activity affects sleep quality. The results suggest that regular and properly organized physical activity can optimize the quality and duration of sleep, potentially improving overall health and mental well-being. Encouraging consistent, regular physical activity can be a valuable strategy to improve sleep in various populations. Similar results were presented by Yint et al. (2022). According to them, for students of Chinese universities, too few hours of sleep and sleep quality have a significant impact on health. According to their research, students' lifestyle and factors related to mental health showed different patterns of relationships with sleep quality. In addition, it was indicated, among others, that aerobic exercise, mindfulness training, should be regularly carried out in groups. Also, the analyses presented by Rutkowska et al. (2022) confirmed that an adequate amount of sleep reduces nervous tension and reduces the occurrence of symptoms of depression. A similar position was presented in their studies (Castiglione-Fontanellaz et al., 2022; Stutz et al., 2019; Hallal et al., 2006; Lang et al., 2016; Ortega et al., 2011; Kalak et al., 2012), where it was noted that practicing any activity has a beneficial effect not only on the aspect related to health but also on sleep. Importantly, as the authors pointed out, practicing physical activity is an antidote to preventing lifestyle diseases such as cancer and diabetes.

Interesting research in the field of physical activity and sleep quality and the mental health of students was presented by Ghrouz et al. (2019). According to them, there is a strong connection between the level of physical activity and the quality of sleep and mental health. This means that a low level of physical activity, stress or anxiety negatively affects the quality of students' sleep and their mental health. In turn, Badicu (2018) indicated that physical activity among students is beneficial for the body if it is performed regularly and can affect the quality of sleep. In addition, as indicated in the study, there are significant sta-

tistical differences between the level of physical activity and the quality of sleep depending on the year of study, gender and academic specialization. Similar results were presented (Leger et al., 2012; Pelletier et al., 2014; Keating et al., 2005; Sepehr et al., 2016), where it was indicated that a poor diet and lack of physical activity among young people can lead to sleep disorders and poor quality of sleep. Another study looking at physical activity and sleep was conducted by Sepehr et al. (2016). According to them, sleep disorders mainly affect female students, because they are influenced by several factors, including stress, fear of exams, lack of acceptance.

Studies conducted by (Hirshkowitz et al., 2015; Kredlow, Capozzoli et al., 2015; Baum et al., 2014; Wunsch et al., 2017) show that people who regularly practice any sport sleep better and fall asleep faster. Presented results can be compared with the results of a study conducted among 1,326 students in Hubei Province, China during the COVID-19 pandemic (CDC, 2023). They confirm that physical activity plays a proactive role in sleep quality. The need to stay at home during the pandemic and the often associated lack of exercise contributed to a reduction in the quality of sleep.

This is confirmed in the study conducted by Badicu (2018), who showed that men and women in the first and second year of studies have a higher level of physical activity and then have better sleep quality compared to, for example, third or fourth year students. Another important study was presented by the team of Wunsch et al. (2017). According to them, an important factor is also stress, which affects both sleep and physical activity of students. This means that maintaining a high level of physical activity during periods of academic stress should be a goal for students as it also affects sleep quality.

At this point, it should be pointed out that with the increase in the intensity of human effort, the need for sleep increases. Therefore, e.g. so many athletes at the time of important competitions try to rest rationally and provide the body with the right amount of sleep. The main task of sleep is primarily rest related to the regeneration of vital forces, strengthening the immune system, as well as strengthening concentration and memory.

In the literature on the subject, the authors (Crowley et al., 2018; Ohayon et al., 2017) emphasize that the daily need for sleep is an individual feature and often changes with age, which means that the younger the person is, the greater the need for sleep.

The latest research shows that not all activities will affect the quality of sleep to the same extent (Hori et al., 2016; Hurdiel et al., 2017). Activities such as running, cycling, yoga or even gardening perform better than others (Hori et al., 2016). Studies also show that physical activity may not have an immediate impact on sleep quality. This means that only after the appropriate time has elapsed, there will be a change in terms of better quality and volume of sleep,

provided that the activity is practiced for a certain period of time. In turn, (Hurdiel et al., 2017; Kashefi et al., 2014) indicated that moderate exercise performed by humans showed a more promising effect on sleep quality than intense exercise.

Research by Mahfouz et al. (2020) indicated that the majority of Jazan University students had poor sleep quality and were physically inactive. This means that students struggled with many disorders, including concentration. Therefore, the authors of the study emphasized that an important aspect is the promotion of physical activity among students, as well as building awareness and prevention strategies in the field of good health.

Despite the growing demand for active leisure time, the COVID-19 pandemic that broke out in 2020 caused numerous and often negative changes in the physical activity of students. During the pandemic, many young people had more free time than before, but this did not translate into increased physical activity, as it was mainly due to the restrictions imposed by a given state on citizens (Halabchi et al., 2020; Jiménez-Pavón et al., 2020; Hull et al., 2020; Jakobsson et al., 2020; Jukic et al., 2020; Ferreira et al., 2020). The coronavirus pandemic has led to a change in current habits. Social isolation, closing swimming pools, fitness clubs, university gyms were intended to prevent the spread of the COVID-19 virus, but at the same time it affected physical activity and sleep.

However, the COVID-19 pandemic also produced other results (Chen et al., 2020; Roman et al., 2023; Roman et al., 2022; Alencastro et al., 2023; Narici et al., 2020). Students willingly chose physical activity in the open air while maintaining social distance. On the other hand, it has been noted that the Covid-19 pandemic has also had an impact on sleep quality. Many people locked up due to social isolation were unable to cope with such a situation and, unfortunately, this was reflected in the deterioration of the quality and quantity of sleep. This resulted mainly from the lack of motivation to engage in physical activity and thus led to a significant deterioration of physical condition (Hall et al., 2020; Hammami et al., 2020; Tremblay et al., 2007; Youngstedt, 2005; Stutz et al., 2018).

Conclusions

Physical activity is undoubtedly an important component of the life of a modern man (Füzéki et al., 2020; Lesser & Nienhuis 2020; Song et al., 2022; Yin et al., 2022; Rutkowska et al., 2022). Health-promoting behaviors undertaken by human beings are conscious actions. Regular practice of any activity develops not only physical condition but also intellectual self-awareness and affects the quality and duration of sleep. As presented in this article, people [especially young people] need movement, activity, because it is their natural ally

in the fight against lifestyle diseases and an excellent antidote to stress. Despite the growing demand for movement and active leisure time, the COVID-19 pandemic has caused many changes.

Physical activity, especially vigorous and moderate activities, appears to influence sleep duration and quality. The students from the first and second clusters with higher physical activity levels tend to have shorter sleep but of adequate quality. Moreover, the students from the third cluster, with minimal vigorous and moderate activity but higher walking days, require longer sleep, possibly to compensate for the lower intensity of physical activity. The students from the last cluster with irregular activity patterns might necessitate the longest sleep duration for sufficient rest. Described findings imply that regular and structured physical activity can optimize sleep quality and duration, potentially improving overall health and well-being. Encouraging consistent physical activity routines could be a valuable strategy for enhancing good sleep patterns among different populations.

Statement of Ethics

This study was conducted in accordance with the World Medical Association Declaration of Helsinki. The study protocol was reviewed and approved by the Bioethics Committee at the Medical University of Wrocław, Poland (No. KB-251/2020; date: 10.05.2020). All participants provided written informed consent to participate in this study. The online questionnaire included information that the participation in the study is voluntary and that by completing it a given participant given informed consent to participate in the study.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interests with respect to the research, authorship, and/or publication of the article *Physical Activity and Sleep Patterns During the COVID-19 Pandemic: Insights from a Cluster Analysis.*

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Część IV

Turystyka i rekreacja

SPORT I TURYSTYKA
Środkowoeuropejskie Czasopismo Naukowe

UNIWERSYTET JANA DŁUGOSZA
W CZĘSTOCHOWIE

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INTELLECTUAL STRUCTURE OF BEHAVIOURAL INTENTIONS STUDIES IN TOURISM AND HOSPITALITY: A BIBLIOMETRIC OVERVIEW

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Struktura intelektualna badań intencji behawioralnych w turystyce: analiza bibliometryczna

Streszczenie

Ostatnie badania w dziedzinie turystyki i hotelarstwa skupiały się intensywnie na intencjach behawioralnych. Jednak żadne badanie nie przeanalizowało badań nad intencjami behawioralnymi (BIs) w turystyce przy użyciu analizy bibliometrycznej. Istnieje zatem potrzeba badań bibliometrycznych w celu zbadania badań BIs w turystyce. W tym kontekście niniejszy artykuł skupia się na przedstawieniu aktualnego stanu badań naukowych dotyczących koncepcji BIs w turystyce. W niniejszym badaniu przyjęto podejście bibliometryczne do analizy badań „intencji behawioralnych" opublikowanych w dziedzinie turystyki w ogóle, a do tego celu wykorzystano bazę danych WoS. W tym badaniu wykorzystano oprogramowanie Vosviewer do zbadania prawidłowości dotyczących publikacji, wybitnych autorów i czasopism, krajów wnoszących wkład i partnerstw instytucjonalnych, opierając się na 382 artykułach na temat intencji behawioralnych z bazy danych Web of Science (WoS) obejmujących lata 2000–2022. Wyniki pokazują, że w ciągu ostatnich 20 lat badania dotyczące intencji behawioralnych znacznie się rozwinęły i stopniowo osiągnęły różnorodność tematów badawczych. Ponadto wizerunek miejsca docelowego oraz lojalność, satysfakcja

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i motywacja są często powiązane z intencjami behawioralnymi. Na podstawie wyników badań przedstawiono kilka sugestii dotyczących przyszłych badań.

Słowa kluczowe: podejście bibliometryczne, analiza wizualizacji, zamiar ponownej wizyty, poczta pantoflowa, Vosviewer.

Abstract

Recent studies in the field of tourism and hospitality (T&H) have intensively focused on tourists' behavioural intentions (BIs). However, no study investigates BIs specifically in T&H using a bibliometric approach. Thus, there is a need for bibliometric research to investigate BIs research in T&H. In this regard, this article focuses on demonstrating the current state of scientific studies regarding BIs in T&H. This study adopts bibliometric methods to examine BIs studies published in the field of T&H in general, using the Web of Science (WoS) database for this purpose. VOSviewer software was employed to examine the patterns in publications, prominent authors, and journals, contributing countries, and universities. This analysis drew on 382 documents from the WoS database, spanning the years 2000 to 2022. The findings demonstrate that over the past 20 years, BIs research has grown significantly and has gradually attained diversity in research topics. In addition, destination image, loyalty, satisfaction, and motivation are frequently associated with BIs. Based on the results of the study, several suggestions are made for future research.

Keywords: bibliometric approach, visualisation analysis, revisit intention, word of mouth, Vosviewer.

Introduction

In the tourism and hospitality field, the decision-making processes of tourists (Dinc,2023; Dinc & Huang, 2023; Dinc, 2024) and their post-travel behaviours are quite popular research topics (Cifci et al., 2024; Ogretmenoglu et al., 2025). In the realm of tourism, the notion of BIs is pivotal as it reflects travellers' willingness to engage in particular behaviours, such as visiting a destination (Ciki et al., 2024; Pujiastuti et al., 2017), staying in a hotel (Dedeoglu et al., 2015), participating in a tour (Chan et al., 2015) or participating in a festival (Ciki et al., 2025). For the success of the tourism sector, understanding the factors that shape the BIs of travellers is essential. Thus, over the last 20 years, researchers have frequently examined the factors affecting the BIs of tourists (Baker & Crompton, 2000) as well as the variables associated with these intentions (e.g. revisit intention and word of mouth) (Khajehshahkoohi et al., 2022; Som et al., 2012). Consequently, a body of knowledge has emerged concerning tourists' BIs (Chen & Chen, 2010; Chen & Tsai, 2007; Ryu et al., 2012; Tanriverdi & Ciki, 2024).

Bibliometric studies (BSs) help examine the accumulated knowledge about specific topics or certain fields (Ruhanen et al., 2015; Siwach & Kumar, 2015). Bibliometrics was proposed by Pritchard et al. in 1969 (Patra et al., 2006). It is described as using statistical and mathematical techniques in written works and

other forms of communication. BSs provide an extensive overview of articles in various areas (Pritchard, 1969).

This method has been frequently employed across various fields, including education (Budd, 1988), industrial engineering (Cancino et al., 2017), mathematics (Behrens & Luksch, 2011), marketing (Nicolas et al., 2020), gastronomy (Vogel et al., 2019), medicine (Kokol et al., 2021), business administration (Mas-Tur et al., 2020), anthropology (Madadin et al., 2022), linguistics (Sun et al., 2021), finance (Khan et al., 2022), psychology (Tur-Porcar et al., 2018), and economics (Kesici, 2022). Moreover, BSs are also prevalent in the T&H field (Atsiz et al., 2022; Ciki, 2022; Ciki et al., 2023; Ciki & Tanriverdi, 2023; Goyal & Kumar, 2021; Hall, 2011; Koseoglu et al., 2016; Ogretmenoglu et al., 2022a; 2022b; 2023; Comerio & Strozzi, 2019).

Previous studies have conducted bibliometric analyses on various types and topics within T&H (e.g., Au & Tsang, 2022; Qiao et al., 2022). For instance, Qiao et al. (2022) examined the progression of knowledge, key research areas, and prospective developments within accessible tourism literature. Similarly, Au and Tsang (2022) investigated articles on smart travel experiences published between 2010 and 2021 in the WoS Core Collection and Scopus databases.

However, no study has investigated BIs in T&H through a bibliometric approach. Thus, there is a need for bibliometric research to investigate BIs research in T&H. In this regard, the current article focuses on demonstrating the current state of scientific studies regarding BIs of tourists in T&H. By doing so, this study can be helpful for both T&H researchers and practitioners. Motivated by the bibliometric analysis conducted by Borgohain et al. (2022), this study aims to uncover insights into several research queries, including:

— Who are the leading authors and research bodies in this field?
— Which journals were the most active during the period covered by the study?
— Which countries published the most articles on BIs in WoS between 2000 and 2022?
— How does the keyword co-occurrence form a cluster network?
— How does bibliometric coupling (BC) among authors, countries, and organizations form cluster networks?

This research is crucial for scholars seeking to understand the topic of BIs, as it offers a comprehensive overview of BIs research within the T&H sectors. This bibliometric analysis illustrates the framework, evolution, significant trends and influences of the topic (Comerio & Strozzi, 2019; Okumus et al., 2018; Jiang et al., 2019). Moreover, this study can be helpful for practitioners aiming to understand tourists' BIs.

This research is structured into four distinct parts. Following this introduction, the second segment outlines the research methodology, detailing the da-

tabases, indicators, and the research procedure. The third part then presents the results of the paper. Lastly, the fourth segment discusses the study's conclusions and associated limitations.

Research methodology

This research utilized a bibliometric approach to examine studies on BIs within the field of T&H (Koseoglu et al., 2016). The study presents a bibliometric analysis encompassing descriptive and science mapping (network analyses) of BIs studies in T&H. In any bibliometric study, the research design stands as the initial and pivotal phase. Authors embark on defining the research question and subsequently opt for the most suitable bibliometric techniques. Various bibliometric techniques can be adopted (Zupic & Carter, 2015), encompassing descriptive statistics, such as identifying the most contributing authors, institutions, countries, journals, annual publication rates, and most cited articles (Kesici, 2022), along with network analysis techniques, such as co-occurrence of keywords, BC, and co-citations (Sigala et al., 2021). In this study the authors adopted co-occurrence of keywords and BC for network analysis.

Data collection and process

The data were retrieved from WoS on March 22, 2023. WoS was chosen because it is a popular and widely used database. Moreover, it is often utilized for analysing scientific publications (Liu & Li, 2020).

In this study, "behavioural intentions" was selected as the keyword for the search. This meant specifically targeting publications where "behavioural intentions" appears in the title. To ensure accuracy, quotation marks were used around the search term, following the methodology outlined in previous studies by Van Nunen et al. (2018) and Mavric et al. (2021). The search culminated in the identification of 382 documents in the WoS database, encompassing articles, proceedings, books, and book chapters, as detailed in Table 1.

Table 1
Data search procedures

Steps	Search Outcome
1. On WoS: Search for studies with the keyword "BIs" in the title.	2252 documents
2. Refined by Web of Science Categories as hospitality, leisure, sport and tourism.	394 documents
3. The year of publication was chosen as 2000-2022.	382 documents

Results

Descriptive results

The WoS contains 382 documents published between 2000 and 2022 dealing with BIs studies in T&H. Most of the BIs documents published in the fields of T&H are research articles; the rest are conference papers, book chapters, and review articles. Published documents containing the term BIs tend to increase over time. The number rose from 1 to 20 in 2014 to 44 in 2020. The number in 2021 reached a peak of 49. However, the trend decreased slightly in 2022 (39 documents).

Table 2 below indicates the journals that have published the most documents on BIs. "The International Journal of Hospitality Management (IJHM)" ranks first with 32 studies.

Table 2
The journals that have published the most studies on BIs in T&H

Rank	Journal Name	Document Number	Index	Publisher
1	International Journal of Hospitality Management (IJHM)	32	Social Sciences Citation Index	Elsevier
2	Journal of Travel & Tourism Marketing (JTTM)	30	Social Sciences Citation Index	Taylor & Francis Group
3	International Journal of Contemporary Hospitality Management	24	Social Sciences Citation Index	Emerald
4	Journal of Quality Assurance in Hospitality & Tourism	18	Emerging Sources Citation Index	Taylor & Francis Group
5	Asia Pacific Journal of Tourism Research	17	Social Sciences Citation Index	Taylor & Francis Group
6	Journal of Hospitality Marketing & Management	13	Social Sciences Citation Index	Taylor & Francis Group
7	Tourism Management	13	Social Sciences Citation Index	Elsevier
8	Tourism Analysis	12	Emerging Sources Citation Index	Cognizant Communication Corporation
9	Journal of Travel Research	11	Social Sciences Citation Index	Sage
10	International Journal of Hospitality & Tourism Administration	10	Emerging Sources Citation Index	Taylor & Francis Group

Figure 1 shows the most contributing authors in the literature on BIs in T&H. As depicted, the most prolific authors are Heesup Han (Sejong University), Hung-Che We (Pennsylvania State University), SooCheong (Shawn) Jang (Purdue University), Seongseop Sam Kim (The Hong Kong Polytechnic University), and Kisang Ryu (Sejong University).

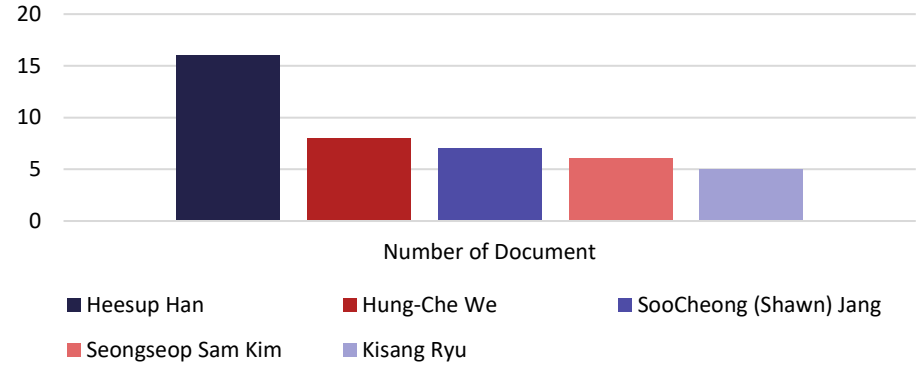

Figure 1
Researchers contributing most to BIs studies in the T&H field

The universities with the highest productivity are outlined in Figure 2. These universities include the State University System of Florida, Hong Kong Polytechnic University (PolyU), Sejong University, University of Central Florida, and Kyung Hee University.

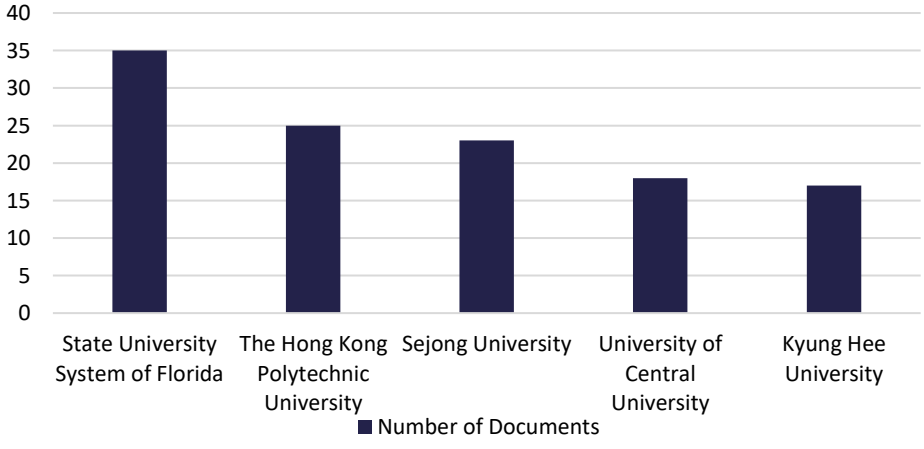

Figure 2
The universities contributing most to BIs studies in the T&H fields

Network analysis results

This research employed graphical mapping for network analysis of bibliometric data, in addition to descriptive analysis. Network analysis reveals the connections between various entities, such as authors, affiliations, nations, publications, and more (Cobo et al., 2011). This section begins with a network analysis of bibliometric data using VOSviewer software, followed by a discussion of the results.

KEYWORD CO-OCCURRENCE MAPPING

Figure 3 depicts a pattern of keyword co-occurrence, focusing on those appearing at least twice. Keywords that recur more frequently are represented by larger nodes. The proximity of nodes to each other indicates a stronger association between the respective keywords (Jiménez-García et al., 2020). The software detected six clusters, which consist of keywords related to each other. "Value," "motivation," and "structural equation modelling" belong to the green cluster; "word of mouth," "effective image," and "destination image" belong to the blue cluster; "perceived value," "market segmentation," and "memorable tourism experiences" belong to the red cluster; "BIs" and "destination attractions" belong to the yellow cluster; "involvement" and "experience quality" belong to the purple cluster; and "satisfaction" belongs to the turquoise cluster.

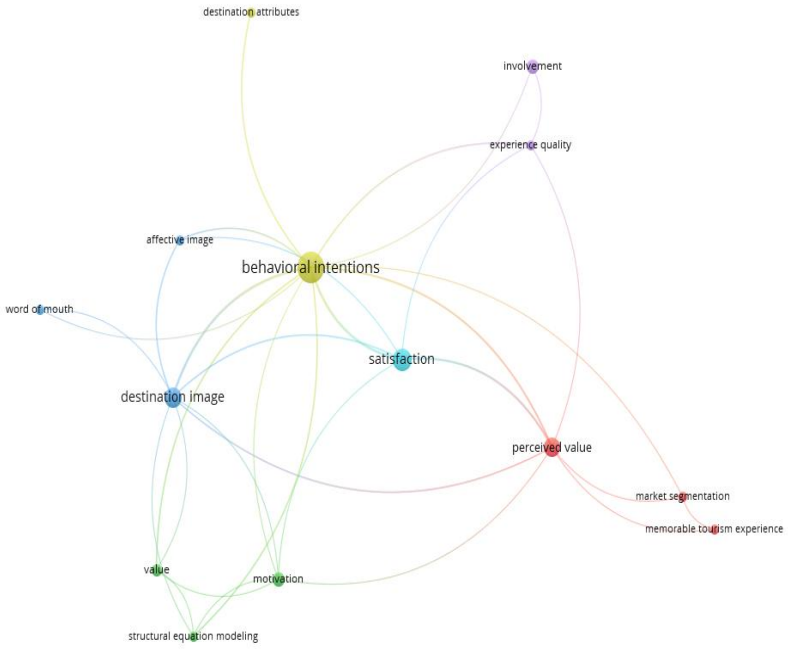

Figure 3
Network visualization of keywords in BIs studies

Figure 4 shows the visualization of the time-wise publication trends. Satisfaction, destination attractions, and affective and destination images dominate the initial research directions. Market segmentation, memorable tourism experiences, and structural equation modelling dominate BIs studies in more up-to-date research directions.

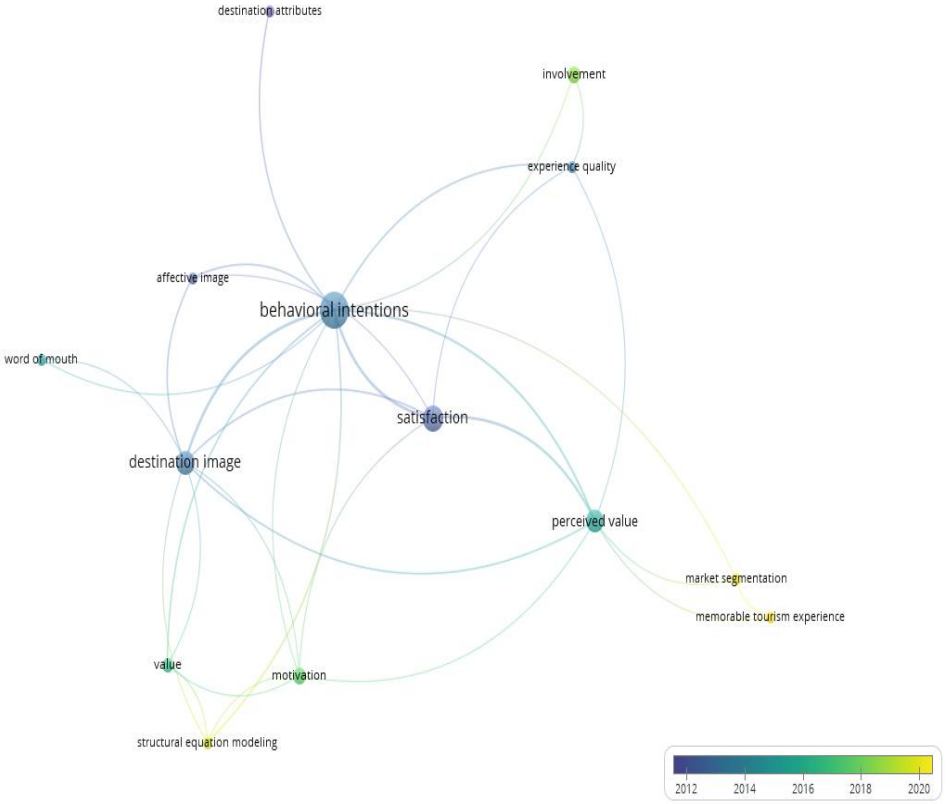

Figure 4
Timewise publication trend of BIs

BC OF COUNTRIES

When articles from two distinct nations cite works from a third one, bibliographic coupling among countries occurs (Farrukh et al., 2020). Figure 5 displays these findings, using a minimum criterion of two documents. The analysis reveals that the USA exhibits the most extensive BC, with China, Australia, and Taiwan also showing notable connections.

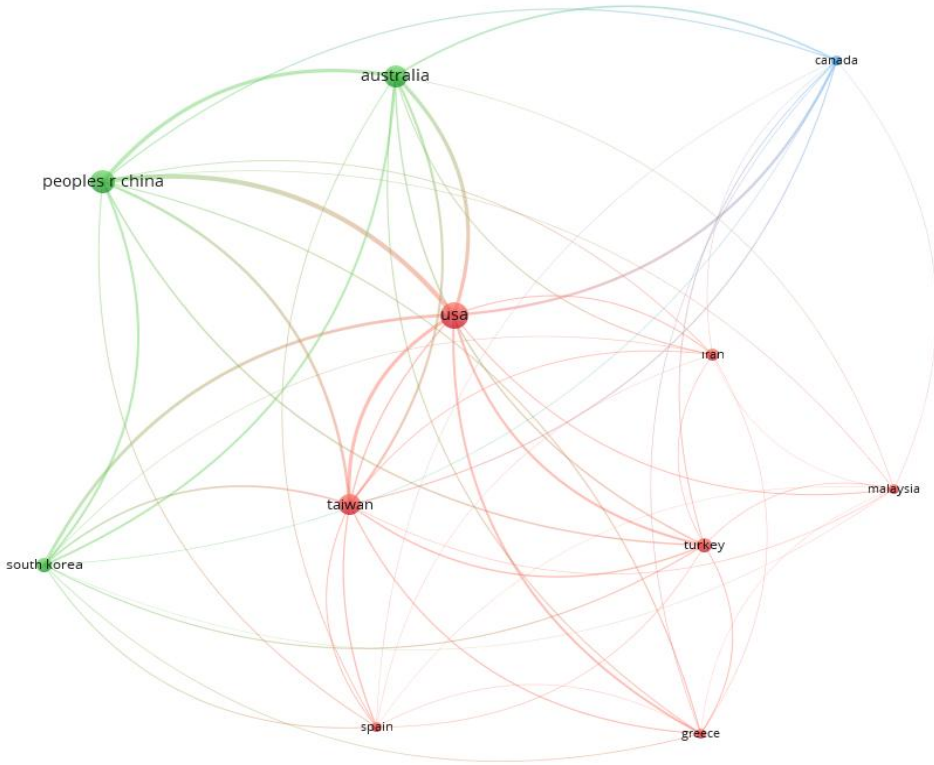

Figure 5
The BC of countries

BC OF ORGANIZATIONS

Observing the connections between the contributing universities and institutes is another critical aspect of bibliometric research. Organizational bibliographic coupling occurs when publications from two separate institutions cite works from a shared third institution (Farrukh et al., 2020). Figure 6 displays various clusters, each distinguished by a unique colour representing these universities. Universities grouped in the red cluster demonstrate a strong bibliographic interconnection, a pattern similarly observed in the green cluster.

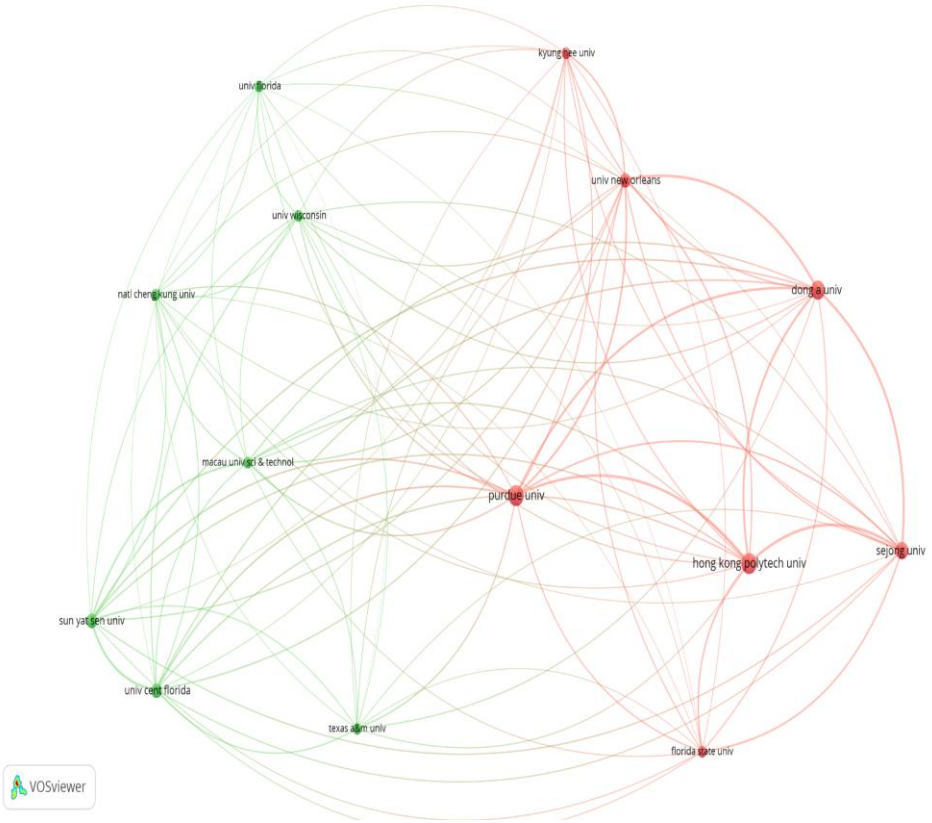

Figure 6
The BC of organizations

BC OF AUTHORS

Figure 7 illustrates the BC of authors. A large cluster (red) of coupled authors is anchored by Hung-Che Wu, whose research focuses on quantitative social research. The other significant clusters are anchored by Kisang Ryu and Heesup Han (yellow).

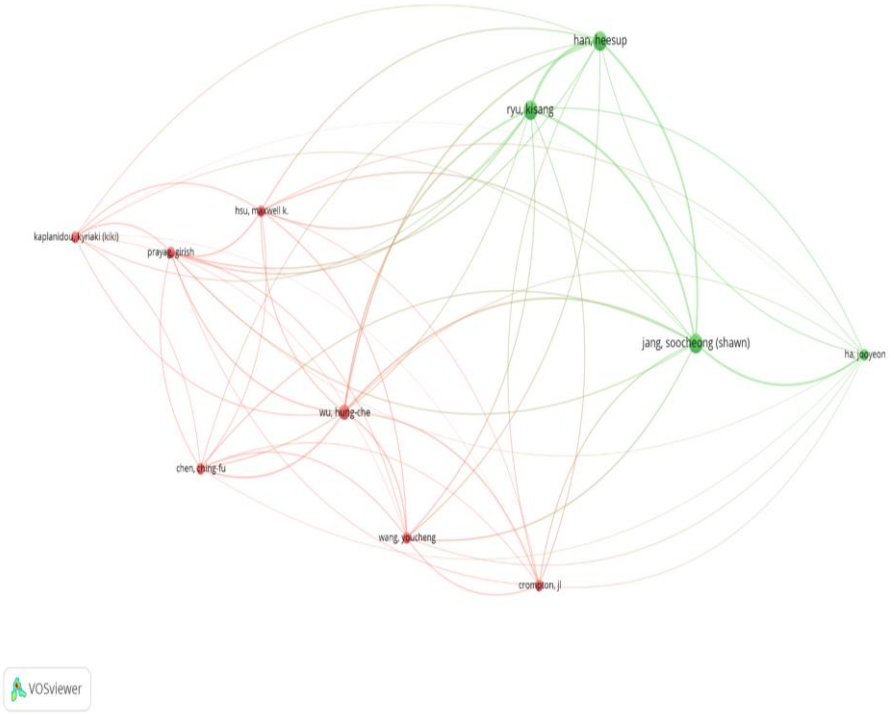

Figure 7
The BC of authors

Discussion and conclusions

This paper attempted to comprehensively examine published documents on BIs in T&H from 2000 to 2022 through a bibliometric approach. To do this, the authors obtained data from the WoS database and analysed this data with VOSviewer software, producing network maps. Descriptive findings were also analysed before mapping network relationships. Descriptive findings can be summarized as follows.

A significant number of studies on BIs in T&H compared to previous years was published in 2020, 2021, and 2022 (e.g. Bae & Chang, 2021; Hamid & Bano, 2021; Rehman et al., 2022). Despite the global impact of the COVID-19 pandemic

during these years (Kesici, 2023; Kesici & Uzunöz Altan, 2021), which led to a reduction in academic publications in certain fields, the decrease did not significantly affect studies on BIs in T&H. Contrarily, a significant number of studies on BIs in T&H was published during these years (e.g. Cheng et al., 2022; Rehman et al., 2022; Zhang et al., 2022). In these years, many academics delved into the question of whether the COVID-19 pandemic affected the BIs of tourists (Sánchez-Pérez et al., 2021; Xu et al., 2022).

This research revealed that the leading journal in publishing studies on BIs was the IJHM and the JTTM. These findings are consistent with bibliometric analyses conducted on these journals (Sigala et al., 2021). Specifically, Mulet-Forteza et al. (2018) focused their bibliometric paper on the "JTTM," while Sigala et al. (2021) concentrated on the IJHM. Both studies highlighted that BIs emerged as a frequently utilized keyword in the publications of these journals.

In this study, the author who contributed the most to BIs in T&H was determined to be Heesup Han. He has 17 studies published on this subject in the WoS (e.g. Ryu & Han, 2010; Ryu et al., 2008; Ryu et al., 2010). Some of his notable articles include the green image of hotels and BIs (Lee et al., 2010), the overall quick-casual restaurant image and BIs (Ryu & Han, 2010; Ryu et al., 2008), and green consumerism and BIs (Han & Yoon, 2015).

In addition, this article examined the countries and institutions that publish the most on the topic. The results showed that the USA, China, and South Korea were the most productive countries. This outcome is hardly surprising. Due to the intensity of tourist arrivals and tourism investments, academics in these countries show a heightened interest in understanding the BIs of tourists.

Moreover, this study identified the State University System of Florida, the Hong Kong Polytechnic University (PolyU), and Sejong University as the most productive universities in terms of publications on BIs in T&H. These universities were also found to be the most productive institutions in various BSs on different topics in tourism (e.g. Kesici, 2022).

In addition, the network analyses have revealed several remarkable results regarding BIs in T&H. The co-occurrence analysis of keywords summarized the most frequently considered terms in BIs studies. Among these keywords, the most striking were destination image, motivation, and satisfaction. Destination image refers to tourists' perceptions of a particular destination, influenced by factors such as advertising, media, personal experiences, and word of mouth (Jalilvand, 2017; Ishida et al., 2016). Numerous studies have shown that a positive destination image significantly influences tourists' BIs (Afshardoost & Eshaghi, 2020).

Travel motivation is another crucial factor influencing tourists' BIs (Bayih & Singh, 2020). Travel motivations encompass the reasons behind travel, such as leisure, adventure, or cultural experiences. These motivations can significantly impact tourists' BIs. For example, travellers seeking relaxation may prefer

visiting a beach area and staying in a resort (Van Vuuren & Slabbert, 2012), whereas those seeking adventure may be more inclined to engage in outdoor activities (Pomfret & Bramwell, 2016). Thus, depending on travel motivation, tourists' intentions to revisit a destination and recommend it to others may vary.

One of the essential factors in the T&H sectors is satisfaction because it significantly affects travellers' BIs (Žabkar et al., 2010). Travellers who find satisfaction in their travel experiences tend to have a positive outlook and show a higher inclination to return to the same destination. Additionally, they are more inclined to tell others about their holidays, positively promoting the destination (Hui et al., 2007). According to a study by Zaitul et al. (2022), satisfaction was positively connected to returning to a particular destination. The recommendation of the destination to others is another way in which satisfaction affects tourists' BIs. Tourists who feel satisfied with their vacation are more likely to tell others about the destination. This recommendation significantly impacts the visibility and reputation of the destination (Ardani et al., 2019). Ardani et al.'s (2019) research found a significant positive connection between travellers' satisfaction and their willingness to recommend a destination.

Lastly, this study examined the BCs of countries, organizations, and authors through network analysis. As a result of this analysis, it was found that generally developed countries (e.g., the USA, South Korea), universities, and academics in developed countries are quite productive on this topic.

Theoretically, this paper provides a fundamental understanding of BIs in T&H. Utilizing a range of bibliometric visualization tools, this research elucidates the structural elements of BIs research. This endeavour aims to assist academics, particularly junior researchers interested in BIs, in comprehensively exploring this topic from various dimensions. Furthermore, the article offers a detailed analysis of prevailing trends and advancements in the field of BIs, thereby contributing to a comprehensive understanding of tourism research in this domain. Such insights enable scholars to identify existing gaps in the literature and potential subjects for future research endeavours (Singh et al., 2022).

Utilizing bibliometric visualization tools such as VOSviewer, this research reveals the intellectual structure of the field, identifying key authors, influential journals, and prominent research institutions. This mapping not only highlights the major contributors and their collaborations but also unveils the evolution of research themes over time. Such a comprehensive overview is essential for academics aiming to align their research with established trends or to pioneer new directions.

Furthermore, the findings of the study can impact the design of future empirical research. For example, by uncovering the most frequently studied topics and methodologies, researchers can steer clear of redundancy and instead concentrate on underexplored areas. This approach can foster more innovative and impactful research, thereby advancing the field.

This work holds significant practical implications for policymakers and professionals. Firstly, the study showcases the productivity of T&H academia in researching tourist' BIs. Therefore, policymakers can leverage academic research findings when crafting policies aimed at enhancing tourists' inclination to revisit destinations and recommend them to others.

The tourism sector possesses a dynamic and continuously evolving structure. As a result, decision-makers within the industry require current and precise information. Bibliometric analyses unveil the latest research within the sector and the insights garnered from these studies, empowering managers to make more informed, data-driven decisions. For instance, understanding the factors influencing tourists' BIs can be instrumental in enhancing marketing strategies and service quality.

The present study underscores the significance of destination image in shaping tourists' BIs. This insight implies a heightened focus on image management within the marketing strategies of tourism destinations. It is advisable for destinations to utilize advertising, media, and other communication tools effectively to cultivate a positive image. Moreover, the study underscores the pivotal role of tourist satisfaction in influencing BIs. By prioritizing enhancements in service quality aimed at bolstering customer satisfaction, tourism businesses can augment the likelihood of tourists revisiting and recommending the destination to others.

Limitations

Like any study, this one has some limitations that could guide future research. First, this study is restricted to documents published in English due to the language limitations of its authors. Second, the sampling frame was confined to the WoS database. To fully explore and understand knowledge maps, future studies may need to incorporate data from other sources, such as Scopus and Google Scholar (Qiao et al., 2022).

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CAN WEARABLE AND DIGITAL TECHNOLOGIES AUGMENT BUSINESS-TO-CONSUMER DATA DRIVEN OUTCOMES IN HEALTH AND FITNESS INDUSTRY?

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Czy technologie ubieralne i cyfrowe mogą zwiększyć wyniki oparte na danych przesyłanych między przedsiębiorstwami a konsumentami w branży zdrowia i fitnessu?

Streszczenie

W artykule wyjaśniono potencjalną rolę, jaką technologie ubieralne i cyfrowe mogą odgrywać w relacjach między specjalistami zajmującymi się zdrowiem i fitnessem a konsumentami. Ta pozytywna relacja może potencjalnie zmienić dynamikę relacji między przedsiębiorstwami a konsumentami (B2C) w branży. Celem tego artykułu jest dostarczenie czytelnikom informacji i wskazówek w następujących aspektach: *A*) identyfikacja aktualnych zastosowań technologii ubieralnych i innych zasobów cyfrowych w codziennych praktykach specjalistów zajmujących się zdrowiem i fitnessem, *B*) zrozumienie potencjału tych narzędzi w zakresie kompleksowej obsługi klientów i pacjentów monitorowanie, niezależnie od wieku i umiejętności cyfrowych oraz *C*) optymalizacja wykorzystania tych zasobów w celu zwiększenia zaangażowania konsumentów w działania na rzecz zdrowia i sprawności fizycznej. Badanie obejmuje technologie ubieralne, aplikacje fitness i narzędzia oparte na danych. Co więcej, wymieniono praktyczne spostrzeżenia na temat zastosowania i użyteczności powszechnie przyjętych wersji sztucznej inteligencji, aby uwzględnić różnorodne cele użytkowników w zakresie zdrowia i sprawności fizycznej, takie jak wzmocnienie pozycji

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dzięki technologii, ulepszona łączność między profesjonalistami a klientami, zoptymalizowana dynamika branży i potencjał ciągłej ewolucji.

Słowa kluczowe: technologia ubieralna, technologia cyfrowa, sztuczna inteligencja, napędzane danymi, aplikacja fitness, branża fitness.

Abstract

This paper explains the potential role wearable and digital technologies might play in the relationship between health and fitness professionals and consumers. This positive relationship could, potentially, change the industry's Business-to-Consumer (B2C) dynamics. This article aims to provide information and guidance to readers in the following aspects: *A*) identifying current applications of wearable technologies and other digital resources in the daily practices of health and fitness professionals, *B*) understanding the potential of these tools for comprehensive client and patient monitoring, irrespective of age or digital literacy, and *C*) optimizing the utilization of these resources to enhance consumer engagement in health and fitness endeavors. The examination encompasses wearable technologies, fitness applications, and datadriven tools. Moreover, practical insights into the applicability and usability of widely adopted artificial intelligence versions are enumerated to encompass diverse health and fitness user objectives such as empowerment via technology, enhanced professional-customer connectivity, optimized industry dynamics, and potential for continuous evolution).

Keywords: wearable technology, digital technology, artificial intelligence, data driven, fitness app, fitness industry.

Introduction

The global sports technology market is projected to exhibit continuous annual growth, reaching USD 40 billion within the next three fiscal years (2024-26), a trend corroborated by the latest *ACSM's Worldwide Survey of Fitness Trends* (A'Naja et al., 2024).

Extensively researched since 2016, wearable technology (also known as fitness and/or activity trackers – AT) offer real-time data including heart rate, step counts, active minutes, and sleep duration (Kroll et al., 2016; Wang Julie et al., 2015). This technology enables fitness professionals to personalize daily physical activity (PA) regimens for their clients, monitoring trends, performance metrics, and long-term progresses (Liguori et al., 2018; Picard et al., 2016). One significant categorization worthy of emphasis involves native mobile features and/or an external physical device linked to an application. In efforts to influence *Business-to-Consumer* (B2C) activity, strategies employed on smartphones tend to be more pragmatic than theory-based approaches (Bort-Roig et al., 2014). The range of novel and engaging intervention strategies used by smartphones (or other digital tools), and user perceptions on their usefulness and viability, highlights the potential such technology has for PA promotion.

So, is it still viable to pursue this strategy to foster engagement and promote behavioral changes in our health and fitness consumers? Are the creation of PA profiles, goal setting, real-time feedback, social support networks, and online expert consultations still relevant or already considered outdated?

Many health and fitness professionals, who themselves are active consumers, understand that the reliability of any app or device tracking human activity in most of cases depends on individual trust. There is evidence indicating that depending on whether the measurement is automatic (utilizing accelerometers, pedometers, calorimetry, energy expenditure detectors, etc., through direct or indirect means) or self-reported (involving different data extraction regarding healthy routines), there can be both overestimation and underestimation. These discrepancies may arise when using data across various levels (Evenson et al., 2015).

Wearable and Digital Technologies landscape

Since the initiation of the 21st century, the augmentation of PA within primarily sedentary adult populations has consistently occupied a prominent position on the public health agenda (Tudor-Locke & Myers, 2001). This commitment stands resolute as a perpetual cornerstone, as pillar number three out of seventeen, enshrined in *The 2030 Agenda for Sustainable Development* (Cf, O. D. D. S., 2015).

Over the past two decades, the significance of wearable technology has struggled to secure a definitive position, encountering ambiguity among both health and fitness practitioners and clients. For instance, this specific trend emerged initially in 2016 (ranking #1 until 2017, then dropping to #3 in 2018) due to the saturation of this “overbooked” sphere, where numerous commercial entities, primarily for-profit companies, vied for prominence without considering the myriad stakeholders involved in this industry (Thompson, 2018).

It is important to delineate the classification under which wearable technology falls: the domain of “digital” technologies (1). This territory primarily encompasses three key components: wearable technology or AT (ranked #1), mobile exercise apps (#7), and data-driven training technology (#18) (Table 1). An attempt to clarify the most pertinent aspects of these three digital pillars is underway.

Understandably, given the level of advancements reached, it seems plausible to envisage a potential shared trajectory among these three digital facets within the health and fitness industry, especially with recent discussions around artificial intelligence (AI) and big data approaches. Traditionally, wearables and apps have often been perceived as more established and interconnected in the timeline, whereas the emergence of data-driven training applications represents a relatively "fresh" introduction. However, it is likely that during this early

stage of technological stabilization or affirmation, these tools might evolve along different trajectories, albeit closely related, potentially forming distinct paths in the perceptions and applications within most B2C dynamics. Wearable technology primarily emphasizes continuous data collection and monitoring, mobile exercise apps predominantly offer guidance and tracking through smartphones, and data-driven training technology utilizes amassed/stored data to deliver personalized and optimized training plans (Bort-Roig et al., 2014). Each of these components possesses distinct strengths and serves varying user needs within the fitness and wellbeing sphere (Table 2). These practical actions aim to empower fitness and health professionals with tangible steps they can take in their daily practice to leverage digital technologies effectively and enhance consumer outcomes (Herberger & Litke, 2021; Monteiro-Guerra et al., 2019; Peart et al., 2019).

Table 1
Digital technologies trends comparison chart (*overall aspects*)

Aspect	**Wearable Technology**	**Mobile Exercise Apps**	**Data-Driven Training Technology**
Functionality	Captures biometric data	Provides workout guidance	Analyzes data for optimization
Portability	Worn on the body	Accessible on smartphones	Software-based, accessible online
Data Collection	Continuous monitoring	User input and tracking	Aggregates and analyzes various data
Features	Biometric tracking (HR, sleep, etc.)	Exercise guidance, tracking	Personalized training plans, analytics
Interactivity	Limited interaction	Moderate interaction	High interaction for analysis and adjustments
Customization	Limited customization	Some level of customization	Highly customizable plans based on data
Feedback	Real-time feedback	Post-workout analysis	Continuous feedback loop for improvement
Integration	Syncs with apps/software	Often stand alone	Integrates with various devices and platforms
Cost	Range of prices based on features	Often free with premium versions	Can vary based on complexity and services

Table 2
Practical tasks and actions for fitness and health professionals in day-to-day practice

Technology	Practical Tasks	Actions
Wearables	1. Conduct Device Assessments	regularly assess and recommend wearable devices based on client needs, considering factors like health goals and lifestyle preferences
	2. Educate on Biometric Data	explain the significance and limitations of biometric data to clients, ensuring they understand how to interpret and use the information
	3. Personalized Goal Setting	set personalized health and fitness goals based on the data collected by wearables, adjusting targets over time as clients progress
	4. Troubleshooting Guidance	provide troubleshooting tips for common wearable issues, enhancing user experience and adherence
	5. Stay Informed	stay updated on emerging wearable technologies and attend relevant workshops or training sessions to enhance proficiency
	6. Client Communication	effectively communicate with clients about privacy concerns, data security, and the importance of honest input for accurate insights
	7. Integration with Programs	seamlessly integrate wearable data into individualized fitness programs for a holistic approach to health improvement
Apps	1. App Familiarity	explore various fitness apps to recommend those aligning with client preferences, offering a diverse range of exercises and features
	2. App Personalization	guide clients in personalizing app settings, setting reminders, and adjusting preferences for tailored user experiences
	3. Regular App Updates	keep track of app updates and inform clients about new features or improvements that could enhance their experience
	4. Motivational Support	encourage clients to leverage app features for motivation, such as goal tracking, social sharing, and virtual challenges (including user gamification)
	5. Data Privacy Conversations	discuss the importance of data privacy with clients, helping them understand how their information is used and protected
	6. Training Program Integration	integrate app-based workout routines and nutrition plans into personalized training programs for consistent progress tracking
	7. User Training Sessions	conduct training sessions to familiarize clients with app features, ensuring they optimize the tools for their benefit

Table 2
Practical tasks and actions for fitness and health professionals in day-to-day practice (*cont.*)

Tech-nology	Practical Tasks	Actions
Data Driven	1. Technology Proficiency	develop proficiency in using sports data-driven technologies, attending training sessions or seeking certifications as needed
	2. Biomechanical Understanding	deepen understanding of biomechanics and physiological metrics collected by wearables, mobile apps and sensors
	3. Interdisciplinary Collaboration	collaborate with sports scientists, physiologists, and coaching staff to comprehensively analyze and interpret athlete data
	4. Video Analysis Workshops	conduct or participate in video analysis workshops to enhance the ability to provide feedback on technique improvement
	5. Injury Prevention Programs	develop and implement injury prevention programs based on insights derived from sports data analytics
	6. Regular Data Reviews	regularly review team-wide data, identifying patterns and areas for improvement in both individual and team performance
	7. Stay Tech-Savvy	stay updated on advancements in sports technology, attending conferences and engaging with industry publications

Consumer Typology Proficiency Dynamics

Digital technologies such as websites, online discussion forums, social media, content-sharing platforms, mobile apps, and wearable devices, have been available for over a decade as avenues for individuals, to acquire knowledge about and advocate for their health, physical fitness, and overall well-being in an age characterized by co-created content (Lupton, 2020). These insights acknowledge the physical, emotional, and relational aspects inherent in navigating digital health and fitness environments, surpassing human-centric viewpoints and perspectives. Within the portfolio of clients engaged with field practitioners, the primary differentiation often relies on the level of involvement with digital technologies, particularly evident following the thresholds set after the COVID-19 pandemic (Angosto et al., 2023). The differentiation among users of sports and fitness wearables requires an understanding of their behaviors, motivations, and interactions with these resources, typically categorized into three groups (Table 3): beginners, average users, and enthusiasts/experts (each group characterized by four main traits). Customer engagement varies significantly among these groups and has persisted since the postmodern era of the

health and fitness industry (Glassner, 1989). Enthusiastic users display higher engagement levels due to their deeper integration and exploration of wearable/digital features. They actively seek new functionalities, participate in communities, and provide feedback for enhancements. Average users maintain consistent engagement, driven by specific fitness goals and a desire for gradual progress. Beginners exhibit sporadic engagement, influenced by their evolving interest in fitness and health.

Table 3
Digital technologies levels and consumer typologies in health and fitness sector

Pillars	**Users**		
Traits	***Beginner***	***Average***	***Enthusiast/Expert***
1	*Low Commitment* often exhibiting low dedication levels using these devices intermittently, especially during initial phases of adopting a routine	*Consistent Usage* maintaining a moderate level of engagement, using regularly to monitor progress and maintain routines	*Self-Motivated & Competitive* largely self-motivated, driven by personal challenges, competitions, or mastery of their healty regime
2	*Basic Tracking* usage revolves around fundamental features like step counting or basic activity monitoring	*Goal-Oriented* focus on achieving specific fitness goals, utilizing to track progress, such as calorie burn, heart rate, and distance covered	*Tech-Savvy & Experimentation* inclination to experiment with different physical tools or apps, seeking the latest technology or features to optimize their routines
3	*Motivation* (pretended) newfound interest in active goals, seeking external motivation to kickstart a healthier lifestyle	*Social Integration* engaging more with social features, connecting with friends or communities for motivation and accountability	*Advanced Tracking & Analysis* exploring and utilizing various features extensively, including advanced metrics like sleep analysis, detailed workout breakdowns, and comprehensive health data
4	*Sporadic Engagement* fluctuating, influenced by external factors such as social support or initial (intrinsic) enthusiasm	*Incremental Growth* exploring gradually additional features beyond basic tracking, incorporating more advanced functionalities	*Highly Engaged* exhibiting high and sustained devotion, often integrating them deeply into their lifestyle (not only limited to physical activity)

It is worth emphasizing that active workers in health and fitness field are not only active consumers of these *general* tools, which act as the linchpin connecting them with consumers. They are, across various levels within this 'working class' classification, also influenced by customer relationship management software, i.e. often diverse programs or applications that their own facilities or employers employ to serve *specific* business objectives (Addolorato et al., 2024).

In commercial product-service research, factors like applicability, usability, personalization, social integration, and the ability of digital solutions to motivate diverse user groups are often examined (Addolorato et al., 2020). Comprehending these behaviors and motivations aids companies in tailoring their resources to better engage and retain users amidst the wave of enthusiasm associated with the "experience". Health and fitness professionals should recognize the fact that from the manufacturers/providers' perspective, they can be perceived as additional, on-the-field promoters of their creations along this continuum.

Digital technologies from now on

The health and fitness industry currently holds a favorable position owing to the longstanding adoption of digital technologies, a historical legacy that surpasses many other digital sectors. Over recent years, both industry professionals and the general public have gradually embraced this trend. Within AI-based digital technologies, exemplified by the latest fitness apps and their advancements, the effective integration of behavior change techniques stands as a pivotal factor in promoting active lifestyles and enhancing health outcomes (Kuru, 2023).

The incorporation of these solutions into wearable technology, mobile exercise apps, and data-driven training technology has the potential to revolutionize the health and fitness industry, benefiting both trainers and end-users (Anderson et al., 2022; Eysenbach, 2023). Goal setting, action planning, behavior self-monitoring, personalization, and social support represent primary and noteworthy effects of both conversational artificial intelligence (CAI) and generative artificial intelligence (GAI) when applied to instilling healthy habits (Table 4).

Table 4
Digital technologies levels and AI typologies in health and fitness sector

AI	**Digital Technologies**		
Typologies	***Wearables***	***Apps***	***Data Driven***
Conversational (interaction, CAI)	*Integration* utilize algorithms to provide deeper insights into health data. For instance, could analyze biometric data to detect patterns, predict health issues, and offer proactive suggestions for improvement	*Guidance* could enhance exercise by offering more personalized guidance. Advanced algorithms could analyze user behavior, preferences, and performance to recommend customized workout routines or nutrition plans	*Optimization* could leverage for more sophisticated data analysis. Identifying nuanced correlations within data sets to optimize training plans, foresee plateaus, and suggest adjustments for better results among varied data segments (up to what is in possession)

Table 4
Digital technologies levels and AI typologies in health and fitness sector (*cont.*)

AI	**Digital Technologies**		
Typologies	***Wearables***	***Apps***	***Data Driven***
Generative (prediction, GAI)	*Creation* generating personalized exercise routines or adaptive health goals based on real-time data. For example, a powered tool might create dynamic workout plans considering an individual's progress, energy levels, and overall health data	*Feature* might generate workout plans, dietary suggestions, or even mental health exercises tailored to individual needs. Could create adaptive, engaging content to keep users motivated and focused	*Customization* could create highly personalized training regimes by considering various factors such as genetics, lifestyle, and performance data (predicting proposals). It could dynamically adjust training plans in real-time, maximizing efficiency

CAI holds potential to support practitioners by leveraging extensive datasets, providing comprehensive insights for informed decision-making in training strategies, injury prevention, and personalized client recommendations (Uunona & Goosen, 2023). Meanwhile, GAI, by e.g. ChatGPT (Eysenbach, 2023), applied to tailored planning tools could aid professionals in devising hyper-personalized plans by utilizing client data to customize exercises, nutrition, and recovery strategies. CAI for consumers could offer highly personalized experiences, delivering bespoke exercise routines, dietary advice, and wellness plans adjusted to individual needs and objectives (Guelmami et al., 2023; Shajari et al, 2023; Zhou et al., 2022). Conversely, GAI might provide adaptive support through powered platforms capable of recognizing shifts in user behavior or health metrics, adjusting recommendations for continual improvement and motivation (Table 5).

Table 5
Practical interactions for fitness and health professionals to interact with conversational (*CAI*) *and generative artificial intelligence* (*GAI*) *based on user levels* (*beginners, average, and enthusiast/expert*) *across three different categories of digital technologies* (*wearables, apps, and data-driven platforms*)

Category	**User Level**	**Practical Interactions**	**CAI and GAI Routine Activities for Health and Fitness Professionals**
Wearables	Beginner	Personalized Setup Assistance	use conversational AI to guide through the setup process of wearable devices, explaining functionalities and providing step-by-step instructions
		Basic Data Interpretation	implement generative AI chatbots to interpret basic biometric data, offering simple explanations to beginners and ensuring they understand the significance
		Goal Setting Support	utilize conversational AI to assist in setting realistic health and fitness goals based on their current abilities and preferences

Table 5
Practical interactions for fitness and health professionals… (*cont.*)

Category	User Level	Practical Interactions	CAI and GAI Routine Activities for Health and Fitness Professionals
Wearables	Average	Progress Review Sessions	schedule regular AI-assisted progress review sessions, providing insights into their achievements, areas for improvement, and adjustments to goals
		Troubleshooting Guidance	use generative AI to troubleshoot common issues or questions that average users might encounter with their wearables
		User Education Webinars	conduct webinars with conversational AI support to educate on the advanced features and capabilities of their wearable devices
	Enthusiast / Expert	Advanced Data Analysis	collaborate with AI specialists to provide in-depth data analysis, leveraging advanced and predicting algorithms to extract actionable insights
		AI-Integrated Workshops	organize workshops integrating AI tools to educate on optimizing the use of wearables for specific health and fitness objectives
Apps	Beginner	App Onboarding with Chatbots	implement chatbots for guiding through mobile fitness app onboarding, explaining features, and answering basic questions
		AI-Personalized Workout Plans	utilize generative AI to create friendly-personalized workout plans within the app, ensuring appropriate exercises and intensity
		Motivational Chat Support	incorporate conversational AI for providing motivational chat support, encouraging adherence and positive behavior change
	Average	AI-Enhanced Progress Tracking	integrate AI algorithms for more sophisticated progress tracking, offering detailed insights and trend analysis
		Adaptive Training Recommendations	utilize generative AI to suggest adaptive training recommendations based on feedback, performance data, and changing/improving fitness levels
		Nutritional Guidance Chat	implement conversational AI for providing nutritional guidance and answering dietary questions
	Enthusiast / Expert	AI-Integrated Challenges	organize AI-driven fitness challenges within the app, creating personalized and competitive experiences (full app domain)
		AI-Enhanced Virtual Coaching	introduce AI-enhanced virtual coaching sessions, combining expert knowledge with generative AI insights for highly customized training

Table 5
Practical interactions for fitness and health professionals… (*cont.*)

Category	User Level	Practical Interactions	CAI and GAI Routine Activities for Health and Fitness Professionals
Data Driven	Beginner	AI-Guided Consumers Onboarding	utilize conversational AI to guide through the onboarding process of sports data-driven technologies, ensuring a smooth introduction
		Basic Performance Insights	implement generative AI for providing basic insights into athlete performance data, helping in understand key metrics
		AI-Enhanced Injury Prevention Tips	use conversational AI to deliver injury prevention tips and guidance based on their health or sports data
	Average	Automated Training Adjustments	integrate generative AI to automatically adjust training plans based on performance data and recovery metrics
		AI-Driven Recovery Strategies	provide advanced recovery strategies through AI algorithms, optimizing performance and reducing injury risks
		Performance Review Webinars	conduct webinars with AI support for reviewing performance data, offering insights and actionable recommendations to users
	Enthusiast / Expert	AI-Supported Game Strategy Sessions	collaborate with AI specialists to conduct game strategy sessions, incorporating AI insights for tactical improvements
		AI-Integrated Sports Science Workshops	organize workshops integrating AI tools to provide them with in-depth insights from sports science and technology

While the potential of these technological advancements is encouraging, it is imperative to exercise meticulous deliberation concerning data privacy, the ethical application of artificial intelligence, and the preservation of equilibrium between automation and human expertise, encompassing the enduring dynamics of human-machine interactions. The primary aim is to empower both professionals and consumers (patients and general clients) with state-of-the-art technology that optimizes health outcomes while respecting individual preferences and privacy concerns.

Conclusion

This article delves into the transformative capacity of wearable and digital technologies in revolutionizing B2C dynamics within the health and fitness industry. Acting as a bridge between professional practices and consumer needs,

these technologies function as a unifying force, offering unprecedented empowerment to both parties. Wearable and digital technologies are fundamentally reshaping the dynamics between health and fitness professionals and consumers within the B2C landscape.

The first set of pillars underscores the personalized nature of health and fitness interventions enabled by these technologies. Leveraging real-time biometric data collected through wearables, professionals can tailor individualized health and fitness plans, ensuring a targeted and responsive approach. Remote health monitoring becomes an integral facet, offering professionals the ability to track and manage consumer well-being in real-time, leading to proactive interventions and a continuous healthcare experience. Engaging consumers through gamification elements within digital platforms fosters adherence to fitness goals and cultivates a sense of community. Telehealth consultations capitalize on wearables and digital platforms to extend healthcare accessibility, allowing professionals to leverage wearable data for informed virtual discussions. The integration of wearables with Electronic Health Record (EHR) systems creates a unified health profile, enhancing the comprehensive understanding of consumer health histories.

The second set of pillars emphasizes the data-driven and behavioral change aspects facilitated by wearable and digital technologies. Data-driven wellness programs leverage aggregated information from wearables to design holistic health programs, incorporating individual preferences and behavioral patterns. Behavioral change interventions, guided by AI-driven insights, enable professionals to identify and address behavior patterns through personalized nudges and coaching strategies. Seamless integration of wearable data with EHR systems contributes to a unified health profile, aiding in informed decision-making. The establishment of health and fitness communities within digital platforms creates a supportive environment, fostering mutual encouragement, motivation, and accountability among users. In summary, these pillars collectively represent the transformative power of wearable and digital technologies, acting as conduits for personalized, data-driven, and socially connected health and fitness experiences.

In conclusion, by leveraging accurate and reliable data from wearables, health and fitness professionals can promote personalized and effective interventions that encourage better adherence to physical activity regimens. However, ethical considerations, including data privacy and the responsible use of personal health information, must be prioritized to ensure trust and protect client confidentiality. Additionally, the use of GAI and CAI can further support professionals by providing insights and facilitating communication, but must also be employed ethically and responsibly. Balancing technological advancements with ethical standards will be crucial in maximizing the benefits of wearables in the fitness industry.

Key takeaways

— *Empowerment via technology*, wearable and digital technologies help consumers through real-time data, personalized insights, and guidance, enabling active management of their health and fitness journeys.
— *Enhanced professional-customer connectivity*, these innovations foster a closer bond between health and fitness professionals and consumers, facilitating personalized, data-driven guidance and support.
— *Optimized industry dynamics*, the integration of these technologies reshapes the B2C landscape, creating more efficient channels for sector practitioners to deliver services and for patients/clients to engage in their wellbeing goals.
— *Potential for continuous evolution*, technological advancements promise ongoing innovation in personalized health and fitness solutions, indicating a continual evolution in how professionals and consumers interact and achieve their objective.

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