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EDUCATIO ARTIS GYMNASTICAE

4/2025

STUDIA UNIVERSITATIS BABEŞ-BOLYAI EDUCATIO ARTIS GYMNASTICAE

4/2025
DOI:10.24193/subbeag.70(4)

ISSN (print): 1453-4223; ISSN (online): 2065-9547; ISSN-L: 1453-4223

PUBLISHED BY BABEŞ-BOLYAI UNIVERSITY

EDITORIAL BOARD:

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YEAR **Volume 70 (LXX) 2025**
MONTH **DECEMBER**
ISSUE **4**

PUBLISHED ONLINE: 2026-01-30
PUBLISHED PRINT: 2026-01-30
ISSUE DOI: 10.24193/subbeag.70(4)

CONTENT/ SOMMAIRE/ INHALT/ CUPRINS

STUDIA UBB EDUCATIO ARTIS GYMN., LXX, 4, 2025, pp. 5-18
(RECOMMENDED CITATION)
DOI:10.24193/subbeag.70(4).27

The Relationship Between Movement, Mathematics, and Logical Thinking

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Received 2025 November 09; Revised 2025 December 30; Accepted 2026 January 05; Available online 2026 January 30; Available print 2026 January 30

ABSTRACT. **Introduction:** Sedentary lifestyles among teenagers persist despite initiatives like daily physical education. While schools are primary arenas for promoting activity, many Hungarian students remain hypoactive and overweight, increasing risks of circulatory diseases. Previous research indicates positive associations between physical activity and cognitive functions. **Objective:** This study investigated the direct and indirect effects of movement on mathematical skills and logical thinking. **Methods:** The first part compared physical performance indicators (agility, speed, endurance via 505 tests, sprint, Yo-Yo test) with mathematics test scores and Raven test for logical thinking in 161 grade 6 and 8 students from sports-focused versus general curriculum schools. The second part assessed a 6-week locomotor intervention using the VSL3D ladder in mathematics lessons (2 lessons/week) with 10 lower secondary students with special educational needs (SEN), measuring changes in math performance and subject attitudes. **Results:** Sports school students demonstrated significantly better physical performance and mathematics scores. The VSL3D intervention yielded significant improvements in specific geometry skills (spatial orientation, mirroring) for SEN students, and mathematics became a more frequently preferred subject, though general liking scores did not change significantly. **Conclusions:** These findings support the complex positive effects of movement on cognitive and academic aspects, suggesting distinct benefits from general physical fitness and targeted, coordinative movement interventions.

Keywords: *physical activity, cognitive function, mathematics performance, coordination skills, VSL3D*

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INTRODUCTION

Movement, as a fundamental human activity, is increasingly recognized for its relationship with cognitive functions (Chaddock-Heyman et al., 2018) and academic performance (Yangüez, Bediou, Hillman, Bavelier, & Chanal, 2021). Many studies highlight the concerning prevalence of sedentary lifestyles among adolescents, with daily physical education often insufficient to counteract this trend (Szakály, Bognár, Lengvári, & Koller, 2018). In Hungary, a significant percentage of students are overweight or obese, contributing to circulatory system diseases and impacting national health statistics (Csányi, Kaj, Kälbli, Hernádi, & Király, 2018; Csányi, Kaj, Kälbli, Hernádi, & Király, 2020). Conversely, higher physical literacy, developed through diverse multi-sport activities, is linked to healthier lifestyles (Thür, Fügedi, 2020).

The neurobiological benefits of physical activity are substantial, including structural brain changes (Chaddock-Heyman et al., 2018) and enhanced cognitive processes (Sibley & Etnier, 2003). Specifically, moderate to high-intensity exercise, meeting WHO recommendations of 60 minutes daily for children (WHO, 2020), acts as a catalyst for physiological mechanisms supporting brain health (Stillmann, Cohen, Lehman, & Erickson, 2016). Research suggests a positive correlation between cardiorespiratory fitness and cognitive domains like executive functions, working memory, attention, and processing speed, which are integral to academic subjects such as mathematics and reading comprehension (Donnelly et al., 2016; Geertsen et al., 2016; Hillman, Erickson, & Hatfield, 2017).

Despite a general consensus on the positive link between physical activity and cognition (Burns, Bai, Fu, Pfledderer, & Brusseau, 2019a; Kirk, Hillman, & Kramer, 2015), the translation of these benefits into direct academic achievement, particularly in subjects like mathematics, remains an area of ongoing investigation with varied methodologies and findings. Some studies show a positive association between fitness levels (especially endurance) and mathematics scores (Yangüez et al., 2021), while others indicate that classroom-based physical activity can improve concentration and classroom behaviour but may not directly enhance cognitive function or subsequent activity levels (Watson, Timperio, Brown, Best, & Hesketh, 2017). Motor skills, particularly fine motor skills, speed, and agility, have also been positively associated with mathematics and reading achievement, especially in early school years (Macdonald, Milne, Orr, & Pope, 2018). Moreover, movement interventions may alleviate subject-specific anxiety, a significant barrier to learning, particularly in mathematics (Eysenck, Derakshan, Santos, & Calvo, 2007; Nótin, Páskuné Kiss, & Kurucz, 2012).

Donnelly and Lambourne (2011) proposed a model where physical activity supports learning through conditioning-related factors. However, the specific impact of coordinative movement-based interventions, distinct from general fitness or endurance activities, on mathematical abilities and logical

thinking warrants further exploration. There is a need to differentiate the effects of general physical preparedness (e.g., speed, agility, endurance) from those of targeted movement programs integrated into academic lessons.

OBJECTIVES AND HYPOTHESES

This study, therefore, aimed to investigate the relationship between movement and mathematics and logical thinking from two perspectives:

1. To compare physical performance indicators (speed, agility, endurance) and logical thinking (Raven test scores) with mathematics test scores between students in sports-focused versus general curriculum schools.
2. To evaluate the impact of a classroom-based locomotor intervention using the VSL3D ladder on mathematics performance and subject-related attitudes among students with special educational needs (SEN).

We hypothesized that students with higher physical fitness would exhibit better mathematics and logical thinking scores, and that the VSL3D intervention would positively affect mathematics skills and attitudes in SEN students, potentially offering an alternative pathway for learning support based on coordination skills.

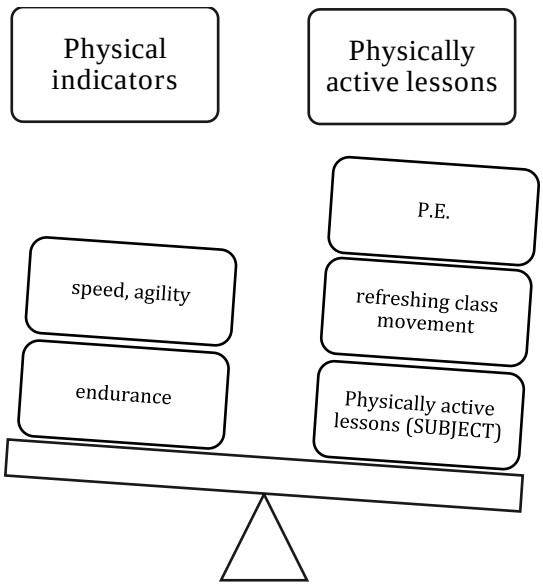

Fig. 1. Conceptual framework of the relationship between physical activity, physical indicators, and subject performance
Source: Authors

MATERIALS AND METHODS

This research comprised two distinct studies investigating the relationship between movement and mathematical/logical thinking. Informed consent was obtained from parents and assent from students where appropriate.

Study 1: Physical Indicators, Logical Thinking, and Mathematics Performance

- *Participants*
  A total of 161 students from grade 6 (n=80) and grade 8 (n=81) in a county town in Hungary participated. Participants were recruited from schools with a standard physical education curriculum (general curriculum group: grade 6, n=39; grade 8, n=38) and schools with a specialized sports-focused public education program (Special type sports class group; sports group: grade 6, n=41; grade 8, n=43). This grouping allowed for comparison based on differences in the pedagogical program and intensity of physical education.
- *Measures*
  - Physical Performance:
    - Speed and Acceleration: Measured using light gates for 5m, 10m, 20m, and 30m sprints from a standing start. The better of two trials was recorded.
    - Agility: Assessed using the validated 505 Agility Test (Draper & Lancaster, 1985). Students performed the test in both left and right directions; the better of two trials was recorded.
    - Endurance: Evaluated using the Yo-Yo Intermittent Recovery Test Level 1 (Bangsbo, Iaia, & Krustrup, 2008). This test was performed once.
  - Mathematics Performance: Scores were obtained from a validated, paper-based mathematics test selected from previous national competency assessments in Hungary. Mathematical literacy tests examine how well students are able to apply mathematical knowledge learned in school to real-world situations and contexts. While the assessment considers mathematics curricula, it doesn't expect students only to use the knowledge required for their specific grade level.
  - **Logical Thinking:** Assessed using a mobile application version of Raven's Progressive Matrices for logical thinking and problem solving. Scores were recorded.

- *Procedures*
  Physical performance tests and the Raven test were administered to all participants. Mathematics test scores were obtained from school records or administered concurrently.
- *Analysis*
  Descriptive statistics (means, standard deviations) were calculated for all measures. Independent samples t-tests were used to compare the mean scores of physical indicators, Raven test results, and mathematics test scores between the sports school groups and general curriculum groups for each grade level. The significance level was set at $p < 0.05$.

Study 2: VSL3D Locomotor Intervention in Mathematics for SEN Students

- *Participants*
  Ten students (N=10) with Special Educational Needs (SEN) from a lower secondary school institution in the South Hungary region participated.
- *Measures*
  - Mathematics Performance: Assessed using pre- and post-intervention mathematics worksheets designed by the researchers. These worksheets included algebraic tasks, geometric tasks (e.g., spatial orientation, mirroring), and problem-solving items. Scores were based on the number of correctly solved items. The worksheet likely consisting of 10 distinct items, identified by "M/" prefixes and point-value suffixes (e.g., "M/1-2p" indicates 2 possible points for that item). For each of these items, performance data (mean scores and standard deviations) was collected from two separate measurement occasions, consistently involving all participants for each. A comparative statistical analysis, specifically a t-test, was then conducted to compare the mean scores between these two measurements for every individual item / subscale. These individual item scores contribute to an overall assessment score, indicated to have a maximum total of 100 points.
  - Attitude towards Mathematics:
    - Liking of Mathematics: Assessed pre- and post-intervention using a 5-point Likert-type scale, modified with smiley faces for easier comprehension by SEN students (1 =very much dislike; 2 =dislike; 3= neutral; 4 =like; 5 =very much like).

§ Subject Preference: Assessed pre- and post-intervention by asking students: "Which are your three favourite subjects?" The frequency of "mathematics" appearing in their top three choices was recorded.

o Intervention Tool: The VSL3D (Variable Sport Ladder 3D) (Kertész, 2021) was used.

· *Procedures*

The intervention lasted for 6 weeks. Participating teachers received three webinars on the use of the VSL3D system and were provided with the tool, a methodological guide (Kertész, Cseresznyés, 2015), and VSL3D-based lesson plans for mathematics. Students used the VSL3D ladder during mathematics lessons for two sessions per week, engaging in movement-based learning activities as part of the intervention. Pre-intervention (input) measures (mathematics worksheets, attitude/ preference) were collected before the intervention began, and post-intervention (output) measures were collected upon its completion.

· *Analysis*

Descriptive statistics were calculated for pre- and post-intervention scores. Paired samples t-tests were used to compare pre- and post-intervention means for mathematics worksheet scores (total and sub-scores) and liking of mathematics scores. Changes in the frequency of mathematics as a preferred subject were descriptively analysed. The significance level was set at $p < 0.05$.

RESULTS

Study 1: Physical Indicators, Logical Thinking, and Mathematics Performance

Students in the sports-focused groups consistently demonstrated better mean scores on physical performance measures compared to students in the general curriculum groups in both grade 6 and grade 8 (see Table 1 and Table 2).

Table 1. Mean Physical Performance Indicators for Grade 6 Students by Curriculum Type (N=80)

Physical indicators (mean)	**Speed (s)**				**Agility**	**Endurance**
	5m	**10m**	**20m**	**30m**	**(s)**	**(m)**
6. general curriculum (n=39)	1.37	2.35	4.17	5.91	3.42	680
6. sport curriculum (n=41)	1.31	2.33	3.89	5.61	3.29	780

Table 2. Mean Physical Performance Indicators for Grade 8 Students by Curriculum Type (N=81)

Physical indicators (mean)	**Speed (s)**				**Agility**	**Endurance**
	5m	**10m**	**20m**	**30m**	**(s)**	**(m)**
General curriculum 8 (n=38)	1.28	2.2	3.9	5.52	3.55	880
Sport curriculum 8 (n=43)	1.21	2.04	3.67	5.36	3.39	1080

Statistically significant differences were found between the sports and general curriculum groups for agility and endurance measures in both grades (independent samples t-test, $p < 0.001$). Significant differences were also observed for speed measures across various distances ($p < 0.001$).

Regarding mathematics performance and logical thinking, students in the sports groups also achieved higher mean scores on the mathematics competency tests and Raven test compared to the general curriculum groups (see Table 3).

Table 3. Mean Mathematics Competency and Raven Test Scores by Curriculum Type and Grade Level

Competence	**Mathematics (points)**	**Raven (scores)**
6 General curriculum (n=39)	1445	85
6 sport curriculum (n=41)	1540	96
General curriculum 8 (n=38)	1510	86
Sport curriculum 8 (n=43)	1634	99

Study 2: VSL3D Locomotor Intervention in Mathematics for SEN Students

Changes in mathematics performance for students with SEN following the 6-week VSL3D intervention are presented in Table 4. Significant improvements ($p < 0.05$) were observed for geometry tasks related to spatial orientation (M/2: $t(9) = -2.52$, $p = 0.021$) and a trend towards improvement was noted for mirroring tasks (M/4: $t(9) = -1.77$, $p = 0.094$). No statistically significant changes were detected in the algebra task scores or the total mathematics worksheet score (Total_100p: $t(9) = 0.15$, $p = 0.885$).

Table 4. Changes in Mathematics Worksheet Scores for Students with SEN (N=10) Pre- and Post-VSL3D Intervention.

Item	Pre-intervention Score	Post-intervention Score	t-value	p	Valid N 1st	Valid N 2nd	Std.Dev. 1st	Std.Dev. 2nd
M/1-2p	0.90	1.00	-0.25	0.809	10	10	0.88	0.94
M/2-6p	2.30	4.40	-2.52	0.021	10	10	1.77	1.96
M/3-8p	7.10	7.00	0.10	0.923	10	10	2.51	2.00
M/4-7p	0.90	2.00	-1.77	0.094	10	10	1.10	1.63
M/5-4p	2.70	2.90	-0.28	0.781	10	10	1.77	1.37
M/6-2p	0.40	1.00	-1.50	0.151	10	10	0.84	0.94
M/7-42p	22.70	19.20	0.56	0.581	10	10	14.80	12.98
M/8-8p	3.40	2.60	0.67	0.509	10	10	2.63	2.67
M/9-9p	1.00	1.20	-0.26	0.795	10	10	1.49	1.87
M/10-12p	2.00	0.60	1.63	0.120	10	10	2.49	1.07
Total_10(	4.40	41.90	0.15	0.885	10	10	24.03	21.58

Regarding affective changes, there was no statistically significant change in the mean liking of mathematics scores pre- and post-intervention (see Table 5).

Table 5. Change in Liking of Mathematics Scores for Students with SEN (N=10) Pre- and Post-VSL3D Intervention.

	Pre-intervention	Post-intervention	t-value	p	Valid N 1st	Valid N 2nd	Std.Dev. 1st	Std.Dev. 2nd
The love of Mathematics	4.20	3.90	0.57	0.572	10	10	1.23	1.10

However, an analysis of the subject preference list indicated a positive shift. Before the intervention, 5 out of 10 students (50%) did not list mathematics among their three favourite subjects. After the VSL3D program, this proportion decreased to 1 out of 10 students (10%), meaning 90% of students included mathematics in their top three favourite subjects (seeFigure2).

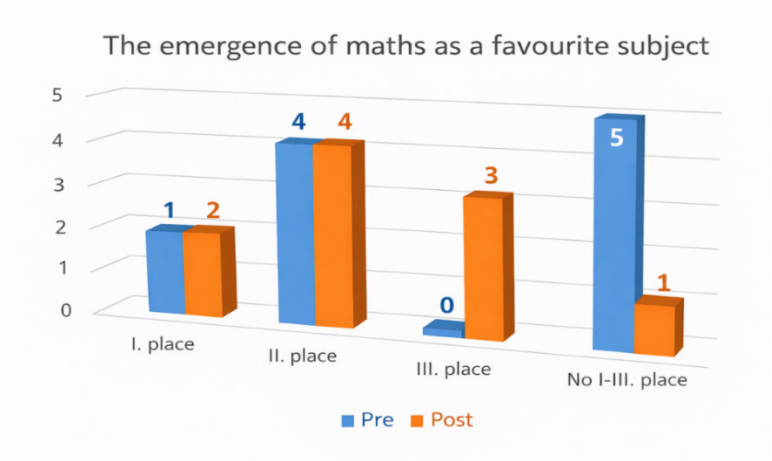

Fig. 2. Frequency of Mathematics Listed Among Top Three Favourite Subjects by Students with SEN (N=10) Pre- and Post-VSL3D Intervention
Source: Authors

DISCUSSION

This study investigated the multifaceted relationship between movement, mathematics, and logical thinking, employing two distinct approaches: comparing physically active students with their peers, and implementing a targeted movement intervention. The findings largely support the hypothesized positive impact of physical activity and specific movement programs on cognitive and academic outcomes.

In Study 1, students enrolled in sports-focused school programs consistently outperformed their peers from general curriculum schools in physical fitness indicators (speed, agility, endurance), mathematics competency, and Raven test scores for logical thinking. This aligns with a substantial body of literature suggesting that higher physical fitness correlates with enhanced cognitive functions and academic achievement (Donnelly et al., 2016; Yangüez et al., 2021). The observed superiority in mathematics might be linked to the general cognitive benefits of regular, structured physical activity, such as improved executive functions and attention (Geertsen et al., 2016). While direct statistical correlations between specific physical indicators and math scores within groups were not performed and assessed in the results presented here, the group differences suggest an overall advantage. The authors' previous work also supports these school-type differences (Thür, Fügedi 2020; 2021). It is plausible that agility, as a skill often requiring rapid decision-making and spatial awareness (Matlák, Rácz, & Tihanyi,

2014), may have a more direct cognitive link to mathematical problem-solving components than pure endurance or speed, though all contribute to overall physical literacy.

Study 2 demonstrated the potential of a targeted, coordination-based locomotor intervention (VSL3D ladder) to enhance specific mathematical skills in students with SEN. Significant improvements were noted in geometry tasks involving spatial orientation and mirroring. This suggests that movement activities emphasizing coordination, spatial awareness, and sequential processing—inherent in VSL3D ladder exercises—can directly benefit mathematical sub-skills that rely on similar cognitive processes. This finding resonates with research highlighting the link between motor skills (especially involving coordination) and academic performance (Macdonald et al., 2018). The lack of significant change in algebra tasks or overall math scores may be due to the relatively short intervention duration (6 weeks), the specific nature of the VSL3D tasks being more aligned with visuospatial and geometric concepts, or the inherent challenges in remediating broad mathematical difficulties in SEN students within a short timeframe.

Affectively, while the general "liking" of mathematics (measured by a Likert scale) did not significantly change for SEN students, there was a notable positive shift in mathematics being listed as a "favourite subject." This suggests the VSL3D intervention may have enhanced engagement or reduced negative perceptions associated with mathematics lessons, even if explicit "liking" scores remained stable. Increased engagement and preference can be crucial precursors to improved learning and sustained effort, especially for students who often experience academic frustration. This experiential aspect, enhancing motivation through movement games, aligns with practical observations (as noted by the authors).

The current findings contribute to the understanding that both general physical fitness and specific, cognitively engaging movement interventions can support mathematical learning. The results from Study 1 support models linking overall fitness and potentially higher cognitive engagement in sports school environments to better academic outcomes, consistent with Donnelly and Lambourne's (2011) model emphasizing conditioning factors (see Figure 3). Study 2, however, suggests an alternative or complementary pathway (see Figure 4, conceptualized by the authors) where learning is supported primarily through coordination-based movement activities, potentially improving specific cognitive skills directly relevant to academic tasks and enhancing student motivation.

Limitations of this research include the non-randomized nature of Study 1 group comparisons; pre-existing differences beyond physical activity levels could have influenced outcomes. The Raven test mobile application used in Study 1 was not formally validated, which should be considered when interpreting logical thinking scores. In Study 2, the sample size was small (N=10), limiting generalizability, and the intervention was short. Future research should explore

longer interventions with larger, diverse samples, potentially incorporating more varied mathematical content and validated cognitive measures. The precise mechanisms—whether improved brain function, enhanced specific cognitive skills like working memory or inhibition, or motivational factors—warrant further investigation using neuroimaging or detailed cognitive testing. As noted by Donnelly et al. (2016), understanding the biological basis, as well as optimal type, extent, intensity, and frequency of physical activity, remains key.

Despite these limitations, this study provides evidence that diverse approaches to integrating movement can be beneficial. The findings underscore the WHO's (2020) call for daily physical activity and suggest that schools have multiple avenues—enhancing general physical education effectiveness and creatively integrating movement into academic subjects—to not only combat sedentary behaviour and improve health but also to potentially support cognitive development and academic success.

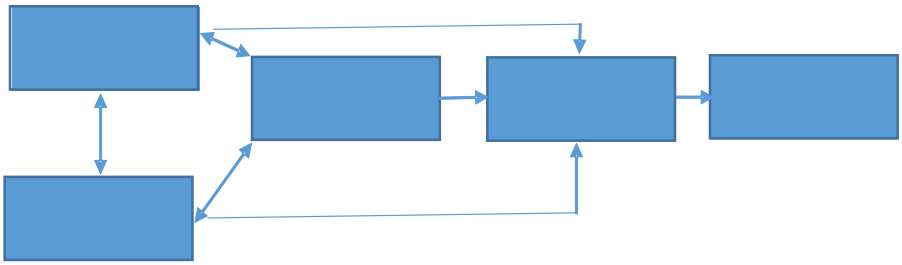

Fig. 3. Model of factors associated with improved learning outcomes
Source: Donnelly, & Lambourne, 2011, p37.

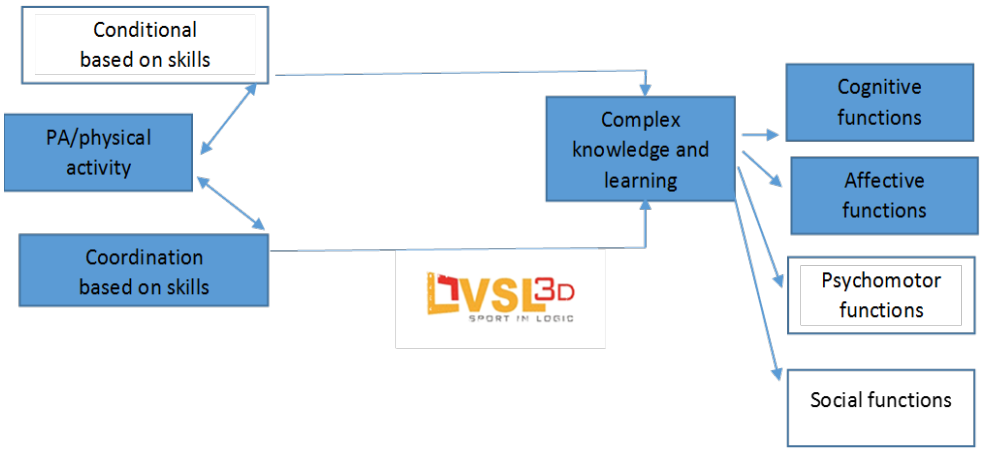

Fig. 4. An alternative way to support learning based on coordination skills
Source: Authors

CONCLUSIONS

This research demonstrated that students in sports-focused school programs exhibited superior physical fitness, mathematical competency, and logical thinking scores compared to peers in general curriculum schools, reaffirming the broad benefits of sustained physical activity. Furthermore, a targeted 6-week locomotor intervention using the VSL3D ladder for students with SEN led to measurable improvements in specific mathematics skills, particularly spatial orientation, and positively influenced their preference for mathematics as a subject.

The findings support a dual role for movement in education: fostering general physical and cognitive advantages through comprehensive physical activity programs, and enhancing specific academic skills and motivation through carefully designed, coordination-based movement activities integrated into classroom learning. While the mechanisms are complex and warrant further study with larger samples and more in-depth methodologies, this study indicates that both pathways contribute positively to student development. Incorporating diverse movement opportunities within the educational framework not only promotes physical health but also appears to be a valuable strategy for supporting cognitive function and academic engagement, aligning with calls for more active learning environments.

Disclosure statement
The authors report no conflicts of interest.

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STUDIA UBB EDUCATIO ARTIS GYMN., LXX, 4, 2025, pp. 19-31
(RECOMMENDED CITATION)
DOI:10.24193/subbeag.70(4).28

Distribution and Statistical Analysis of Refereeing Decisions

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Received 2025 October 02; Revised 2025 November 07; Accepted 2025 November 20; Available online 2026 January 30; Available print 2026 January 30

ABSTRACT. Introduction: Refereeing decisions, often influenced by biases like home advantage, play a crucial role in football outcomes. The introduction of Video Assistant Referee (VAR) in 2018 has sought to reduce subjective errors and improve fairness, leading to increased decision accuracy and potentially encouraging more confident attacking play inside the penalty area. **Objective:** The aim of this research was to explore the impact of the introduction of the VAR technology on the ratio of penalties, ball touches inside the penalty area, and attacking entry methods in the OTP Bank League. **Methods:** Data from the 2018/19 to the 2023/24 seasons were obtained from the Wyscout database. Statistical analyses employed Welch's t-test and Pearson's correlation. **Results:** The results showed a significant drop in penalty rates after VAR was introduced ($p = 0.0496$), with more ball touches inside the penalty area. Unexpectedly, the link between dribbling and penalties weakened, becoming negative post-VAR. Meanwhile, pass-based entries showed a strong positive correlation with penalties ($r = 0.94621$). Although overall entries rose, changes in specific entry types weren't statistically significant. **Conclusion:** The study found that the introduction of VAR in Hungarian top league reduced penalties, increased touches in the penalty area, and shifted attacking strategies by emphasizing pass-based entries over dribbling, highlighting VAR's impact on both refereeing and team tactics.

Keywords: *football, VAR, referee decisions, match analysis*

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INTRODUCTION

Refereeing decisions in football play a decisive role in determining match outcomes, especially regarding the awarding of penalty kicks. Throughout the sport's history, the role of referees has evolved, while match officiating has become increasingly complex (Bartha, 2006). Nevertheless, decision-making, even at the highest level, can be affected by a multitude of internal and external factors. Previous research has demonstrated that home advantage and subconscious referee bias are observable phenomena in professional sport, including football (Sors et al., 2021; Nevill et al., 2017; Harari, 2009). Such influences can often lead to decisions that favor one team, particularly the home side.

Studies on refereeing bias have addressed several aspects, ranging from the effect of crowd presence (Nevill et al., 2017; Işın and Gómez Ruano, 2023) to the sequential influence of prior decisions (Plessner and Betsch, 2001; Schwarz, 2011). Against this backdrop, the introduction of a technology capable of reducing subjective interference and promoting fairer officiating gained particular significance.

The Video Assistant Referee (VAR), officially introduced in 2018, was designed to support referees in the accurate assessment of critical incidents, particularly goals, penalties, red cards, and cases of mistaken identity (FIFA, 2018; Lago-Peñas, Gómez-Ruano et al., 2019). Beyond enhancing fairness, the system also aimed to maintain match flow (FIFA, 2018/19). Its application has yielded measurable outcomes: effective playing time has increased, and decision accuracy, for instance in the Premier League, rose from 82 percent to 96 percent (Li, Wang and Zhang, 2024; Brown, 2024). Although public and professional opinion remains divided (Ipsos, 2024; The Guardian, 2025), several studies confirm that VAR reduced erroneous calls and altered player behavior, including the decline of simulation (Li et al., 2024).

However, the impact of VAR extends beyond refereeing objectivity, it may also have shaped team attacking strategies. Research suggests that attacking players act more boldly inside the penalty area, as the risk of incorrect calls has diminished with VAR (Pérez, Ortega-Toro and Giménez, 2020; Buraimo, Migali and Simmons, 2020). Other investigations argue, however, that its primary effect lies in the more objective adjudication of existing situations, rather than a structural change in attacking play (Kolbinger & Lames, 2019).

This study seeks to determine how the introduction of VAR affected the number of penalties awarded, team activity within the penalty area, and entry strategies in the Hungarian top division (OTP Bank League). By comparing data from three pre-VAR and three post-VAR seasons using statistical methods, the research aims to provide an objective picture of whether technology increased

decision-making fairness and altered attacking philosophies. Ultimately, the goal is to contribute to the understanding of domestic tactical and refereeing trends.

HYPOTHESES

H1: The penalty rate significantly decreased after the introduction of VAR.

H2: The strongest relationship between entries into the penalty area and the penalty rate was consistently associated with dribble-based entries, both before and after the introduction of VAR.

H3: A significant increase can be observed in certain types of entry methods after the introduction of VAR, as teams attack the penalty area more deliberately.

MATERIALS AND METHODS

This study analyzed data from the OTP Bank League covering the 2018/19 to 2023/24 seasons, collected from the Wyscout database. The primary focus was on ball touches inside the penalty area, awarded penalties and their ratios, and the methods of entry into the box.

Data was compiled for both home and away performances, including all penalty kicks awarded (missed attempts included). The dataset was organized by venue, and the penalty rate was calculated relative to total touches inside the penalty area. Entry methods were classified into three categories: crosses, dribbles, and passes.

Since data were not available for all clubs across all six seasons, the analysis was restricted to the accessible dataset. To test the first and third hypotheses, Welch's t-test was applied to identify significant differences, while the second hypothesis was examined using Pearson's correlation to assess the strength of associations between entry methods and penalty rates.

RESULTS

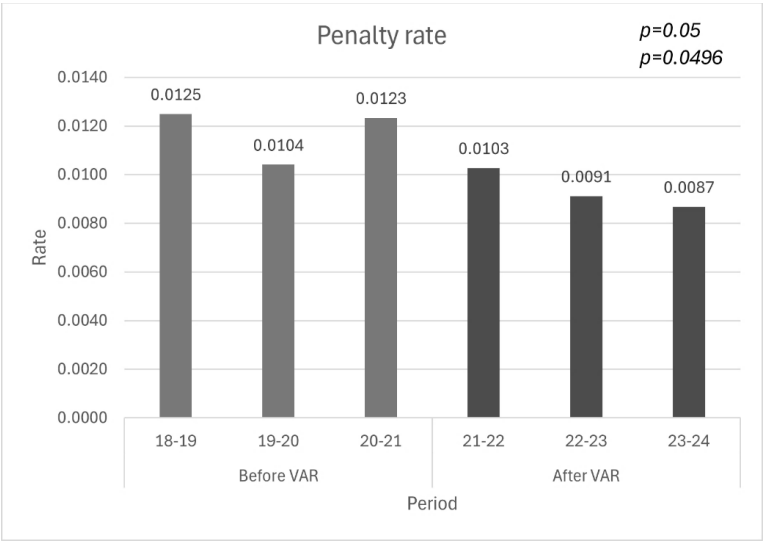

Figure 1. Penalty rate before and after VAR

The statistical results show that the number of penalties decreased while the number of ball touches increased after the introduction of VAR. According to the t-test ($p = 0.0496$), the penalty rate significantly declined following the implementation of the system, indicating that with the same number of touches inside the penalty area, fewer penalties were awarded (Figure 1).

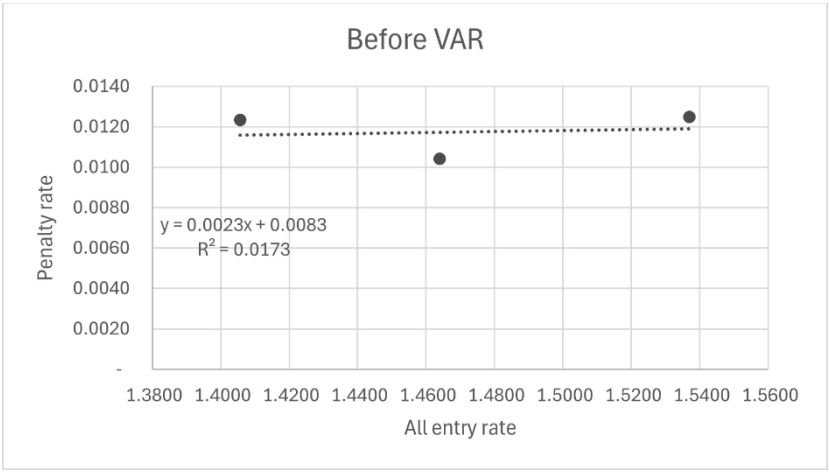

Figure 2. Pearson's correlation: Total entry - penalty rate before VAR

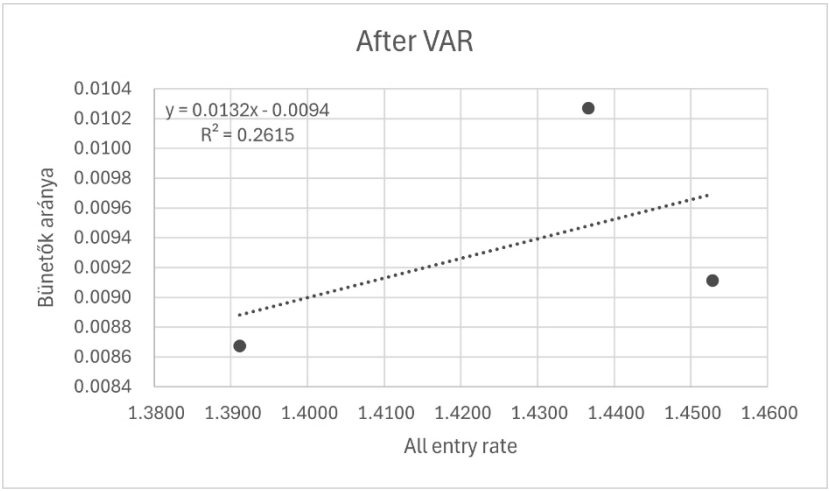

Figure 3. Pearson's correlation: Total entry - penalty rate after VAR

Correlation analysis revealed that the relationship between entry ratios and penalties became stronger after the adoption of VAR as depicted by Figure 2 and 3. In the pre-VAR period, the coefficient (r = 0.13139) suggested only a weak positive link, while in the post-VAR period (r = 0.51139) a moderate positive correlation emerged.

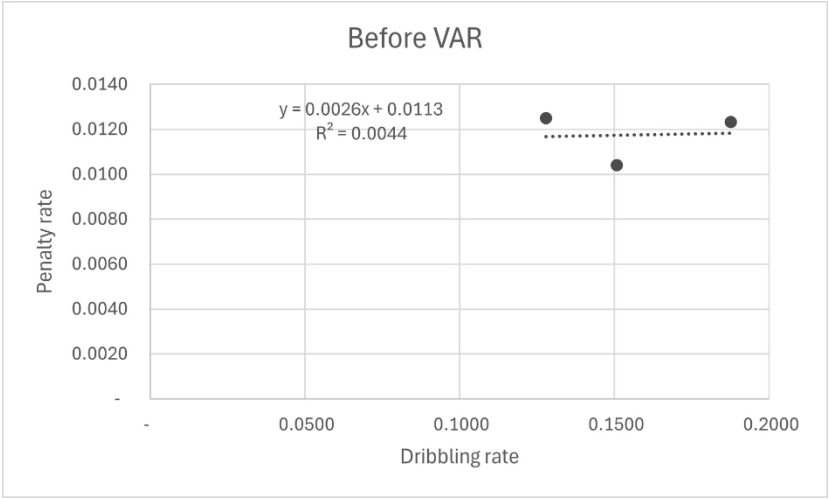

Figure 4. Pearson correlation: Dribbling – penalty rate before VAR

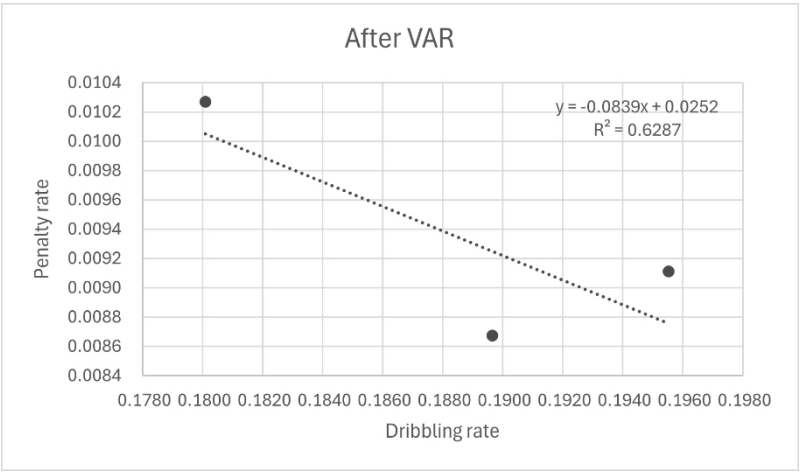

Figure 5. Pearson correlation: Dribbling – penalty rate after VAR

The relationship between entries with dribbling and the proportion of awarded penalties shows a significantly different pattern before and after the introduction of VAR, shown of Figure 4 and 5. In the pre-VAR period, a weak positive correlation (r = 0.06638) indicates no meaningful connection between this type of entry and penalties. In contrast, the strong negative correlation observed after VAR (r = -0.79292) suggests that an increase in dribbling entries into the penalty area actually reduces the likelihood of penalties being awarded.

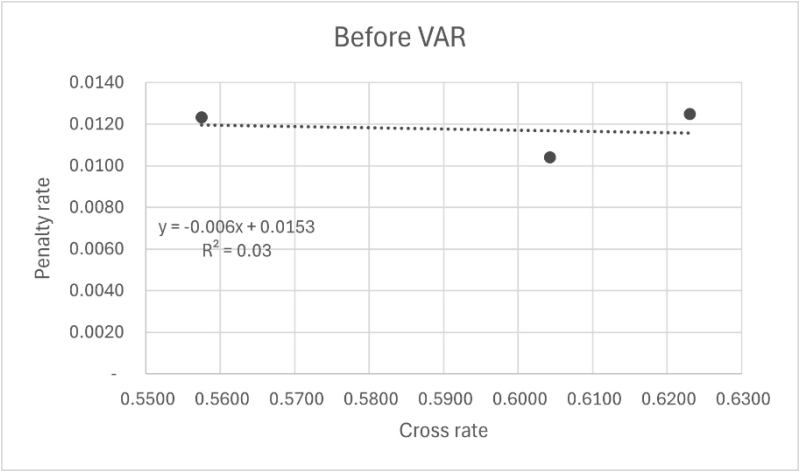

Figure 6. Pearson's correlation: Cross-to-penalty ratio before VAR

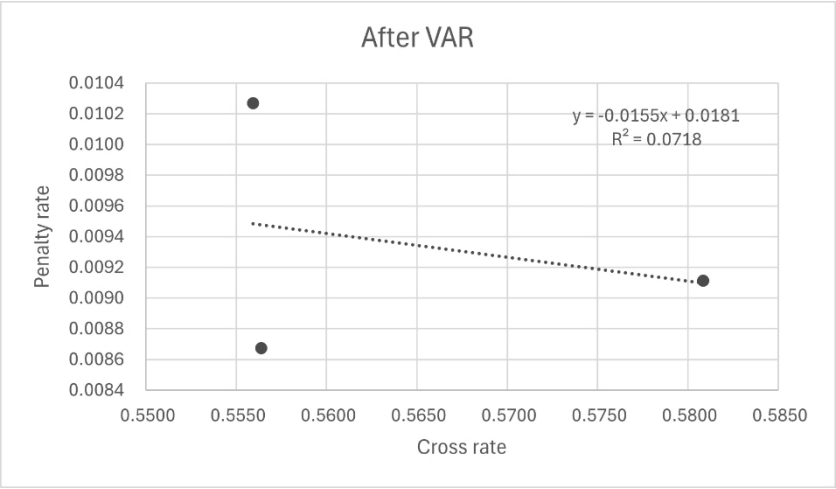

Figure 7. Pearson's correlation: Cross-to-penalty ratio after VAR

Cross-based entries showed weak negative relationships in both periods, illustrated on Figure 6 and 7 (pre-VAR r = -0.17316, post-VAR r = -0.26787).

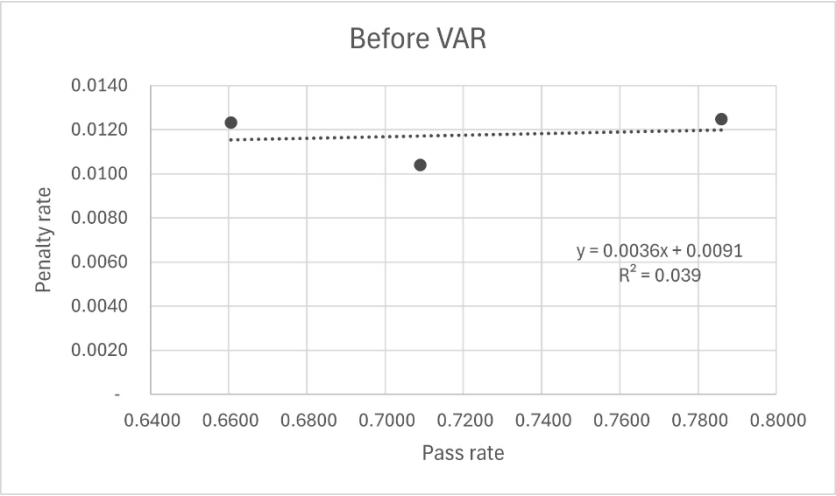

Figure 8. Pearson's correlation: Pass-to-penalty rate before VAR

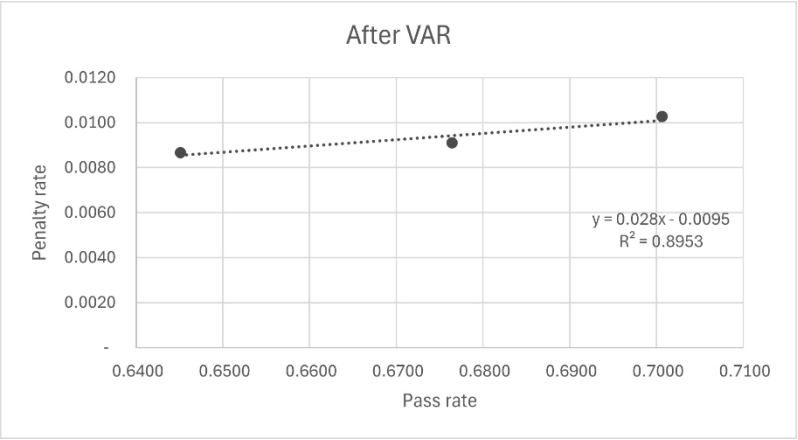

Figure 9. Pearson's correlation: Pass-to-penalty rate after VAR

Figure 8 and 9 show a dramatic strengthening of the relationship between pass-based entries into the penalty area and awarded penalties following the introduction of VAR. While the pre-VAR period exhibited only a weak positive correlation (r = 0.19754), this value rose sharply after VAR to a high level of 0.94621, indicating an almost perfect positive linear relationship.

Table 1. Data of all ball handling methods before and after VAR

Period	Season	All ball handling	Dribble	Cross	Pass	Total ball handling average
Before VAR	2018-2019	8 860	737	3 592	4 531	8 881
	2019-2020	9 005	927	3 717	4 361	
	2020-2021	8 777	1 171	3 481	4 125	
After VAR	2021-2022	9 094	1 140	3 519	4 435	9 267
	2022-2023	9 407	1 266	3 761	4 380	
	2023-2024	9 301	1 268	3 720	4 313	
SUMMARY OF TTEST	-	**0.0313**	0.1455	0.5274	0.7879	-

The results indicate that not all types of entries showed a significant increase before and after the introduction of VAR, summarized by Table 1. While there was a statistically significant rise in the total number of entries (p = 0.0313),

the p-values for individual entry types (dribbling, crosses, passes) exceeded the 0.05 threshold, meaning the changes in these categories are not statistically significant. This suggests that although the overall number of entries into the penalty area increased with the introduction of VAR, no comparable, significant change can be observed in the individual entry types.

DISCUSSION

Based on the results, the research hypotheses formulated from literature can be summarized as follows.

The first hypothesis assumed that the introduction of VAR significantly reduced the penalty rate in the Hungarian NB1 league. This assumption is supported by the results, and therefore the hypothesis is accepted. Although the present findings partly differ from international experiences, they still show several parallels with other leagues. In LaLiga, VAR increased refereeing accuracy, yet its impact on penalty frequency remained inconsistent: greater sensitivity to minor contacts raised penalty numbers in some matches but had no effect in others (Lago-Peñas et al., 2021). At the FIFA Women's World Cups, VAR similarly reduced incorrect decisions while improving the detection of smaller infringements (Zhang et al., 2022). In contrast, the decline in penalties in the NB I suggests that VAR exerted a deterrent effect, encouraging more cautious defending inside the penalty area. Other leagues also demonstrate heterogeneous outcomes: in Italy, Germany and Brazil, VAR either increased penalty awards by revealing minor contacts (Lago-Peñas, Rey & Kalén, 2019) or reduced them through shifts in decision-making patterns and greater referee caution (Meneguite et al., 2022). Broader analyses, including research on the European Championship, further show that VAR influences match structure, foul detection and referee bias, though the magnitude and direction of these effects vary across competitions (Veldkamp & Koning, 2023; Işın & Yi, 2024).

The second hypothesis proposed that dribbling-based entries into the penalty area would show the strongest correlation with the penalty rate both before and after the introduction of VAR. However, the findings do not support this hypothesis, which must therefore be rejected. The data indicates that pass-based entries demonstrated the strongest correlation with awarded penalties in both the pre-VAR and post-VAR periods, rather than dribbling-based entries. The broader literature, particularly Kolbinger and Lames (2019), emphasizes that VAR's primary purpose is to enhance refereeing accuracy rather than reshape attacking structures. Based on this, one might expect that relationships between penalty-area actions and penalty awards would remain stable after VAR's introduction, as the technology evaluates existing situations more objectively

rather than altering attacking styles. However, the present findings diverge from this assumption. Across both pre-VAR and post-VAR periods, passing entries into the penalty area showed the strongest association with penalty frequency, whereas dribbling entries were less correlated.

The relationship observed between dribbling entries and the penalty rate suggests that, although such actions are dynamic and often used to create individual scoring opportunities, defensive players may respond to them with greater awareness and caution. The introduction of VAR appears to have reduced the likelihood of penalties being awarded for minimal contact following individual runs, particularly in the absence of clear fouls. Furthermore, with the awareness of VAR review capabilities, defenders tend to act more carefully in these scenarios, which may have decreased the effectiveness of dribbling-based entries.

In contrast, the strong correlation between pass-based entries and penalty awards may be attributed to the nature of these situations, which often result in sudden and direct attacking opportunities. In such cases, the attacking player typically receives the ball facing the goal, placing significant pressure on defenders. These scenarios increase the likelihood of defensive errors or fouls, especially within the penalty area. Additionally, VAR allows for the review and sanctioning of previously unnoticed infractions, such as slight pushes or mistimed tackles. This effect is particularly pronounced in pass-based attacking sequences, which more frequently lead to goal-scoring opportunities and are subject to greater scrutiny by both referees and the VAR system.

The third hypothesis assumed that a significant increase would be observed in the different types of ball entries into the penalty area in the post-VAR period compared to the pre-VAR period, based on the expectation that teams would attack the penalty area more intensively. While the overall number of entries increased significantly, no individual entry type showed a statistically significant change. Therefore, this hypothesis is also rejected.

The findings suggest that teams have not focused on developing a single method of entry but have instead aimed to increase overall attacking volume. As a result, attacking strategies appear to be multidimensional, flexible, and adaptable, allowing teams to optimize their choice of entry methods based on specific match situations. Comparing these results with prior research confirms the multidimensional nature of VAR's impact. Studies by Pérez, Ortega-Toro and Giménez (2020), and Buraimo, Migali and Simmons (2020) found that VAR encouraged more active attacking play, increasing attempts inside the penalty area. While my aggregated data support this trend, a closer examination of entry methods aligns more closely with Kolbinger and Lames (2019) where teams did not prioritize one specific entry mode but instead expanded overall attacking volume using diverse and flexible approaches.

In summary, out of the three hypotheses, only one was supported by the results.

CONCLUSION

This study examined the impact of the introduction of the Video Assistant Referee (VAR) on refereeing decisions in Hungarian NB1, with particular focus on the awarding of penalty kicks and changes in team attacking strategies. The research was motivated by firsthand observations gathered over more than fifteen years of participation in amateur football, where referee decisions often appeared inconsistent or biased. These experiences provided the initial motivation for a systematic, data-driven investigation of the phenomenon.

The analysis covered six seasons, from 2018/19 to 2023/24, divided into two periods: three seasons before and three seasons after the implementation of VAR. The study focused on the relationship between touches inside the penalty area, different types of attacking entries, and the frequency of awarded penalties. Statistical methods, including Welch's t-test and Pearson correlation, were employed to analyze the data.

The findings indicate that the proportion of awarded penalties declined following the introduction of VAR, while the number of touches inside the penalty area increased. This suggests that VAR contributed to filtering out incorrect decisions. Regarding entry methods, pass-based entries were most strongly associated with penalties, contrary to the original assumption that dribbling would have the strongest link. Although the total number of entries increased, the differences between individual entry types did not reach statistical significance.

The aim of this study was to highlight how VAR has influenced refereeing decisions and indirectly shaped the nature of attacking play in the Hungarian top division. Furthermore, the research is intended to provide a foundation for future studies and to support further analyses related to the use of VAR. It is hoped that the findings contribute to a better understanding of the role of technology in football, particularly in relation to events occurring in the attacking third of the pitch.

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STUDIA UBB EDUCATIO ARTIS GYMN., LXX, 4, 2025, pp. 33-45
(RECOMMENDED CITATION)
DOI:10.24193/subbeag.70(4).29

Teaching Workload and Physical Education Practice: A Comparative Analysis in the Post-Communist Eastern European Context

Horea ŞTEFĂNESCU[1]*, Cosmin PRODEA[2]

Received 2025 November 10; Revised 2025 December 30; Accepted 2026 January 05; Available online 2026 January 30; Available print 2026 January 30

ABSTRACT. This study provides a comparative analysis of the teaching workload of physical education and sport (PES) teachers in 17 countries across Central, Eastern, and South-Eastern Europe: Romania, Hungary, Poland, Czechia, Bulgaria, Estonia, Lithuania, Latvia, Serbia, Greece, Slovakia, Slovenia, Albania, Montenegro, North Macedonia, Croatia, and Bosnia and Herzegovina. The research highlights significant differences between countries with sustainable educational policies (Estonia, Slovenia, Greece, Czechia, Croatia) and those where teachers are overburdened and poorly supported (Romania, Bulgaria, Albania, North Macedonia, Bosnia and Herzegovina). The results show that teaching workload varies between 16 and 21 hours per week, directly impacting teaching quality, teacher health, and the social prestige of the discipline. Positive models are characterized by reduced workloads (16–17 hours), official recognition of extracurricular activities, and investments in modern infrastructure. In contrast, high workloads (19–21 hours), combined with the lack of recognition of invisible work, lead to professional fatigue, demotivation, and lower quality of education.

Keywords: *physical education, teaching workload, educational policies, Central and Eastern Europe, professional sustainability.*

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INTRODUCTION

Physical education plays an essential role in developing healthy lifestyle skills and supporting public health. However, physical education and sport (PES) teachers face complex challenges, particularly in Eastern Europe, where the post-socialist legacy, underfunding of education systems, and inadequate infrastructure have shaped working conditions.

The teaching workload represents the central indicator of work volume and, implicitly, of the sustainability of the profession. In Central, Eastern, and South-Eastern Europe, differences between states are evident: some countries have adopted policies to reduce workload and recognize extracurricular activities (Slovenia, Greece, Estonia), while others maintain rigid models with high workloads and lack of logistical support (Romania, Albania, Bosnia and Herzegovina).

The working hypothesis of the study is that the current teaching workload does not reflect the specific demands of the PES profession. This leads to chronic fatigue, decreased job satisfaction, and reduced quality of education. Furthermore, comparative analysis can highlight reform directions necessary for Romania and other struggling states, by referring to sustainable models in the region.

Defining the Teaching Workload

In legal and pedagogical terms, the teaching workload represents the number of teaching hours established by law or national regulations that a teacher is required to perform weekly. It constitutes the visible and quantifiable part of the employment contract, usually associated with classroom teaching hours (National Education Law No. 1/2011, Romania).

In the specialized literature, the teaching workload is considered an indicator of formal work volume (Eurydice, 2022; OECD, 2021). However, in educational practice, teachers' activity far exceeds these hours, including lesson preparation, assessment, extracurricular activities, and continuous professional development.

Teaching Workload and Employment Contract

A teacher's employment contract is structured around two main components:

• Teaching workload – the number of direct classroom hours (e.g., 16–20 hours/week, depending on the country).

• Additional activities – invisible or contractually unrecognized hours, such as:

– Lesson preparation;
– Student assessment and feedback;
– Extracurricular activities (competitions, camps, school projects)
– Continuous Professional Development (CPD).

For example, OECD (2023) emphasizes that although the official teaching workload may be 18 hours per week, the actual working time of teachers often exceeds 40 hours weekly, aligning with full-time jobs in other fields.

Table 1. Teaching workload and associated tasks of physical education teachers in Europe

Category	European range (hours/week)	Observations
Official teaching workload (teaching)	16–21	Set by law; varies between states (e.g., Estonia – 16, Hungary – 21)
Additional activities (preparation, assessment, extracurricular, CPD)	15–25	Not officially recognized in many countries (Romania, Bulgaria, Serbia); partially recognized in Greece, Slovenia, Estonia
Total actual workload (teaching + additional activities)	35–45	Approaches full-time workload; confirmed by OECD reports (2019, 2021, 2023)

Note: The table highlights both the official teaching workload and the unrecognized yet essential additional activities in daily practice.

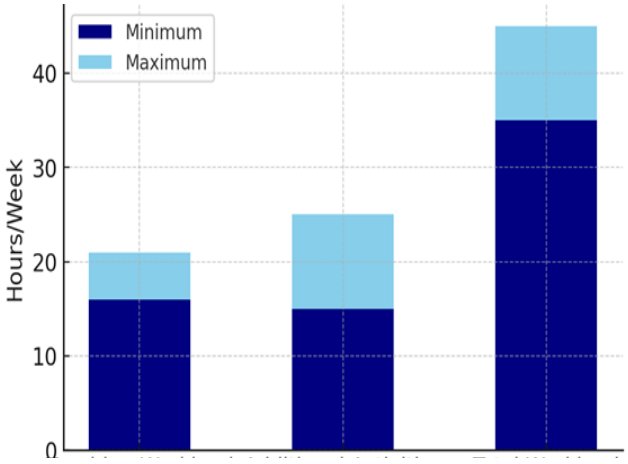

Fig. 1. Teaching Additional Activities
Source: Adapted from Eurydice (2022) and OECD (2019, 2021, 2023)

The previous comparative analysis reveals a significant discrepancy between the official teaching workload and the actual volume of work performed by physical education teachers. Although the law stipulates a limited number of teaching hours (16–21), the associated activities (lesson preparation, assessment, extracurricular activities, and continuous professional development) generate a total workload equivalent to a full-time schedule (35–45 hours per week).

This difference reflects the lack of formal recognition of complementary tasks in many educational systems, which can negatively affect teachers' motivation and professional status. In comparison, countries that partially or fully acknowledge these activities (such as Greece, Slovenia, or Estonia) provide a more balanced and transparent framework for teachers. Therefore, the results highlight the need for educational policies that explicitly integrate the actual workload in order to increase the attractiveness and sustainability of the profession.

METHODOLOGY

The methodology of this study was based on a comparative analysis of educational legislation and official curricular documents from 17 European states: Romania, Hungary, Poland, Czechia, Bulgaria, Estonia, Lithuania, Latvia, Serbia, Greece, Slovakia, Slovenia, Albania, Montenegro, North Macedonia, Croatia, and Bosnia and Herzegovina.

The selection of the 17 states analyzed is not accidental: all shared the communist or post-communist experience, which profoundly influenced educational policies and the status of teachers.

This historical legacy explains structural similarities (chronic underfunding, rigid workloads, inadequate infrastructure) as well as current differences, depending on the pace and depth of reforms adopted after 1990. Analyzing these countries allows the identification of a distinct Eastern European pattern, different from that of Western states.

The inclusion of the 17 European states is based on a common historical and socio-political criterion: their full or partial belonging to the former communist bloc. This institutional and ideological legacy profoundly shaped the organization of educational systems, the regime of teaching work, and the social perception of the teaching profession.

After 1990, each of these states underwent a transition period characterized by curricular reforms, restructuring of the teaching workload, and adaptation to European standards. However, the pace and depth of these transformations varied considerably, which explains the current differences in teachers' workload and recognition of extracurricular activities.

Sources Used

- National legislation and official regulations regarding primary and secondary education, with emphasis on teaching workload and the role of physical education and sport teachers.
- Eurydice reports (2013, 2022, 2023), analyzing curricular structures and teacher workload across Europe.
- OECD reports and the European Commission Education and Training Monitor, offering a comparative perspective on educational trends.
- National studies and specialized articles (Balázs & Kovács, 2020; Radu & Prodea, 2021) on the impact of teaching workload on professional satisfaction.
- Data provided by ministries of education from the analyzed states, accessed through official online documents (2021–2023).

Procedure

A comparative table was developed, presenting weekly teaching workloads and the specific features of each country.

The analysis focused on three major dimensions:

1. Legislative framework and educational policies (workload, recognition of extracurricular activities, funding).

2. Professional and psychosocial dimension (teachers' perceptions of workload, risks of overwork, job satisfaction).

3. Impact on education quality (teaching methods, infrastructure, social prestige of the discipline).

Table 2. Teaching workload and specific features in Eastern Europe and the Balkans

Country	Teaching workload (hours/week)	Specific features
Romania (2025)	20	Recent increase; extracurricular hours unrecognized; poor infrastructure
Hungary	21	Daily Physical Education; high prestige; risk of overwork
Poland	18	Balanced workload; flexible schedule; EU financial support for infrastructure
Czechia	17	Reduced workload; modern infrastructure; focus on holistic education
Bulgaria	18	High workload; invisible hours unrecognized; modest infrastructure

Country	Teaching workload (hours/week)	Specific features
Estonia	16	Reduced workload; digital integration; focus on public health and active lifestyle
Lithuania	17	Close to Czechia; curricular reforms; focus on motor skills
Latvia	17	Flexible workload; focus on daily activity; community support
Serbia	19	Dual role teacher-coach; unpaid extracurriculars; limited resources
Greece	16	Reduced workload; extracurriculars officially recognized; adequate infrastructure
Slovakia	17	Moderate workload; strong institutional support; EU programs
Slovenia	16	Reduced workload; high discipline status; focus on school sport and inclusion
Albania	20	Chronic underfunding; lack of modern infrastructure; teachers use personal resources
Montenegro	18	Serbian influence; similar workloads; extracurriculars unrecognized
North Macedonia	19	High workload; financial and infrastructure issues; strong social role of teachers
Croatia	17	Flexible workload; modern infrastructure; EU programs implemented
Bosnia and Herzegovina	19	High workload; regional differences (Federation/RS); lack of curricular standardization

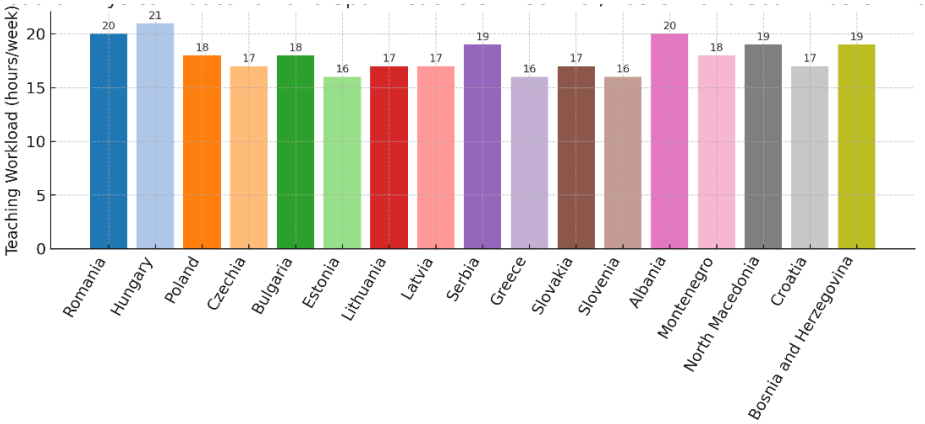

Fig. 2. Teaching Workload of Physical Education and Sport Teachers in Central, Eastern and South-Eastern Europe (2023–2025)

Source: Adapted from Eurydice (2022) and OECD (2019, 2021, 2023)

RESULTS

The comparative analysis of the teaching workload of Physical Education and Sport teachers in the 17 European states highlights significant differences both in terms of weekly workload and in how extracurricular activities and infrastructure investments are recognized.

Teaching Workload and Legislative Framework

The results presented in the chart highlight clear differences between regions. The Baltic countries (Estonia, Lithuania, Latvia) average approximately 16.7 hours per week, confirming their orientation toward sustainable educational policies. Central European states (Poland, Czechia, Slovakia, Slovenia, Croatia) approach the European average with about 17.0 hours per week, benefiting from superior infrastructure and logistical support.

In contrast, Balkan countries (Serbia, Montenegro, Albania, North Macedonia, Bosnia and Herzegovina) record a high average of nearly 19.2 hours per week, reflecting greater pressure on teachers and the lack of recognition of extracurricular activities.

The southern region (Greece, Romania, Hungary, Bulgaria) is heterogeneous: Greece has a reduced workload (16), but Romania (20) and Hungary (21) raise the average to a high level of 18.8 hours per week.

These data confirm that positive models are concentrated in Northern and Central Europe, while major challenges are found in the Balkans and South-Eastern Europe.

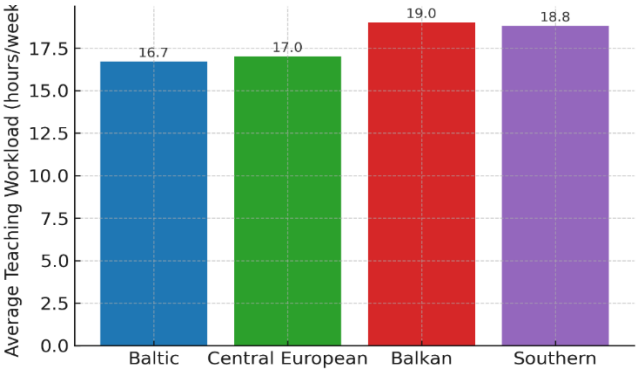

Fig. 3. Average Teaching Workload by Region in Central, Eastern and South-Eastern Europe (2023–2025)
Source: Adapted from Eurydice (2022) and OECD (2019, 2021, 2023)

High workloads (19–21 hours/week): Hungary (21), Romania (20), Albania (20), North Macedonia (19), Serbia (19), Bosnia and Herzegovina (19). These states maintain rigid models, associated with higher risk of overwork and lack of recognition of extracurricular activities.

Moderate workloads (17–18 hours/week): Poland, Czechia, Slovakia, Croatia, Lithuania, Latvia, Bulgaria, Montenegro, Moldova. In these countries there is a relative balance between workload and resources, although infrastructure differs significantly.

Reduced workloads (16 hours/week): Estonia, Slovenia, Greece. These represent positive models, where teachers have a sustainable teaching load and extracurriculars are officially recognized.

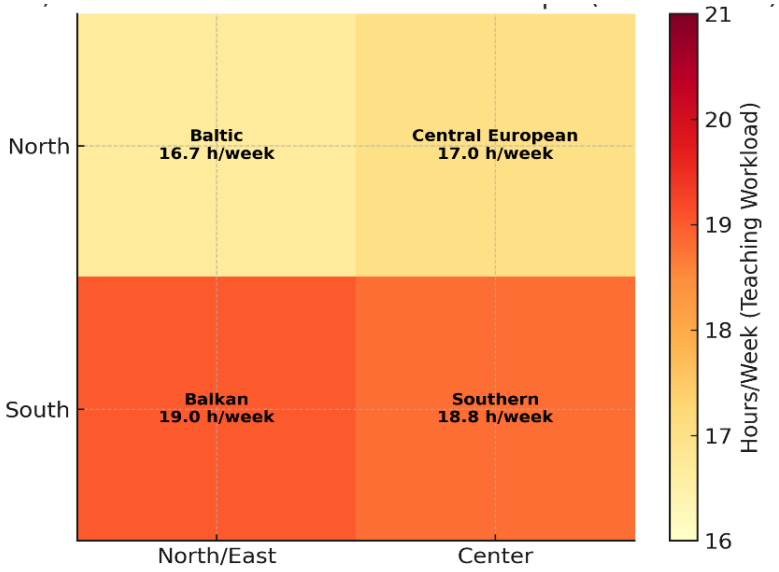

Fig. 4. Average Teaching Workload by Region (Colored Blocks) – Central, Eastern and South-Eastern Europe (2023–2025)
Source: Adapted from Eurydice (2022) and OECD (2019, 2021, 2023).

The chart shows the distribution of the average teaching workload across major European regions. The Baltic and Central European countries maintain a sustainable level (16–17 hours per week), while the Balkan and Southern states frequently exceed 18–19 hours, which reflects greater pressure on teachers. This contrast confirms the structural differences between the educational models of the North and Center compared to those of South-Eastern Europe.

Professional and Psychosocial Dimension

In Romania, 72% of teachers consider the 20-hour workload too high, especially due to the lack of recognition of extracurricular activities. Similar problems are reported in Bulgaria, Serbia, Albania, and Bosnia and Herzegovina.

In Hungary, the implementation of daily physical education increased students' activity levels, but teachers complain of overwork and lack of complementary staff.

The Baltic countries (Estonia, Latvia, Lithuania) created a more favorable framework, with moderate or reduced workloads, integration of technology, and European projects. Teachers enjoy better social perception and institutional support.

In Slovenia and Greece, professional satisfaction is high due to reduced workloads, adequate infrastructure, and recognition of invisible work (extracurricular activities).

Impact on the Quality of Education

High workloads (19–21 hours) limit the diversification of teaching methods and increase the risk of professional fatigue, affecting the quality of education. Examples: Romania, Albania, Bosnia and Herzegovina.

Positive models (Greece, Slovenia, Estonia, Czechia, Croatia) demonstrate that reducing workload, combined with modern infrastructure and recognition of extracurriculars, leads to higher teaching quality and active student involvement.

Hybrid models (Poland, Slovakia, Lithuania, Latvia) show a tendency toward balance: moderate workloads, European funding, and logistical support, though with regional differences in implementation.

DISCUSSIONS

The comparative analysis of the 17 states in Central, Eastern, and South-Eastern Europe highlights strong contrasts between sustainable educational models and systems still facing structural crises.

Regional Differences

The Baltic countries (Estonia, Latvia, Lithuania) invested heavily in infrastructure and digitalization, which allowed reduced workloads (16–17 hours) and increased professional satisfaction. Estonia stands out for integrating physical education into national public health strategies.

Central Europe (Poland, Czechia, Slovakia, Slovenia, Croatia) shows balanced models: workloads of 16–18 hours, modernized infrastructure, and at least partial recognition of extracurricular activities. Slovenia is notable for the high status of the discipline and inclusion of school sport in social inclusion policies.

The Western Balkans and South-Eastern Europe (Serbia, Montenegro, Albania, North Macedonia, Bosnia and Herzegovina) retain post-socialist characteristics: high workloads (18–20 hours), poor infrastructure, lack of recognition of extracurriculars. Teachers face strong social pressure and insufficient resources.

Romania and Bulgaria are in an intermediate but negative-trending position: high workloads (18–20 hours), lack of recognition of invisible work, and insufficient infrastructure. Romania's situation is worsened by the recent increase to 20 hours.

Greece represents a unique model in the region, with a reduced workload (16 hours) and official integration of extracurricular activities, leading to higher professional satisfaction and improved social perception of the discipline.

Positive vs. Problematic Models

Positive models: Estonia, Slovenia, Greece, Croatia, Czechia. All have reduced workloads (16–17 hours), modern infrastructure, and policies supported by education and public health strategies.

Problematic models: Romania, Albania, North Macedonia, Bosnia and Herzegovina. In these states, teachers feel overburdened, extracurricular hours remain unrecognized, and underfunding and lack of infrastructure exacerbate professional tensions.

Hybrid models: Poland, Slovakia, Lithuania, Latvia. Although workloads are moderate, implementation varies regionally. These states benefit from European programs but maintain disparities between urban and rural environments.

Implications for Professional Sustainability

The data show that the professional sustainability of PES teachers depends on three key factors:

1. Weekly workload (teaching hours).
2. Official recognition of extracurricular activities (competitions, projects, camps).
3. Investments in school sports infrastructure and logistical support.

Countries that have managed to balance these factors report higher levels of professional satisfaction, teaching quality, and active student involvement in motor activities.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The comparative analysis of PES teachers' workloads in 17 Central, Eastern, and South-Eastern European countries highlight major contrasts between countries with sustainable educational policies and those facing structural difficulties.

• *Variety of workloads*: workloads vary between 16 and 21 hours/week, reflecting significant differences between educational models.

– Reduced workloads (16–17 hours): Estonia, Slovenia, Greece, Czechia, Croatia.

– Moderate workloads (17–18 hours): Poland, Slovakia, Lithuania, Latvia, Bulgaria, Montenegro.

– High workloads (19–21 hours): Romania, Hungary, Serbia, Albania, North Macedonia, Bosnia and Herzegovina.

• Recognition of extracurricular activities is an essential differentiating factor. Countries that officially integrate these activities (Greece, Slovenia, Croatia) report higher professional satisfaction.

• Infrastructure and resources largely determine the quality of education. Baltic and Central European states (Estonia, Poland, Slovakia, Czechia) benefited from European investments, unlike Balkan states (Albania, North Macedonia, Bosnia and Herzegovina), where deficiencies persist.

• Professional satisfaction is directly influenced by the balance between workload, official recognition, and logistical support. Positive models (Estonia, Slovenia, Greece) show that reducing workload and integrating extracurriculars increase both teaching quality and the social prestige of the discipline.

Recommendations

- Reduce teaching workload toward a sustainable range (14–16 hours), especially in countries with high workloads (Romania, Albania, Bosnia and Herzegovina, North Macedonia).
- Officially recognize and remunerate extracurricular activities, including competitions, camps, and community projects, as an integral part of the profession.
- Invest in school sports infrastructure (modern gyms, adapted equipment, accessible fields), prioritizing rural and disadvantaged regions.
- Reframe the role of the physical education and sport teacher as a public health agent, involved in preventing sedentary lifestyles and promoting active living.

· Align with European best practices (Estonia, Slovenia, Greece, Croatia) through knowledge transfer and pilot programs supported by the European Union and OECD.

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STUDIA UBB EDUCATIO ARTIS GYMN., LXX, 4, 2025, pp. 47-56
(RECOMMENDED CITATION)
DOI:10.24193/subbeag.70(4).30

Coaching Styles in Sport: A Comparative Analysis Between Individual and Team Sports

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Received 2025 August 15; Revised 2025 October 24; Accepted 2025 November 05;
Available online 2026 January 30; Available print 2026 January 30

ABSTRACT. Sports coaching plays a crucial role in developing athletes' performance and psychological well-being, yet the styles adopted by coaches vary significantly between individual and team sports. This paper aims to conduct a comparative analysis of coaching styles used in these two categories of sport, highlighting their specific features and their impact on motivation, cohesion, and performance. In individual sports, the direct and personalized relationship between coach and athlete favors democratic and supportive styles that foster autonomy and mental resilience. In contrast, in team sports, success depends on group dynamics and the coach's ability to manage conflicts and promote collaboration, often by balancing authority with emotional support. Studies indicate that rigidity in applying coaching styles can negatively affect athlete performance and satisfaction, underscoring the importance of adapting the coaching style to the context and the athletes' characteristics. Moreover, cultural and social factors also influence the strategies adopted by coaches. The findings of this analysis can guide practitioners in developing flexible and effective methods that meet the specific needs of athletes from different sport disciplines. In doing so, this paper contributes to the theoretical and practical foundations of sports coaching, offering valuable perspectives for optimizing performance in both individual and team sports.

***Key words**: coaching styles, individual sport, team sport, sports performance*

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INTRODUCTION

Sports coaching is a complex and multidimensional process that influences athletes' performance both physically and psychologically. Coaching styles defined as coherent sets of behaviors and strategies adopted by coaches in their interactions with athletes play a key role in creating an environment conducive to skill development and the achievement of sporting goals (Smith & Smoll, 2016; Cucui, 2013a; Cucui & Cucui, 2014). While the concept of coaching is universal, its application differs significantly depending on the nature of the sport whether individual or team-based. Understanding these differences is essential for coaches, researchers, and practitioners, as the way the coach-athlete relationship is structured directly influences motivation, satisfaction, and performance (Jowett & Cockerill, 2003; Cucui, 2016).

In individual sports, the coach works in a direct and intense relationship with the athlete, often exerting a personalized influence on both the training plan and the athlete's psychological development. This relationship is frequently centered on the individual's specific needs, and coaching styles oriented toward autonomy support and constructive feedback have been associated with increased intrinsic motivation and improved mental resilience (Mageau & Vallerand, 2003; Cucui, 2017). In sports such as athletics, tennis, or swimming, tactical decisions and in-competition adjustments largely depend on the athlete, making democratic and supportive coaching styles essential for success (Amorose & Anderson-Butcher, 2007; Cucui & Cucui, 2016a). Coaches who provide emotional support and encouragement contribute to positive psychological states, reduce anxiety, and enhance self-confidence—factors often translating into superior performance (Gould, Dieffenbach & Moffett, 2002).

By contrast, team sports involve a far more complex dynamic, in which success depends on group collaboration and cohesion. Coaches must manage not only the individual development of players but also their interactions, potential conflicts, and collective strategies (Carron & Eys, 2012; Cucui, 2013b). Coaching styles in team sports often require a delicate balance between authority and emotional support in order to stimulate group motivation, promote effective communication, and strengthen team spirit (Weinberg & Gould, 2014; Cucui & Cucui, 2016b). In disciplines such as football, basketball, or volleyball, the coach's ability to adapt their style according to the players' differing personalities and skill levels is fundamental for creating a positive climate and achieving competitive performance (Horn, 2008; Cucui, 2019). Effective leaders employ both directive and participative styles to address team needs and manage the stress inherent in high-level competition (Jowett & Cockerill, 2003; Cucui & Cucui, 2018a).

A common factor across both sporting contexts is that a rigid, inflexible style can negatively affect athletes' performance and motivation. Research has shown that coaches who exclusively apply an authoritarian style risk generating additional stress and reducing athletes' satisfaction, whereas supportive and democratic styles foster the development of autonomy and competence—essential elements of intrinsic motivation (Mageau & Vallerand, 2003; Amorose & Anderson-Butcher, 2007; Cucui & Cucui, 2018b). The adaptability of coaching style to athletes' individual and collective characteristics is therefore a key determinant of coaching effectiveness (Côté & Gilbert, 2009; Cucui, 2016). For example, a track and field coach may adopt a more directive approach during critical training periods but shift toward a more understanding style when managing the athlete's psychological state before competitions (Smith & Smoll, 2016; Cucui & Cucui, 2025).

Moreover, organizational culture and social context play an important role in determining adopted coaching styles. In some cultures, authoritarian styles are more accepted—and even expected—while in others the emphasis is on athlete autonomy and democratic relationships (Horn, 2008; Cucui, 2020). Consequently, researchers underline the importance of considering the cultural and socio-emotional context when examining the dynamics of sports coaching (Côté & Gilbert, 2009; Cucui & Cucui, 2016c).

Given these differences and contextual factors, a comparative analysis of coaching styles between individual and team sports becomes essential to better understand how to optimize coaching interventions according to the specific characteristics of each sport type. Such understanding can contribute to the development of training programs for coaches that incorporate skills in stylistic adaptation, emotional intelligence, and interpersonal relationship management (Amorose & Anderson-Butcher, 2007; Cucui, 2013c).

Therefore, this paper aims to comparatively analyze the coaching styles applied in individual versus team sports, to highlight their advantages and disadvantages, and to assess their impact on athletes' sporting performance and psychological development. This endeavor is relevant to both academic research and sports practice, contributing to the foundation of coaching strategies tailored to the specific context of each sport.

Hypothesis

We hypothesize that there are significant differences between the coaching styles applied in individual and team sports, and that these differences can support and guide the training process in achieving the specific objectives of each sport type.

MATERIALS AND METHODS

The study sample consisted of 90 active athletes, of which 44 were individual sports (athletics, tennis, swimming) and 46 team sports (football, basketball, volleyball). Participants were selected on a voluntary basis, with inclusion in the study limited to those who provided consent and were willing to complete the online questionnaire.

To evaluate coaching styles, the translated and adapted version of the Leadership Scale for Sports (LSS), originally developed by Chelladurai and Saleh (1980), was used. This scale comprises 40 items designed to measure athletes' perceptions of their coach's behavior in relation to leadership styles, including autocratic, democratic, and supportive approaches. The LSS is a widely validated international tool frequently used to investigate coaches' behaviors and their influence on athletes.

Athletes completed the online questionnaire between February and April 2025. All participants were informed about the purpose of the study, and informed consent was obtained prior to completion. To ensure anonymity, data were collected and processed confidentially.

Data analysis was performed using SPSS version 28. The arithmetic mean and standard deviation were calculated for each dimension of coaching styles. To compare differences between athletes from individual and team sports, an independent samples t-test was applied, with a significance threshold of p= 0.05. The results were interpreted to identify significant differences between groups in terms of perceived coaching styles.

RESULTS

The study analyzed the opinions of 90 athletes: 44 participants in individual sports and 46 in team sports. The Leadership Scale for Sports (LSS) was used to measure athletes' perceptions of coaching style, structured across five dimensions: Training & Instruction, Democratic Behavior, Autocratic Behavior, Social Support, and Positive Feedback.

Table 1. Comparison of coaching style dimensions between individual and team sports

Dimension	M_individual	SD_individual	M_team	SD_team	p-value
Training & Instruction	4.125	0.368	3.794	0.380	0.0001
Democratic Behavior	3.378	0.481	4.067	0.465	0.0000
Autocratic Behavior	2.552	0.636	2.644	0.642	0.4992
Social Support	3.778	0.422	3.984	0.387	0.0178
Positive Feedback	3.857	0.415	3.897	0.436	0.6540

Legend: M = average, SD = Standard Deviation, p-value – statistical significance threshold

Training & Instruction

The results indicate that athletes in individual sports perceive a significantly higher level of coach involvement in technical and tactical aspects of training ($M = 4.125$) compared to athletes in team sports ($M = 3.794$, $p = 0.0001$). This difference may be explained by the specific nature of individual sports, where performance largely depends on individualized technical preparation and the refinement of personal skills. In this context, coaches need to adopt a style focused on rigorous instruction and close monitoring of athlete progress to optimize individual performance. Therefore, the emphasis on Training & Instruction reflects the necessity of adapting coaching to the specific demands of individual sports, where technical details can make a decisive difference in competition.

Democratic Behavior

Conversely, athletes in team sports reported a significantly higher perception of democratic behavior from coaches ($M = 4.067$ vs. $M = 3.378$, $p < 0.001$). This finding highlights the importance of active athlete participation in decision-making and communication within the team. In collective sports, success depends not only on individual skills but also on group cohesion and effective coordination among team members. Thus, coaches adopt a leadership style that encourages dialogue, involvement, and consensus to promote responsibility and commitment from each member. Democratic behavior facilitates a collaborative environment, essential for sustainable team performance.

Autocratic Behavior

Analysis of autocratic style revealed no significant differences between athletes in individual and team sports ($p = 0.4992$). This suggests that perceptions of an authoritarian style, characterized by unilateral decisions imposed by the coach, are relatively balanced across both groups. It is possible that, in both contexts, coaches employ autocratic elements during key moments of training or competition, such as crises or situations requiring strict discipline. However, the overall low prevalence of this style indicates a general tendency to avoid excessive authority in favor of more participative and supportive approaches.

Social Support

Athletes in team sports reported a significantly higher level of social support from coaches ($M = 3.984$ vs. $M = 3.778$, $p = 0.0178$). This aspect is particularly relevant in team sports, where interpersonal dynamics and emotional

support from the coach contribute significantly to group cohesion and maintaining a positive environment. Social support from coaches includes encouragement, empathy, and the provision of a psychologically safe environment that facilitates open communication and collaboration. In individual sports, although social support remains important, the immediate need for it may be perceived as lower due to the more autonomous nature of sport.

Positive Feedback

No significant differences were identified between individual and team sports regarding the provision of positive feedback ($p = 0.6540$). This indicates that coaches, regardless of sport type, recognize the importance of constructive and motivating feedback in the training and performance process. Positive feedback is essential for enhancing athletes' self-confidence, maintaining motivation, and reinforcing effective behaviors. The consistent application of this style suggests a standardized and valued practice in coaching that does not directly depend on sport-specific characteristics but rather reflects good practices in the coach-athlete relationship.

DISCUSSION

The results of this study support the hypothesis that there are significant differences in coaching styles perceived by athletes participating in individual sports versus those in team sports. The comparative analysis highlighted clear distinctions in the perception of coach behavior, particularly in the dimensions of Training & Instruction, Democratic Behavior, and Social Support, reinforcing the idea that the type of sport influences not only coaching practice but also how it is perceived by athletes.

Athletes in individual sports reported significantly higher technical-tactical involvement from their coaches (Training & Instruction), which can be attributed to the specific nature of these disciplines, where the coach-athlete relationship is more direct and success depends primarily on individual preparation. These results align with the multidimensional leadership model proposed by Chelladurai and Saleh (1980), which suggests that coaches in individual sports more frequently adopt a task- and instruction-focused style tailored to the needs of each athlete.

In team sports, participants perceived significantly more pronounced democratic behavior from coaches, reflecting the need for collective decision-making and athlete involvement in strategic and tactical processes. Such approaches

are fundamental in sports where interaction, cohesion, and adaptability to group dynamics are critical for performance (Wang et al., 2009). A democratic leadership style fosters a positive climate in which athletes feel valued and involved, enhancing motivation and collective responsibility (Fransen et al., 2015).

The differences identified in the Social Support dimension indicate a higher level of perceived support among team sport athletes, which can be explained by the importance of emotional support in maintaining morale and group cohesion. Recent literature emphasizes that social support from coaches is an important predictor of athlete well-being and engagement, particularly in team sports where interdependence among team members is critical (Isoard-Gautheur et al., 2021).

Regarding Autocratic Behavior and Positive Feedback, no significant differences were observed between the two sport categories. This result may indicate a convergence of these leadership styles, likely influenced by contemporary trends toward reducing rigid authority and integrating positive feedback as a standard practice in modern sports coaching (Carpentier & Mageau, 2016). The absence of significant differences in these dimensions may reflect coaches' adaptation to athletes' expectations, who value dialogue, support, and clarity of goals regardless of the sport.

The findings have practical relevance, as they support the idea that coaches should adapt their leadership style according to the specific context of the sport practiced. In individual sports, emphasis should be placed on individualized instruction and autonomy, while in team sports, a balance between participative leadership and socio-emotional support is necessary to maintain cohesion and collective motivation. These insights provide a reference framework for coaches' professional development and for optimizing the coach-athlete relationship.

The study also has certain limitations. Data were collected through self-report, which may introduce a degree of subjectivity, and the sample was relatively small and unbalanced in terms of gender and competitive level. Future studies could adopt a mixed-methods approach, including direct observations, qualitative interviews, and comparisons between perceived and actual coaching styles. Additionally, analyzing the congruence between athletes preferred and perceived coaching styles would be valuable, as high alignment is associated with improved performance and satisfaction in sport (Chelladurai, 1990; Jowett & Cockerill, 2003).

This study confirms that coaching styles vary according to the type of sport, providing evidence in support of a differentiated approach in coach training and intervention. These findings contribute to the development of effective sports leadership adapted to the demands and realities of both individual and team sports.

CONCLUSIONS

The present study highlighted significant differences in coaching styles perceived by athletes participating in individual versus team sports, confirming the initial hypothesis that the type of sport influences the perception of coach behavior. Specifically, athletes in individual sports reported greater coach involvement in technical-tactical instruction, whereas athletes in team sports more frequently perceived a democratic style and higher levels of social support.

These findings are relevant for understanding how coaches can adapt their leadership styles according to the sporting context, emphasizing the importance of behavioral flexibility and a needs-centered approach for athletes. Furthermore, the data support the specialized literature promoting a coaching relationship based on trust, participation, and emotional support as key factors in enhancing athlete performance and satisfaction.

Overall, this research contributes to the theoretical and practical foundation of sports leadership, providing a solid basis for the development of coach education programs focused on adaptability, effective communication, and a deep understanding of relational dynamics depending on the specific sport practiced.

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Operational Management Processes in Mountain Bike Enduro Competitions: A Case Study of the Apuseni Bike Cup

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Received 2025 November 27; Revised 2025 December 30; Accepted 2026 January 05; Available online 2026 January 30; Available print 2026 January 30

ABSTRACT. Operational Management Processes in Mountain Bike Enduro Competitions: A Case Study of the Apuseni Bike Cup. **Objectives**: The primary aim of this research is to evaluate the efficiency of the operational process of the Apuseni Bike Cup 2024 and identify critical points, in order to improve organizational performance and the participants' experience. The study analyses how operational activities were planned and carried out, how responsibilities were allocated within the organizing team and how effectively control mechanisms supported responses to unforeseen situations. **Materials and Methods:** This study employed a mixed-methods design, integrating both quantitative and qualitative procedures to analyse the operational management of the Apuseni Bike Cup. Quantitative data were collected through two structured questionnaires administered to 57 participants and 6 members of the organising team, each instrument combining Likert-scale items, yes/no questions and open-ended responses tailored to the role of the respondents. To enhance the depth and reliability of the analysis, the questionnaire data were complemented with direct field observations recorded during the preparation and running of the event, as well as with internal organisational documents used throughout the planning process. **Results**: The Apuseni Bike Cup 2024 achieved some of its goals, but not all. Only a third of organizers felt the objectives were fully met, while half said they were only partially achieved. Challenges were reported in managing resources, assigning tasks and handling critical situations. Most

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participants were satisfied, noting clear information, well-marked trails and good support, though some mentioned issues with communication and logistics. Overall, the results suggest the event worked well in many areas but could be improved to fully reach its objectives in future editions. **Conclusions:** The research confirms that effective operational management is essential for delivering a well-organized sporting event, ensuring participant support, clear communication and smooth logistics. Addressing challenges in resource allocation, task distribution and team coordination is expected to further improve outcomes, providing organizers with opportunities to enhance efficiency and participant experience in future editions.

Keywords: *Sport event management, mountain bike enduro, operational management, participant experience*

INTRODUCTION

Sport events have become key drivers of community development and local tourism due to their ability to attract participants, spectators and investors from various regions and even countries (Mallen & Adams, 2008). Masterman (2021) emphasizes that such events stimulate the local economy, generate significant revenues for local businesses and create direct employement opportunities. For instance, the Olympic Games produce substantial tourism income, enhance international visibility and contribute to infrastructure development, providing lasting benefits for host communities (Masterman, 2009). Mountain bike competitions, including international downhill events, similarly promote local tourism by attracting athletes and enthusiasts from around the world (Tsuji, Bennett, & Zhang, 2007).

The organization of a sport event involves four fundamental stages, each characterized by clearly defined strategic approaches, as outlined by Masterman, (2014): planning, implementation, monitoring and evaluation. The planning stage involves clearly defining the event's purpose, establishing specific objectives, identifying potential risks and developing comprehensive strategies to address them effectively. Implementation focuses on the efficient management and use of available human, material and financial resources to achieve the established objectives. Monitoring ensured continuous oversight of operational activities and the prompt management of unforeseen situations to maintain smooth event conduction. Evaluation examines the efficiency of resource utilization and identifies areas requiring improvement for future events (Masterman, 2014).

In mountain bike competitions, each stage is critical for participant safety, overall satisfaction and logistical efficiency (Mallen & Adams, 2024).

Enduro mountain bike competitions are characterized by a unique format that alternates timed downhill sections (special stages) with untimed transfer segments, usually uphill, which place significant physical demands on the participants motor skills. This type of competition requires both advanced technical skills and superior physical fitness, as athletes were placed under sustained cardiovascular effort over extended periods (Impellizzeri & Marcora, 2007).

Enduro athletes need to possess a well-developed aerobic capacity, combined with anaerobic endurance adapted to high-intensity efforts. Studies on elite competitors indicate average VO_2max values between 70 and 75 $ml \cdot kg^{-1} \cdot min^{-1}$, occasionally exceeding 80 $ml \cdot kg^{-1} \cdot min^{-1}$ in the most highly trained athletes. During races, the mean heart rate of these athletes ranges from 86% to 90% of their maximum heart rate (Lee et al., 2002; Carpes, Mota, & Faria, 2007).

In organizing mountain bike enduro competitions, the competition track often represents the central „product of the event", with the riders' experience defined by its difficulty, safety and clarity of markings (Mallen & Adams, 2008).

Organizers adopt a strategic design approach, combining technical sections (areas with rocks or exposed roots) with wide, fast segments intended to maintain competitive rhythm thourghout the race (Koemle & Morawetz, 2016). Difficulty levels, ranging from "green" for beginners to "black" for experts, are standardized using internationally recognized color codes and graphical symbols (Masterman, 2021).

Accurate timekeeping constitutes a fundamental pillar of credibility in mountain bike competitions, given that recorded times directly determine athlete rankings, prize allocation, and overall sporting integrity. Masterman, (2009) emphasises the necessity of implementing a rigorous timing-system verification protocol, which includes the simultaneous deployment of multiple technologies (e.g., RFID, photocells, backup chronometers) and the execution of three consecutive test runs on the morning of the event to ensure precision to the hundredth of a second.

Strategic planning begins with the formulation of SMART objectives (specific, measurable, achievable, relevant, and time-bound), established on the basis of clearly defined criteria such as expected community impact, projected participation levels, financial performance indicators, and environmental sustainability targets (Masterman, 2021). Risk analysis entails the systematic identification of potential hazards, the evaluation of their likelihood and consequences, and the development of contingency strategies. Resource planning requires a precise estimation of personnel, equipment, facilities, and financial

inputs needed for effective event delivery (Kokolakis, 2018). Within the context of Enduro mountain bike events, detailed race track design and discipline-specific risk assessments are critical to ensuring both operational success and participant safety.

This study focuses on a comprehensive analysis of the "Apuseni Bike Cup", an emblematic mountain bike enduro competition organised annually by the sports club association "ACS CUBS Cluj-Napoca". Since its inaugural edition on 9 July 2022, the event has demonstrated continuous development, culminating in the 28–29 September 2024 edition held in Buscat, Cluj-Napoca. The 2024 edition constituted a substantial organisational undertaking, as it simultaneously hosted the National Mountain Bike Enduro Championship, thereby increasing the operational complexity and strategic responsibilities of the organising team.

The study examines the organizational and logistical dimensions of the event in a concrete and applied manner, with the primary objective of evaluating the efficiency of human and financial resource management, the clarity of responsibility distribution and the handling of unforeseen operational challenges. The findings are intended to serve as a valuable resource for practitioners seeking to implement innovative, efficient, and sustainable management practices, ultimately supporting the development of a more robust and engaged mountain bike community in Romania and promoting the broader values of active and healthy living.

PURPOSE OF THE STUDY

The objective of this study was to assess the efficiency of operational management within a mountain bike enduro event, focusing specifically on the planning, coordination, and execution of essential organisational processes. By examining the operational structure of the "Apuseni Bike Cup 2024", the research aims to highlight the practices that contribute to a coherent, safe, and effectively managed competition.

MATERIAL AND METHODS

This study involved the "Apuseni Bike Cup 2024", an event chosen as the primary case due to its scale, organisational complexity and relevance within the Romanian mountain bike enduro competitions. Held on 28–29 September 2024 in the Băișorii Mountain Resort area of the Apuseni Mountains, the competition brought together both elite and recreational athletes. Organised under the authority

of the Romanian Cycling Federation, the event served simultaneously as the National Enduro Championship for licensed riders, while also welcoming amateurs, hobby cyclists, youth competitors and E-MTB participants. The race stages were manually constructed single-trail segments ranging between 1.1 and 1.5 km, each designed to test advanced technical skills and reflect the terrain-specific challenges characteristic of mountain bike enduro competitions.

To understand how operational management functions in practice within a mountain bike enduro event, within the study, we examined two key groups whose perspectives together provide a comprehensive view of the organisational process: the organising team and the event participants. These complementary viewpoints reveal both the internal mechanisms of event execution and the participant experience shaped by those mechanisms.

The first group consisted of six members of the Apuseni Bike Cup 2024 organising committee, whose responsibilities covered essential operational components such as logistics, trail planning, timekeeping, volunteer coordination and the allocation of human, technical and financial resources. The organisers completed their questionnaire between October 2024 and May 2025, allowing sufficient time for reflective assessment of each phase of planning and implementation.

The second group comprised 57 riders from various competition categories. Their feedback was collected shortly after the event, between 3 and 11 October 2024, when perceptions related to course safety, trail design, logistical organisation and overall event satisfaction were still fresh and accurately remembered. To gather these perspectives, the study employed two tailored questionnaires. Following the evaluation framework outlined by Tsuji et al. (2007), the participant questionnaire captured five core dimensions of event quality: perceived difficulty (rated on a 1–5 scale), logistical efficiency, clarity of trail marking, safety and overall impression.

Both surveys integrated Likert-scale items, yes or no questions and open-ended prompts, enabling respondents to provide structured ratings alongside more detailed qualitative insights. Questionnaires were distributed online via direct links, and all responses were collected anonymously to encourage candid and unbiased input. After data collection, responses from both groups were systematically organised and coded in Microsoft Excel, creating a structured dataset for subsequent quantitative and qualitative analysis. Together, these procedures generated a multidimensional view of how organisational decisions shaped the execution and lived experience of the Apuseni Bike Cup 2024. Table 1. provides the items included in both questionnaires, illustrating the combination of quantitative and qualitative measures employed.

Table 1. Surveys for both respondent groups

Respondent Group	Questions
I. Organizers	1.1 To what extent were the objectives of this event achieved? 1.2 Was the time allocated for event planning sufficient? (Yes/No) 1.3 How were the resources managed in preparing the event? 1.4 Was the distribution of tasks and responsibilities within the team effective? (Yes/No) 1.5 How effective was the collaboration with volunteers, sponsors, and the marking/kit teams? 1.6 How efficient was the allocation and management of human, technical and financial resources?
II. Participants	2.1 How would you rate the overall organization of the event? 2.2 Did you receive enough information about the competition, both before and during the event? (Yes/No) 2.3 Did you receive accurate and complete information regarding the trails, markings and safety measures? 2.4 Would you recommend this event? (Yes/No) 2.5 Which aspects of the event's organization do you consider were most successful? 2.6 What aspects do you think should be improved for future editions?

RESULTS

From the perspective of being directly involved in the organising team, the most valuable aspect of the planning phase was the high level of interdepartmental coordination. Weekly briefings and constant communication via shared digital channels allowed rapid decision-making and immediate redistribution of tasks when unexpected issues emerged. Direct field visits to the trail area, performed together with the technical and safety teams, provided a precise understanding of environmental constraints, which facilitated informed adjustments to trail marking, shuttle logistics and staffing needs. Competition was planned with careful attention to detail, beginning 4 months prior to the event. Tasks were clearly categorized (e.g. marketing, logistics, technical team, volunteers) and assigned to responsible team members with realistic deadlines. All planning was documented in Microsoft Excel, allowing team members to update progress

as tasks were completed. Key features of the planning process included a clear task structure, detailed budgets for each logistical component, a staged timeline covering pre-event, race-day and post event activities, and a color-coded status system that allowed the team to monitor progress. Continuous monitoring enables real-time adjustments to operational strategies, helping maintain high standards of quality and safety (Pott, Breuer, & ten Hompel, 2023).

The analysis of the questionnaire responses provides a comprehensive overview of how the event was perceived by both organizers and participants. The results are organized according to the core dimensions investigated in the study: achievement of event objectives, communication effectiveness, team management practices: including task distribution, coordination and problem-solving, as well as the aspects that functioned effectively and those requiring improvement. The presentation of findings is structured in two stages. First, the perspectives of the organizers are examined, offering insight into internal operational processes and managerial challenges. This is followed by the participants' evaluations, which capture the external experience of the event, including communication quality, trail information, safety measures and overall satisfaction.

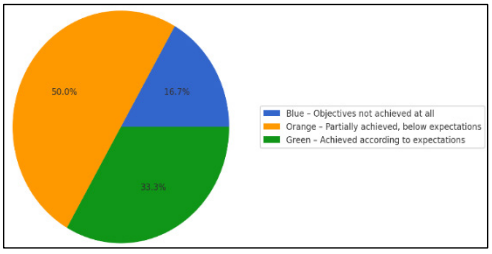

Fig. 1. To what extent were the objectives of this event achieved?

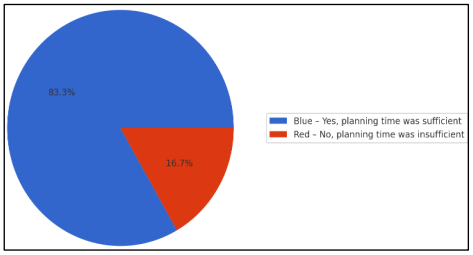

Fig. 2. Was the time allocated for event planning sufficient?

In response to the question on whether the event's objectives were achieved, 50% of the organizers indicated that the objectives were only partially met. A further 16.7% reported that the objectives were not met at all, while 33.3% stated that the objectives were achieved as expected (Fig.1). None of the respondents indicated that the objectives were exceeded. According to Fig.2, the majority of respondents, 83.3%, reported that the allocated preparation period, which spanned several months prior to the event, was sufficient to organize all necessary operational details, whereas 16.7 considered the available time inadequate.

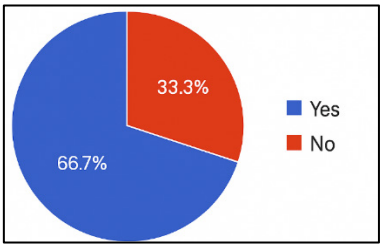

Fig. 3. Was the distribution of tasks and responsibilities within the team effective?

According to the results shown in Fig. 3, 66.7% of organizers reported that the distribution of tasks within the team was effective, ensuring a clear operational structure and facilitating smooth coordination. On the other hand, 33.3% of respondents noted that certain responsibilities remained unclear, indicating opportunities to further refine role allocation.

Table 2. Assessment of Resource Allocation Efficiency

Response	Nr. organizers
Yes/balanced	2
Partially/could be improved	2
No/inefficient	1
Ambiguous/not classified	1

Among the six organizers, two indicated that resources were allocated in a balanced and effective way, supporting smooth event operations. Another two organizers considered the distribution of resources only partially satisfactory, highlighting areas where adjustments could enhance efficiency. One respondent reported significant deficiencies in resource management and one response was too vague to categorize, leaving its assessment of resource allocation unclear.

Table 3. Management of Challenges Encountered

Category	Nr. Org.	Example
Effective management	2	*"Yes, we addressed the issues that arose adequately."*
Partial management -requiring contingency planning	2	*"It would be helpful to have back up plans for all potential problem scenarios."*
Critical issues	2	*"The problems that occurred at the premiere, shuttle transport and timekeeping were not handled appropriately"*

An assessment of the organizers' responses showed that two considered operational challenges to have been managed effectively, reflecting competent real time decision-making. Another two highlighted that the absence of pre-established contingency plans limited their ability to address unexpected issues. The final two reported significant difficulties in managing critical aspects, especially final timekeeping results and the coordination of the premiere ceremony.

Table 4. Well-Executed Aspects of the Event

Nr.	Example	Highlighted aspects
1	*"Collaboration with sponsors, race kits, marking of the trails, decision to move the event to Saturday."*	Sponsors, race kits, trails, scheduling adjustments
2	*"Trail design, hydration point and placement of the Race Village."*	Trails quality, layout of competition and vendor area
3	*"Allocation of resources, management of volunteers."*	Efficient resource distribution, volunteer coordination
4	*"Starting the organization early and being more digitalized compared to previous editions."*	Early initiation of preparations, digitalization of operational processes

Organizers highlighted several strengths that contributed to the smooth running of the event. They emphasized the benefits of early planning, clear coordination of volunteers and sponsors, well executed trail markings, efficient digital management of processes and timely adjustments to the schedule. These factors collectively ensured that the event was well structured and operationally effective.

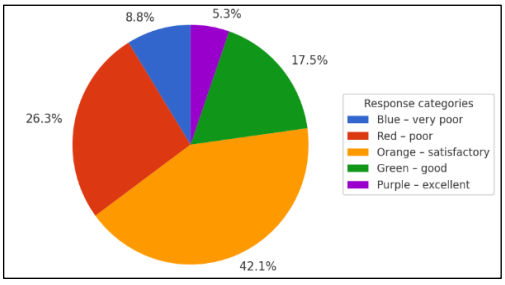

Fig. 4. How would you rate the overall organization of the event?

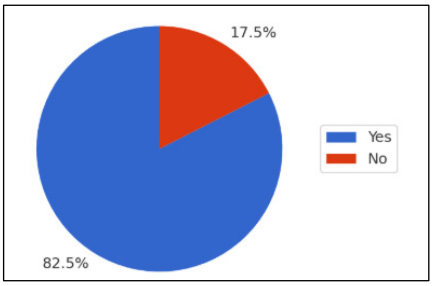

Fig. 5. Communication efficiency before and during the event

According to Fig. 4, the 57 respondents, 42.1% rated the overall organization of the event as "satisfactory", while 26.3% considered it "poor", 17.5% described it as "good", 8.8% as "very poor" and only 5.3% rated it as "excellent". These results indicate that, while a majority found the event organization acceptable, there is a notable proportion of participants who perceived significant areas for improvement. The results revealed that most participants, 82.5%, reported receiving sufficient information both prior to and during the competition, whereas 17.5% expressed dissatisfaction with the volume or clarity of communication (Fig. 5). These findings suggest that, while most of the participants felt well-informed, there remains a need to enhance communication strategies.

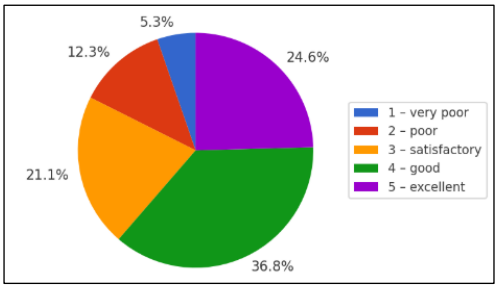

Fig. 6. Information regarding trails markings and safety measures

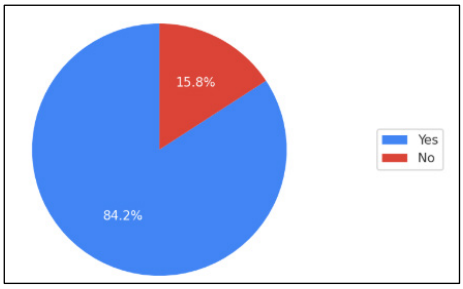

Fig. 7. Would you recommend this event?

Regarding the clarity and adequacy of information on trails markings and safety measures, participants reported varied levels of satisfaction. Among the 57 respondents, 36.8% rated the information as "good", 24.6% as "excellent" and 21.1% as "satisfactory". Contrarily, 12.3% considered the information "poor", while 5.3% classified it as "very poor". These results indicate that, although the majority viewed the provided information positively, a notable minority experienced difficulties in understanding or accessing key details related to course navigation and safety protocols.

Out of the 57 respondents, 84.2% indicated that they would recommend the event to others, whereas 15.8% stated that they would not do so.

Table 5. Key Event Elements Positively Evaluated by the Participants

Key strengths	Nr. of mentions	Key strengths	Nr. of mentions
Racing trails	13	Information/communication	5
Course markings	7	Staff and volunteers	4

Key strengths	Nr. of mentions	Key strengths	Nr. of mentions
Hydration points	6	Weather and location	4
Shuttle transport	6	Other aspects (prizes, kit, race categories, organizational flexibility)	9

This item was included to identify the most appreciated aspects of the event's organization, with the aim of highlighting strengths that can be maintained or enhanced in future editions. In the initial analysis of the 39 open-ended responses, the elements mentioned most frequently were the trail design, course markings and hydration points.

Table 6. Improvements Suggested for Future Editions

Category	Nr. of mentions	Example
Shuttle/transport service	30	*"A dedicated coordinator should manage the shuttle area, with queues formed in order of arrival."*
Timing and results	20	*"Half of the results were incorrect, a new timing team needed"*

Participants were asked to identify the organizational elements that they perceived as most in need of improvement. Analysis of the responses shows that the shuttle and transport service generated the highest number of mentions (n = 30), with participants indicating the need for a dedicated coordinator to manage the shuttle area and to organize queues. Timing and results were the second most frequently reported concern (n = 20), commonly associated with inaccuracies in recorded times and the perceived need for a new timing team.

DISCUSSIONS

The analysis of the Apuseni Bike Cup reveals distinct perspectives between organizers and participants regarding the effectiveness of operational and managerial aspects, as demonstrated by the responses collected. The success of a mountain bike competition is determined not only by the race itself but also by the quality of facilities and supplementary services provided to participants. Elements such as hydration stations, medical services, vendor areas, bike wash points and technical support stations directly contribute to the overall experience of riders and can significantly influence their perception of the professionalism of event organization (Bunning, Cole, & McNamee, 2016).

Resource-related issues represent a significant challenge in event management. The allocated budget is not always sufficient or optimally managed, which can affect access to essential materials, equipment and services. Additionally, a lack of transparency in resource allocation can lead to misunderstandings and potential conflicts. One recurring concern highlighted by an organizer emphasizes the limitations imposed by available resources stating that good ideas cannot be implemented due to insufficient funding. This issue underscores a significant barrier to effective project execution limiting the ability to expand the solutions proposed. Another significant issue relates to the uneven distribution of responsibilities within the team.

Frequently, certain tasks are handled by only a few individuals, which can lead to overwork and a decrease in the quality of their performance. Moreover, this situation may cause frustration and demotivation, as not all team members feel they are contributing fairly. In this context, organizers noted that a lack of clarity in role assignments generates confusion and inefficiency. To address this issue, the implementation of RACI matrix (Responsible, Accountable, Consulted, Informed), as proposed by Masterman, (2014), could provide a structured solution. For example, assigning overall event oversight to the Race Director, safety protocols to the Safety Director, trail management to Route Marshals, media to the Media Liaison, and logistics to the Logistics Officer. Applying such a framework would clarify roles, ensure equitable distribution of tasks and improve coordination.

Shuttle management was identified as a key operational challenge. Participants reported insufficient shuttle availability, resulting in long queues, boarding confusion and occasional use of private vehicles, creating unfair advantages. Equipment handling was also problematic, with some bicycles damaged during transport. Several participants suggested that shuttles should be reserved for training rather than incorporated into the competitive event. Time measuring and results management emerged as a major area of concern, with both organizers and participants reporting significant errors and inadequate handling. Most organizers explicitly acknowledged the timing issues, emphasizing the need for additional resources and more effective coordination with specialized external providers. Participants expressed high levels of dissatisfaction due to frequent mistakes and delays, which negatively impacted the perceived credibility and professionalism of the event.

In addition to the challenges and difficulties identified, the research highlighted several positive aspects that provided an encouraging outlook for future editions of the event. A key factor was the enthusiasm and active engagement of participants, which represented a valuable resource for any successful project. This positive attitude translates into a genuine willingness to collaborate and contribute to the continuous improvement of the event, potentially accelerating the resolution of operational issues.

Participants particularly valued the quality of the trails, describing them as challenging and well-aligned with the enduro spirit, providing a complete and satisfying experience. Although trail markings could be further improved, they were generally effective, allowing riders to focus on performance rather than navigation, which is essential for maintaining flow during the competition. In mountain bike enduro competitions, assessing trail safety and obtaining detailed participant feedback are essential for improving future editions (Tsuji et al., 2007). Another key strength identified is the support provided by volunteers and the organizing team. Despite some limitations, their visible commitment to assisting participants and ensuring smooth event operations represented a solid foundation upon which clearer and more efficient procedures can be developed.

Volunteer management involves strategic recruitment, comprehensive training and continuous motivation to ensure optimal performance. Ongoing monitoring enables real-time adjustments to operational strategies, maintaining high standards of quality and safety (Pott, Breuer, & ten Hompel, 2023). Another positive aspect is the transparency and openness of the organizers to feedback, even though not all issues were resolved perfectly. This attitude is essential for building trust and fostering a collaborative environment between participants and organizers.

Despite the criticisms raised, both groups involved in the study acknowledge a shared enthusiasm and positive potential for the event, which can serve as a strong foundation for its future development and for addressing the identified challenges.

CONCLUSIONS

The findings of this study show that operational management in mountain bike enduro events is a complex process that relies on coordinated planning, efficient communication and the ability to respond to unexpected situations. Event quality depends not only on trail design and safety measures, but also on how effectively resources are allocated, responsibilities are structured and teams coordinated across all operational stages. Key strengths identified include the systematic design and marking of trails, combined with the strategic placement of hydration stations, which together ensured efficient course flow throughout the event.

At the same time, several gaps emerged in transport logistics, timekeeping accuracy and external communication, highlighting the need for clearer role definitions, improved technical systems and stronger contingency planning. In conclusion, the study reinforces that effective operational management is

fundamental to ensuring both the credibility and long-term development of sporting events. As expectations continue to increase and organizational demands evolve, refining logistical systems, strengthening communication practices and improving team coordination will be essential steps towards enhancing future editions and advancing best practices in event management.

Acknowledgment

This article is the result of teamwork between the authors and started from the findings in Podaru Larisa Georgiana's masters' degree thesis.

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STUDIA UBB EDUCATIO ARTIS GYMN., LXX, 4, 2025, pp. 73-82
(RECOMMENDED CITATION)
DOI:10.24193/subbeag.70(4).32

The Secret Paradise Mountain Cross-Country Race in the Bârgău Mountains — Between Athletic Performance and Tourism Promotion. A Case Study on a Local Endurance Event

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Received 2025 October 13; Revised 2025 December 20; Accepted 2026 January 05;
Available online 2026 January 30; Available print 2026 January 30

ABSTRACT. Mountain running represents a complex form of physical activity that combines athletic performance, mental endurance, and the appreciation of natural landscapes. **Objectives:** This paper analyzes the organization and outcomes of the "Secret Paradise" mountain cross-country race, held on October 4th, 2025, in the Bârgău Mountains, around Zimbroaia Peak (1345 m). The 16 km course, featuring a total elevation gain and loss of 1000 m, brought together 39 participants (27 men, 12 women) aged between 14 and 73. **Methods:** The analysis is based on direct observation, organizational data, and participants' feedback. **Results:** Results highlight the potential of such events to foster community cohesion, promote active tourism, and encourage outdoor physical activity. **Conclusions:** Despite adverse weather conditions, the combination of a challenging course, effective organization, and scenic landscapes ensured the event's success.

Keywords: *mountain running, Bârgău Mountains, sport tourism, performance, case study*

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INTRODUCTION

In recent years, mountain running competitions have experienced significant growth in Romania, reflecting a global trend toward endurance sports and outdoor activities. Mountain cross-country races combine elements of athletic performance, health education, and active tourism. They take place in exceptional natural settings, encouraging mixed participation (amateurs and professionals alike) and social interaction.

This article aims to document and analyse a concrete example — the "Secret Paradise" mountain cross-country race — held in the Bârgău Mountains, in order to highlight the organisational, athletic, and touristic aspects of a local endurance event. The purpose of the research is to demonstrate how a community-based initiative can contribute to developing a culture of movement and promoting a mountain region with high touristic potential.

GEOGRAPHICAL AND ORGANISATIONAL CONTEXT

The event took place in the Bârgău Mountains, part of the Eastern Carpathians, characterised by picturesque hills (măguri) developed on intrusive magmatic massifs and plateaus modelled on sedimentary rocks (Bîca & Onofreiu, 2016), with altitudes ranging between 1,000 and 1,600 m. The cross-country race unfolded around Mount Zimbroaia (1,345 m), with both the start and finish points located at the Secret Paradise Guesthouse (https://secretparadise.ro; https://www.facebook.com/p/Secret-Paradise-Transylvania) (fig. 1).

The course covered a distance of 16 km, with a total elevation gain of 1,000 m (500 m ascent and 500 m descent), running along dirt and gravel roads through deciduous and spruce forests, meadows, and hayfields (fig. 2, fig.3). Weather conditions were difficult: heavy overnight rain, wet soil, and low temperatures.

The organizers of this sporting event were the Faculty of Geography and the Faculty of Physical Education and Sport within Babeş-Bolyai University, and Secret Paradise Transylvania.

Fig. 1. Geographic localization of Zimbroaia Mountain
Sourse: https://geoportal.ancpi.ro/portal/home/webmap/viewer-with changes

Fig. 2. Secret Paradise Mountain Cross-Country Trail
Source: Strava-with changes

Fig. 3. The profile of Secret Paradise Mountain Cross-Country
Source: Google Earth-with changes

The organizational process was rigorously structured, as follows:
- formulation of the competition concept;
- formation of the organizing core team;
- selection and mapping of the route;
- cleaning and marking of the route (paint, tape, signs);
- testing and evaluation of the route by experienced mountain marathon runners;
- formation of the volunteer team (at base and along the route);
- event promotion and opening of online registrations;
- processing of entries and establishment of award categories;
- identification of sponsors and determination of prizes;
- actual race execution and awards ceremony (fig.4).

Fig. 4. The poster of Secret Paradise Mountain Cross-Country
Source: Secret Paradise Transylvania

The event involved 39 runners (27 men and 12 women), aged between 14 and 73, and a group of 50 volunteers, supported by several county and local institutions such as Salvamont Bistrița-Năsăud, the Bistrița-Năsăud Gendarmerie, Sanovil Bistrița, and the Tiha Bârgăului Municipality.

METHODOLOGY

The research employed a mixed-method approach based on:

- direct observation during the event;
- analysis of organizational data (number of participants, times, categories, environmental conditions);
- a post-race questionnaire administered to a sample of 30 participants, addressing motivation, satisfaction, and perceived route difficulty.

Results were statistically summarized and interpreted in comparison with the specialized literature.

Literature review in the context of the secret paradise mountain cross-country race

The organization and development of the Secret Paradise Mountain Cross-Country Race in the Bârgău Mountains (4 October 2025) can be analyzed from several theoretical and empirical perspectives within the specialized literature on mountain sports, sports tourism, and participant motivation. Recent research highlights the complex relationship between athlete motivation, landscape attractiveness, and the community impact of such activities (Guereño-Omil et al., 2024; Hallmann & Zehrer, 2024).

1. Participant Motivation and Psychological Dimensions

In the specialised literature, the motivation of mountain runners is explained through the Self-Determination Theory (Deci & Ryan, 2000), which distinguishes between intrinsic motivation (the pleasure of the activity itself, contact with nature, self-improvement) and extrinsic motivation (rewards, social status, competition). Studies on ultramarathon runners (Waśkiewicz et al., 2019) show that they train and compete mainly for intrinsic reasons, such as the desire for exploration, connection with the natural environment, and the authentic experience of exertion.

These findings are also reflected among the participants in the Secret Paradise race, who described the course as “beautiful, varied, and challenging,” expressing aesthetic and emotional satisfaction beyond the physical effort.

Similarly, León-Guereño et al. (2021) demonstrated that, regardless of age, motivation for running includes psychological dimensions such as relaxation, inner balance, and a sense of community. The social atmosphere at Secret Paradise — composed of volunteers, participants, and spectators — fostered the creation of a temporary community, reinforcing the social dimension of mass sport.

2. The Mountain Landscape as a Motivational and Experiential Factor

Research in sports tourism indicates that the natural landscape is not merely an aesthetic backdrop but a constitutive element of the sporting experience (Hallmann & Zehrer, 2024). The concept of sportscape — the space perceived and experienced through physical activity — implies an integration between route, terrain, vegetation, signage, and visual perception. In the study by Guereño-Omil et al. (2024), outdoor competition participants reported choosing locations that offer not only technical challenge but also aesthetic and cultural value.

The 15 km course at Secret Paradise, circling Mount Zimbroaia (1,345 m), traverses forests, clearings, and hayfields, showcasing a wide range of visual and sensory elements — from autumn colors and moving fog to alternating slopes and surface textures. The runners' appreciation of the landscape, recorded in post-event interviews, confirms the findings of Hallmann and Zehrer (2024) regarding the importance of sensory interaction with the natural environment for overall participant satisfaction. Thus, the event managed not only to test the runners' physical limits but also to evoke aesthetic and contemplative experiences.

3. Mass Sport and Community Impact

Mountain cross-country events significantly contribute to the development of mass sports and the promotion of active tourism. Chang et al. (2021) show that local community support for sports tourism is closely linked to perceived benefits — economic, social, and identity-related. The Secret Paradise race directly involved local volunteers, sponsors, the host guesthouse, and county and local authorities, generating a form of social capital that, according to the literature, is essential for the sustainability of such events.

The participation of 39 runners from diverse backgrounds and age groups (14–73 years) also confirms the observations of León-Guereño et al. (2021) regarding the intergenerational and inclusive character of mountain running as a form of recreational physical activity. Moreover, the community dimension of the awards ceremony and post-race socialisation can be interpreted as a form of strengthening local cohesion through sport.

4. The Physical Factor and Adaptation to Mountain Effort

Recent Romanian studies (Enoiu, Găinariu & Mîndrescu, 2024) have analyzed the influence of altitude and elevation differences on athlete performance, showing that the mountain environment requires complex physiological adaptations and enhances general endurance. In the context of the Secret Paradise race — with a total elevation difference of 1,000 m and challenging weather conditions (rain, low temperatures, soft ground) — physical effort was amplified, giving the event a semi-competitive and engaging character, suitable for recreational athletes with an intermediate level of training (Șandor, 2025; Man, 2022).

From the perspective of the reviewed literature, Secret Paradise can be regarded as a model for integrating recreational sport within the natural mountain context, with multiple effects:

- development of intrinsic motivation and self - fulfilment through effort (Waśkiewicz et al., 2019);
- valorization of landscape as an aesthetic and psychological factor (Guereño-Omil et al., 2024; Hallmann & Zehrer, 2024);
- strengthening of social capital and local tourism (Chang et al., 2021);
- promotion of health and intergenerational inclusion (León-Guereño et al., 2021);
-stimulation of physical and mental adaptation to demanding environments (Enoiu et al., 2024).

Overall, the event aligns with current trends in sustainable outdoor sport, where performance, nature experience, and community complement one another.

RESULTS

Participants and Performance

Participants recorded an average completion time of 1 h 58 min, ranging between 1 h 22 min and 2 h 45 min. All runners completed the course, with no withdrawals.

Participation Motivation

According to the questionnaire results:

-52% of runners stated they participated for the pleasure of mountain running;
-28% participated for personal performance development;
-20% participated for socialization and group experience.

Perceived Difficulty and Satisfaction

-60% of runners rated the course as of “medium” difficulty, 35% as “difficult”, and 5% as “easy”.

The overall satisfaction level was high (average score: 4.7/5). Participants particularly appreciated the clear signage, landscape variety, and organizers' hospitality.

DISCUSSION

The results confirm the specialized literature regarding the positive effects of outdoor sports on physical and mental health (Deci & Ryan, 2000; Hallmann & Breuer, 2010). The predominance of intrinsic motivation and experience-oriented attitudes indicates that these competitions have become authentic forms of active tourism and environmental education.

Adverse weather conditions tested participants' endurance and adaptability but did not diminish overall enthusiasm. Efficient organization, inter-institutional collaboration, and local community involvement demonstrate the capacity of local initiatives to generate positive social and touristic impact.

The mountain cross-country race as a vector of sports tourism

The "Secret Paradise" event contributed to promoting the Bârgău area as a destination for sports tourism and active recreation. Participants engaged with remarkable landscapes — magmatic hills (măguri), clearings, deciduous and spruce forests — representing an exceptional natural resource.

The awards ceremony, held at the Secret Paradise Guesthouse, provided a setting for social interaction and experience exchange, encouraging the event's continuity. Thus, the mountain cross-country race emerges as both a tool of territorial marketing and a means of ecological and sports education (fig. 5).

Fig. 5. The Start of Secret Paradise Mountain Cross-Country
Source: Secret Paradise Transylvania

CONCLUSIONS

The "Secret Paradise" mountain cross-country race illustrates how a local initiative can harmoniously integrate sport, tourism, and community. The event demonstrated: the viability of mountain competitions in rural areas with touristic potential; the benefits of endurance activities for health and social cohesion; the educational and formative value of sport practiced in nature.

Recommendations for future editions include expanding physiological monitoring (heart rate, exertion level), analyzing local economic impact, and developing an annual calendar of mountain competitions in the Bârgău Mountains.

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STUDIA UBB EDUCATIO ARTIS GYMN., LXX, 4, 2025, pp. 83-104
(RECOMMENDED CITATION)
DOI:10.24193/subbeag.70(4).33

Teachers' Knowledge of ADHD and its Background Variables: A Questionnaire-Based Study in Hungary

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Received 2025 October 11; Revised 2025 November 20; Accepted 2025 December 10; Available online 2026 January 30; Available print 2026 January 30

ABSTRACT. ADHD is among the most frequently diagnosed child psychiatric condition. Teachers play an important role in identifying ADHD and providing appropriate education for children with ADHD. The KADDS scale is a tool commonly used to measure teachers' knowledge of ADHD. Using the KADDS scale and a background questionnaire, we conducted a survey of a sample of Hungarian teachers (n=158). Results reveal that our sample's general level of knowledge is 62.5%. Our statistical correlation analyses show that the two most important background factors that affect the level of knowledge are attendance at ADHD training and a family member or close relative diagnosed with ADHD.

Keywords: *ADHD; teachers' knowledge; KADDS; inclusive education.*

INTRODUCTION

ADHD is among the most frequently diagnosed disorders within child psychiatry. According to DSM-5, its highly varied symptoms include attention deficit disorder and hyperactivity/impulsivity (APA, 2013). The behavioral features of ADHD do not exist in a binary (i.e. typical-atypical) form; rather, they lie along a continuum, with patterns varying from one individual to the next. This also means either that, in certain situations, some aspects of ADHD are likely to be adaptive rather than detrimental, or that some of those concerned

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are likely to have certain strengths or traits that can compensate for their ADHD-related difficulties (Sedgwick et al., 2019). Self-report-based research has identified many positive aspects of ADHD, such as creativity, flexibility, dynamism, or honesty (Schippers et al., 2022).

The underlying causes of ADHD include complex multifactorial pathologies (e.g. genetics, perinatal complications, alcohol consumption during pregnancy, etc.), and ADHD has a diverse neurobiological and neuropsychological background (Roberts et al., 2015).

International studies have found prevalence to be around 5% (Polanczyk et al., 2007). The boy-to-girl ratio in childhood is 3:1, while the ratio among those seeking medical help is 6:1. The ratio of school-age and adolescent boys is 2.3–2.4 times higher; while gender gap is not that wide among preschoolers and adults (1.8:1 and 1.6:1, respectively) (Willcutt, 2012).

People diagnosed with ADHD often have difficulty in adjusting to familial, social, and school expectations. Self-control and self-discipline in the classroom may pose challenges to these children, which often results in behavioral difficulties, continuous reprimands, a negative self-image, and a feeling of being mistreated at school (Strelow, 2021). These difficulties adversely affect academic performance (Pang et al., 2021).

ADHD may often occur with several other psychiatric disorders, such as oppositional defiant disorder (25–50%), conduct disorder (25%), anxiety disorders, depression, OCD, tic disorders, autism spectrum disorder, etc. (APA, 2013). The presence of other disorders accompanying ADHD may also influence its emergence and outcome to a large extent.

The Importance of Teachers' Knowledge in Inclusive Education for Children Diagnosed with ADHD

ADHD is also a challenge for teachers, as their teaching practice has to be employed in situations that differ from normal circumstances. Teachers can identify the potential predictive signs of ADHD, as school situations are, by nature, stressful for a child with ADHD. Therefore, symptoms may be more frequent in the classroom and can act as a reliable informant for clinical staff in the diagnostic process (Barkley, 2009). Teachers, however, play a crucial role in supporting students with ADHD in school, and should be trained to recognize the behavioral, cognitive and emotional characteristics of children with ADHD, support inclusive interventions (e.g. differentiated tuition, developing individualized motivational systems, etc.) in the classroom, and provide feedback to families (Robledo-Castro, 2024).

Teachers' attitude has been identified as one of the key factors for the success of inclusive education (Dogan & Beginsoy, 2017; Lindner et al., 2023; Papp et al., 2012; Shareefa, 2016). Research suggests that teachers' attitude towards students with special educational needs is closely related to the knowledge they have acquired about the subject during their pedagogical studies (Cueli et al., 2022).

Teachers' attitudes and knowledge about inclusion can predict teachers' effectiveness in applying inclusive teaching strategies in the classroom (Alsarawi & Sukonthaman, 2023; Jones, 2020; Opoku et al., 2021).

In addition, numerous other studies (Kwon et al., 2017; Movkebayeva, 2016; Pershina et al., 2018; Zulfija et al., 2013) have confirmed that knowledge of inclusive education constitutes a significant factor in the effective implementation of inclusive practices. Subsequent research has consistently demonstrated a relationship between teachers' knowledge and understanding and their familiarity with inclusive education (Ekstam et al., 2018; Leyser et al., 2011; Mngo & Mngo, 2018; Rabi et al., 2018; Sharma et al., 2018; You et al., 2019). In their meta-analysis, Brock and Carter (2017) have found a deep impact of intensive teacher training programs on how they manage students.

In their research, Ohan et al. (2008) found that, in general, teachers with profound knowledge of ADHD and, to some extent, those with average knowledge reported a higher number of instances of helping attitude (e.g. seeking help for their students) and more positive perception (e.g. becoming aware of the benefits of behavioral and special education methods). Teachers' knowledge about ADHD also plays an important role in identifying the problem correctly and asking for help (Sciutto et al., 2016).

Teachers' Knowledge About ADHD

Our daily practice and extensive international literature show that teachers' knowledge of ADHD is insufficient. In order for inclusive education for children diagnosed with ADHD to be successful, deeper knowledge of the status and characteristics of students with ADHD is needed.

Research reveals that many teachers feel unprepared to deal with students diagnosed with ADHD and would like to have more opportunities to develop their competence (Al-Omari et al., 2015; Martinussen et al., 2011; Mohr-Jensen et al., 2019; OECD, 2019; Snider et al., 2003).

As a result of this knowledge deficit, teachers are likely to feel that attention and discipline problems, which can be common with children diagnosed with ADHD, place increasingly high burden upon them (Moore et al., 2017; Nash et al., 2016).

Evaluation of Teachers' Knowledge with the KADDS Questionnaire

The Knowledge of Attention Deficit Disorder Scale (KADDS) is a 39-item scale that measures teachers' knowledge of and misconceptions about ADHD in three areas: general information about the nature, causes and prognosis of ADHD (15 items); symptoms and diagnosis of ADHD (9 items); and treatment of ADHD (12 items). Questions can be answered with 'True', 'False' and 'I don't know' responses (Sciutto & Feldhamer, 2005).

In prior research conducted with US samples, the internal consistency of the overall KADDS score demonstrated Cronbach's alpha values ranging from 0.82 to 0.89 (Herbert et al., 2004; Sciutto et al., 2016). The validity of the Cr. α values of the three subscales varied in the different studies: the general information subscale Cr. α 0.54–0.74, the symptoms and ADHD diagnosis subscale Cr. α 0.52–0.75, and the ADHD treatment subscale Cr. α 0.61–0.75. The most satisfactory values were obtained in the study conducted by Herbert et al. (2004): general information Cr. α 0.74, symptoms Cr. α 0.75, and treatment Cr. α 0.75.

The KADDS scale is widely used internationally to measure teachers' knowledge of ADHD. Table 1 presents data from European, American and Asian countries on the level of general knowledge about ADHD as measured by the KADDS scale. These data show that though the proportion of correct answers across samples from different countries varies widely, knowledge about ADHD ranges from low to moderate.

Table 1. Teachers' general level of knowledge about ADHD as measured by the KADDS scale based on research in different countries.

Country	Sample size (persons)	Overall knowledge level (proportion of correct answers in percentage share (%))
Czech Republic (Sciutto et al., 2016)	482	57
Germany (Sciutto et al., 2016)	350	54
Greece (Sciutto et al., 2016)	198	47
Iraq (Sciutto et al., 2016)	200	45
South Korea (Sciutto et al., 2016)	146	39
Saudi Arabia (Sciutto et al., 2016)	429	15
South Africa (Sciutto et al., 2016)	212	52
USA (Sciutto et al., 2016)	159	62
Vietnam (Sciutto et al., 2016)	131	33
Canada, Nova Scotia (Blotnicky-Gallant et al., 2015)	113	68
Spain (Cueli et al., 2022)	170	68.91

Country	Sample size (persons)	Overall knowledge level (proportion of correct answers in percentage share (%))
South Korea (Lee et al., 2020)	73	64.4
New Zealand (Dilaimi, 2013)	84	48.3
Kenya (Kablra, 2012)	24	42.6
USA, South Texas (Guerra & Brown, 2012)	107	46.49
Saudi Arabia (Alshammari, 2020)	89	41
Saudi Arabia (Al-Moghamsi et al., 2018)	416	38 ± 11.3
Egypt (Farag et al., 2024)	213	41.1
Portugal (Rodrigues et al., 2013)	1,109	39.36
Greece (Galanis et al., 2021)	152	49.9
Spain (Jarque Fernández et al., 2007)	146	42.5
South Africa (Perold et al., 2010)	552	42.6
USA (Sciutto et al., 2000)	149	47.8

METHODS

The target group of the study are teachers working in Hungarian schools. In order to collect data, we used an online questionnaire the public link of which was shared on various social media platforms that teachers use (e.g. Facebook and Instagram), and recruited participants using the snowball method. At the top of the questionnaire brief information about the purpose of the data collection, voluntary participation and anonymity was provided. The background questionnaire and the KADDS scale together took 20–25 minutes to complete.

Participants

A total of 158 primary school teachers participated in the study by completing the questionnaires. The students they taught ranged in age from 6 to 15 years. The mean age of the participating teachers was 45.2 years, with an average of 17.8 years of teaching experience. Of the respondents, 156 were female and 2 were male.

Tools

Background Questionnaire

The background questionnaire collected basic demographic information (age, years of teaching experience, type of workplace), and included items

regarding prior experience with children diagnosed with ADHD (both teaching-related and within the respondents' personal circles), as well as participation in in-service training related to ADHD.

KADDS. As KADDS was originally developed in English, and the participants were teachers who are native speakers of Hungarian, it had to be translated into Hungarian. The translation was done by a special education teacher and a psychologist. The questionnaire was then translated back into English. Finally, the two English versions were examined to see how much of the original semantic content of the questions had been preserved. Where semantic discrepancies were identified, the translated items were refined to better preserve the original meaning of the questions. To finalize the translation and support decision-making, the translated items were also compared with a previously available Hungarian version of the questionnaire, which had demonstrated low reliability (Benke & Lukács, 2022). Finally, a pilot study involving thirty teachers asked to comment on how easy it was for them to understand the individual questions was conducted. The suggestions provided were incorporated into the final version of the questionnaire. Prior to the current research, we assessed the reliability of the Hungarian version of the scale on a sample of 400 respondents. Our data show that it measures reliably in terms of its total scores. Regarding this sample of 400 respondents, the reliability of the questionnaire is Cronbach's α=0.742, which, considering the sample size and the three sub-scales, is a correct value for a questionnaire measuring declarative knowledge. Reliability indices for the three subscales were as follows: general information regarding the nature, causes, and prognosis of ADHD ('G' subscale): Cronbach's $\alpha = 0.554$; symptoms and diagnosis of ADHD ('S' subscale): Cronbach's $\alpha = 0.442$; and treatment of ADHD ('T' subscale): Cronbach's $\alpha = 0.563$ (Szigethi, 2024). Given the low reliability coefficients obtained for the individual subscales, correlations with the subscales were not examined; instead, the overall level of knowledge in each domain is presented.

RESULTS

Teachers' General Knowledge About ADHD

In the present sample, the mean number of correct responses on the 36-item KADDS questionnaire (KADDS total score) was 22.5 (SD = 4.7). When expressed as a percentage, the mean proportion of correct responses was 62.5% (SD = 12.9%). In line with the KADDS Manual (Sciutto et al., 2000), the percentage of correct responses is interpreted as the indicator of knowledge level assessed by the KADDS questionnaire.

The proportion of correct answers on the three sub-scales of the KADDS questionnaire also represents the level of knowledge for each sub-scale.

Correlations with the Data from the Background Questionnaire

ADHD-Independent Background Variables Pertaining to Teachers

The Pearson correlation does not show any significant correlations between age and ADHD-knowledge measured by the KADDS scale (p=0.708), i.e. there is no linear relationship between age and knowledge. However, when teachers are grouped according to their age (age group 1: 22–35 years of age /27 persons/, age group 2: 36–45 years of age /41 persons/, age group 3: 46–55 years of age/70 persons/, age group 4: 56–67 years of age /20 persons/), and an ANOVA analysis of variance followed by Tukey's post-test is conducted, our results show that the difference between the highest measured level of knowledge for age group 1 (67.0%) and the lowest average value for age group 2 (58.5%) is significant (F=3.072, p=0.030). No significant difference was found between the other age groups.

The Pearson correlation did not establish any linear interconnection between the number of years in teaching and the level of knowledge measured by the KADDS questionnaire (p=0.629) either. Based on the number of years in teaching, the respondents were included in four groups: 1–5 years (32 respondents), 6–15 years (45 respondents), 16–29 years (51 respondents) and 30–46 years (30 respondents). Based on the results of the ANOVA analysis of variance, differences between the groups in terms of knowledge about ADHD were not significant (F=0.401, p=0.753).

ADHD-Related Background Variables for Teachers

Based on whether those completing the questionnaire currently teach a student with ADHD, teachers were included in three groups: 1: do not currently teach any child with ADHD (26 participants); 2: teach a child with presumed ADHD, not diagnosed (44 participants); 3: teach a child diagnosed with ADHD (88 participants). In these groups, the level of knowledge about ADHD as measured by the KADDS scale is the lowest for those who do not teach any children with ADHD (57.1%) and the highest average value of the knowledge surveyed is for those who also teach children diagnosed with ADHD (63.9%). The difference between the average values of these two groups is significant according to the ANOVA analysis of variance and Tukey'b post-test (F= 4.255, p=0.016).

On the basis of whether the respondents had already taught children with ADHD, we formed four groups of teachers (1: no /25 persons/; 2: yes, but rarely /31 persons/; 3: yes, fewer than 5 children /47 persons/; 4: yes, more

than 5 children/55 persons/). The differences between these groups with regard to knowledge about ADHD were not significant according to the results of the ANOVA analysis of variance (F=1.693, p=0.171); however, the average values of group 4 were the highest (F=1.693, p=0.171) in each case. They have considerable own experience in teaching children with ADHD. Since the average values showed a similar pattern across the groups, group 4 was compared with the other groups using a two-sample t-test. The results of the two-sample t-test revealed a significant difference in the levels of knowledge when teachers had significant experience, i.e. If they had taught more than 5 children with ADHD. Cohen's d effect size value is d=0.37, indicating a detectable, moderate difference (see Figure 2).

Table 2. Mean values and standard deviations of knowledge levels measured by the KADDS questionnaire and its sub-scales in the present sample.

Sub-scale		Average (%)	Deviation (%p)
G (15 items)	General information about the nature, causes and prognosis of ADHD	58.2	15.6
S (9 items)	Symptoms, the diagnosis of ADHD	78.6	15.7
T (12 items)	Treatment of ADHD	56.2	17.2
KADDS questionnaire		62.5	12.9

Teachers with significant experience, i.e. those that have taught at least 5 children with ADHD while working as teachers, scored higher on the scale as a whole. The difference between averages is significant (F=4.312, p=0.039; t=2.459, p=0.015).

Based on whether the respondents had a child diagnosed with ADHD in their family or close neighborhood, two groups were created: 1: none (102) and 2: yes (56). As regards the general level of knowledge as measured by KADDS, according to the two-sample t-test, the result for part sample 'None' is significantly weaker than the result for part sample 'Have' (KADDS: F=4.071, p=0.045, t=-3.713, p<0.001). Cohen's D effect size 0.56, which indicates a meaningful, moderate difference. Thus, those who have children diagnosed with ADHD in their immediate environment or neighbourhood have significantly more knowledge about ADHD as measured by the KADDS scale than those who don't.

Background Variables for In-service Training Courses

Based on the number of hours of in-service training, three groups of the respondent teachers are analyzed: 1: no in-service training related to ADHD (66); 2: fewer than 40 hours of in-service training (42); 3: more than 40 hours of in-service training related to or a degree in ADHD (50).

Based on the ANOVA analysis of variance and Tukey's post-test, those who had no in-service training scored significantly lower on the KADDS questionnaire than those who had in the form of either a short or a long course ($F= 18.798$, $p<0.001$). The differences between the average values of the groups created based on these variables were the most marked. When dividing respondents into two groups—those who 'had not participated in in-service training' and those who 'had participated in in-service training'—the difference in total KADDS scores exceeded 10%. Specifically, the mean percentage of correct responses was 55.9% for those without in-service training and 67.3% for those with in-service training. The corresponding Cohen's d value was 0.979, indicating a very large effect size between the two group means.

Background Variables Pertaining to the Working Environment

There were no significant differences between the average values of ADHD-related knowledge of the groups as measured by the KADDS scale by settlement type (capital city /59 persons/, county /34 persons/city or town 47 persons/, village /18 persons/) (ANOVA results $F=2.577$, $p=0.094$) where the respondents' place of work is.

Based on whether an ADHD specialist was available where respondent teachers work four groups were formed: 1: No (49 persons); 2: Don't know (5 persons); 3: Available but had not yet consulted them (27 persons); 4: Available and had already consulted them (77 persons). The ANOVA analysis of variance revealed no significant differences between these groups' levels of knowledge about ADHD as measured by the KADDS scale. However, the reason for wording the question and providing the response options was to clearly identify teachers who had had the opportunity to seek support from an ADHD professional with their work and those who had chosen not to do so. Therefore, a two-sample t-test is used to compare the average values of the general knowledge levels of those in these two part-samples as measured by the KADDS questionnaire.

The knowledge of the teachers across the KADDS questionnaire and its sub-scales who took the opportunity to seek the support of an ADHD specialist available at work is significantly higher (64.7%) than that of the teachers who did not though they had had the opportunity to do so (57.1%). The average values are significantly different ($F=7.817$, $p=0.006$; $t=-2.135$, $p=0.040$). The differences are moderate, but significant, Cohen's $d = 0.60$.

Regarding whether the school where the respondent teacher works organizes ADHD-related training, no differences in the average values of the teachers' knowledge as measured by the KADDS questionnaire were found (1: Does not organize /107 persons/; 2: Rarely organizes /40 persons/; 3: Organizes more

than once /11 persons/), nor were any differences identified with the ANOVA analysis of variance in the case of sub-scales. Two-sample t-tests run after Groups 1 and 2 and Groups 2 and 3 had been merged did not indicate significant differences in the indicators tested, either. The second test examines whether in-service training has any detectable effect, and the first one examines whether regular in-service training has a detectable effect on the knowledge items of the teachers tested. Statistics show that there is no effect in either case.

Neither the ANOVA analysis of variance nor the two-sample t-tests revealed any significant differences between the knowledge levels measured with the complete KADDS questionnaire of the groups formed on the basis of the background variables generated on the basis of the additional questions in the background questionnaire on the work environment (Can you ask your colleagues for advice on ADHD? If you have difficulty with a child diagnosed with ADHD, do you share this with your colleagues? Are there any organized opportunities for case conferences or supervision in the institution?). It follows then that these parameters do not affect the measured knowledge levels significantly.

The Complex Impact of the Background Variables Examined on the Level of Knowledge Examined

Regression Analysis of the KADDS Total Score

Model 1. Including all relevant (12 independent) variables of the background variables studied, and using a linear regression model, we examined the KADDS total score as a dependent variable ($F=3.583$, $p<0.001$). The overall explanatory power of the model was 22.9 per cent ($R2=0.229$).

Table 3 shows the four background variables the absolute value of the effect of which is above 1 per cent. It is safe to say that the other eight variables included in the model have no effect on the dependent variable in this model. The combined explanatory power of the four variables is 23.5 per cent. This is a higher value than the total explanatory power of the model (22.9%) because the effects of the 8 variables that had not been included. included values ranging between 0 and -1.

Model 2. Retaining the four variables with an effect greater than 1 per cent in the previous model, and using a linear regression model, we examined the total KADDS score as a dependent variable ($F=10.571$, $p<0.001$). The overall explanatory power of the model was 21.7 per cent ($R2=0.217$) (Table 4).

Table 3. Regression analysis of the KADDS total score – model 1

Background variable	r	ß	Effect (r*ß*100)	p
Have you attended any training in ADHD?	0.387	0.365	14.1	0.001
Is there a child or an adult diagnosed with ADHD in your family or among friends, peers or acquaintances?	0.262	0.190	5.0	0.018
Location of respondent's workplace	0.182	0.140	2.5	0.073
Do you currently teach a child diagnosed with ADHD?	0.201	0.093	1.9	0.237
Total explanatory power (R2*100) =			22.9	

Table 4. Regression analysis of the KADDS total score – model 2.

Background variable	r	ß	Effect (r*ß*100)	p
Have you attended any training in ADHD?	0.387	0.333	12.9	0.000
Is there a child or an adult diagnosed with ADHD in your family or among friends, peers or acquaintances?	0.262	0.185	4.9	0.014
Location of respondent's workplace	0.182	0.125	2.3	0.086
Do you currently teach a child diagnosed with ADHD?	0.201	0.082	1.6	0.277
Total explanatory power (R2*100)			21.7	

In Model 2, variables related to in-service training and having a person diagnosed with ADHD among relatives, peers, friends or acquaintances continue to have a significant effect. It is safe to say that, regarding the background variables examined, these two variables exert dominant influence on the level of knowledge measured by the KADDS questionnaire.

Model 3. The two variables with a significant effect in the previous model (in-service training and having a person diagnosed with ADHD among relatives, peers, friends or acquaintances) are considered as explanatory variables, and the KADDS total score remains the dependent variable. The aim of this model is to determine the proportion of the effect of the two variables as precisely as possible. The model is significant ($F=18.597$, $p<0.001$) with an overall explanatory power of 19.4 per cent ($R2=0.194$) (Table 5).

Table 5. Regression analysis of the KADDS total score – model 3.

Background variable	r	ß	Effect (r*ß*100)	p
Have you attended any training in ADHD?	0.387	0.357	13.8	0.000
Is there a child or an adult diagnosed with ADHD in your family or among friends, peers, or acquaintances?	0.262	0.212	5.6	0.004
Total explanatory power (R2*100)			19.4	

The results of the model show that regarding the two background variables, both exerting a significant effect, it is the variable describing the length of ADHD-related training that has a larger proportion of the explanatory power. In addition, the effect of having a person diagnosed with ADHD in the family or among friends, peers or acquaintances is significant, but to a lesser extent.

Thus, it is the number of hours of training and knowing a person diagnosed with ADHD in the family or among friends, peers or acquaintances that are the background variables with a significant effect in the regression models. Figure 5 enables us to examine the ADHD-related knowledge as measured by the KADDS scale of the 6 groups created in accordance with the breakdown established by a cross-tabulation containing these two background variables. Presumably, we have thus found, from among the part-samples outlined by means of background variables, the groups with the lowest level of knowledge (no training in ADHD and nobody diagnosed with ADHD in the family or among friends, peers or acquaintances: 52.6%) and the one with the highest level of knowledge (participated in ADHD-related training and knowing a person diagnosed with ADHD in the family or among friends, peers or acquaintances: 71.2%).

DISCUSSION

Teachers' General Knowledge About ADHD

This study examines teachers' ADHD-related knowledge. The general knowledge level of teachers measured by the KADDS scale is 62.5%, which is in the upper category of knowledge level identified in international studies (see Table 1).

This result is similar to the ADHD knowledge level of teachers as measured by the KADDS scale in, for example, the United States (Sciutto et al., 2016) or South Korea (Lee et al., 2020).

The knowledge level that we measured is lower than, for example, the knowledge level of Spanish (Cueli et al., 2022) and Canadian (Blotnicky-Gallant et al., 2015) teachers.

The teachers in our study scored higher on the KADDS scale than teachers in Vietnam (Sciutto et al., 2016), Saudi Arabia (Sciutto et al., 2016), Greece (Galanis et al., 2021; Sciutto et al., 2016), Iraq (Sciutto et al, 2016), New Zealand (Dilaimi, 2013), Kenya (Kablra, 2012), South Texas, USA (Guerra & Brown, 2012), Saudi Arabia (Alshammari, 2020), Egypt (Al-Moghamsi et al., 2018), Spain (Jarque Fernández et al., 2007) or South Africa (Perold et al., 2010).

Although Hungarian teachers' knowledge of ADHD is among the higher in international comparisons, it is still considered moderate, and educational interventions are needed to increase this level of knowledge in Hungary.

Age and Knowledge About ADHD

The influence of age on teachers' knowledge of ADHD remains a subject of debate in the literature. Safaan et al. (2017) found that an increase in age was associated with an increase in teachers' knowledge of ADHD, but Hosseinnia et al. (2020) found the opposite in their research. Their research has revealed that the younger generation of teachers usually holds a degree from an institution of higher education, with a higher proportion having completed a master's or doctoral degree than older teachers. The higher level of knowledge about ADHD observed among younger teachers may be attributed to their more recent educational attainment (Safaan et al., 2017; Yussef et al., 2015; Perold et al., 2010). Conversely, older teachers possess greater professional experience, which may in turn be associated with enhanced knowledge regarding ADHD (Al-Moghamsi & Aljohani, 2018; Safaan et al., 2017; Sciutto et al., 2000). In our survey, respondents aged 22–35 years of age scored significantly higher on the KADDS scale than those aged 36–45 years of age. Also, members of the oldest age group have more knowledge about ADHD, especially in terms of symptom recognition and practical methods. In other words, the results of our sample support both assumptions and highlight the need to support the middle generation.

Number of Years Spent the Teaching Profession

In line with previous international research (Aly et al., 2015; Alfageer et al., 2018; Saad et al., 2022), the results of our present study show that the number

of years spent teaching is not interconnected with the level of knowledge about ADHD.

Previous or Current Teaching Experience with Children Diagnosed with ADHD. International research has produced conflicting results on the impact of previous or current teaching experience with children diagnosed with ADHD on ADHD-related knowledge levels. Nasr et al. (2024) and Farag et al. (2024) have found no significant connection between previous experience and ADHD-related knowledge levels, contradicting the findings of Alfageer et al (2018) and Saad et al (2022), who have found that having taught children with ADHD either in the past or currently has a positive effect on teachers' ADHD-related knowledge levels. Our study has found that teachers who are currently also teaching children with an ADHD diagnosis have the highest level of ADHD-related knowledge. As regards the role of prior teaching experience, there is a significant difference in the level of knowledge about ADHD according to whether teachers have significant experience, i.e. whether they have taught more than 5 children with ADHD.

Children Diagnosed with ADHD in the Teacher's Family or Among Their Friends

In a study conducted in 9 countries, Sciutto et al. (2016) found that teachers who had a family member, a friend, a peer or an acquaintance diagnosed with ADHD had higher levels of ADHD-related knowledge. Such close relationship is likely to provide them with relevant knowledge about symptoms, diagnoses and treatments. In addition, research on the stigmatization of individuals with ADHD has consistently identified personal (emotional) involvement as an effective component of interventions (Corrigan et al., 2012). Corroborating these data, our survey also confirms that teachers in whose family there are children diagnosed with ADHD, or who have friends, peers or acquaintances diagnosed with ADHD have significantly higher levels of ADHD-related knowledge than those in whose family or among whose friends, peers or acquaintances there are no such persons.

In-Service Training

International research has shown that ADHD training is effective because teachers' knowledge about ADHD increases after training (Jones & Chronis-Tuscano, 2008; Ward et. al, 2022; Zentall & Javorsky, 2007), which usually leads to more positive attitudes towards affected children (Cueli et. al, 2022). In Sciutto's (2016) cross-national study of 9 countries, the connection between

knowledge and training was found to be modest, which is consistent with other previous studies (Sciutto et al, 2000; Kos et al, 2004; Jarque Fernández et al, 2007; Jones & Chronis-Tuscano, 2008; Perold et al, 2010). In contrast, in a study by Mohr-Jensen et al (2019), the strongest predictor of accurate knowledge was postgraduate education in ADHD.

The results of our study suggest that there is a significant difference in the level of knowledge about ADHD between teachers who have attended relevant postgraduate training compared with those who did not.

Work Environment

In our study, the only background data on the work environment that was significantly interconnected with ADHD knowledge levels as measured by the KADDS scale was whether or not teachers have used the services of an ADHD specialist 'available' at the workplace. We hypothesize that this may be since teachers who visit a specialist is interested in ADHD in the first place, believe that the proper education of the children concerned is important, and therefore, and use other sources to receive information. While teachers whose school employs an ADHD specialist, but who do not consult them, are presumably less interested in ADHD and they may not teach affected children.

The two background variables with significant effects according to the regression analysis are participation in in-service training and social involvement. From among the part-samples outlined by means of background variables, the group with the lowest level of knowledge was the one whose members had had no training in ADHD or had nobody diagnosed with ADHD in the family or among friends, peers or acquaintances (52.6%), and the group with the highest level of knowledge was the one whose members had participated in ADHD-related training and had a person diagnosed with ADHD in the family or among friends, peers or acquaintances (71.2%).

Limitations

Our study has several limitations. Given the fact that we collected data using the snowball method, the research is not representative of the Hungarian teaching profession as a whole. We used a self-administered questionnaire to map teachers' knowledge about ADHD, which may, therefore, result in biased information. Finally, there may be a number of demographic, educational, personal and workplace determinants of teachers' knowledge of ADHD, and we were able to investigate only a few.

CONCLUSIONS

The results of our research suggest that the level of knowledge about ADHD is the most strongly influenced by two factors: a close personal relationship with a child diagnosed with ADHD and high number of (more than 40-) hours of ADHD-related or tertiary-level training.

An early diagnosis is essential to ensure that children with ADHD receive the right support. Teachers are usually the first professionals who are likely to notice the characteristics of ADHD in children, and hence, are in a position to refer them to an appropriate specialist. In addition, teachers are the ones who spend the most time with children, so their methodological training is essential. Teachers, therefore, need to have the appropriate ADHD knowledge to understand this condition, provide appropriate support in the classroom, and have a positive attitude towards the children concerned. The knowledge-enhancing role of a personal relationship suggests that it is worth involving people diagnosed with ADHD and their families in educational and research issues.

Acknowledgement

The Research Ethics Committee of the Faculty of Education and Psychology, Eötvös Loránd University granted ethical approval for the research (Approval Number: 2022/628-2). All participants gave their informed consent prior to participation. Data collection and handling were carried out in full compliance with relevant ethical standards and data protection regulations.

This study was conducted as part of a doctoral research project at the Faculty of Education and Psychology, Eötvös Loránd University, supported by a doctoral scholarship. The author declares no competing interests. The data that support the findings of this study are available from the corresponding author, upon reasonable request.

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STUDIA UBB EDUCATIO ARTIS GYMN., LXX, 4, 2025, pp. 105-113
(RECOMMENDED CITATION)
DOI:10.24193/subbeag.70(4).34

The Impact of Resistance Training on Body Composition and Muscle Strength in Elderly Patients With Sarcopenia

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Received 2025 October 29; Revised 2025 November 20; Accepted 2025 December 05; Available online 2026 January 30; Available print 2026 January 30

ABSTRACT. Introduction: Sarcopenia is a progressive and widespread condition characterized by the loss of muscle mass and function, commonly seen among older adults. This condition leads to decreased functional capacity, a higher risk of falls, impaired independence in daily activities, and, implicitly, a significant decline in quality of life. **Objective**: This paper aims to show the effects of a resistance training program on body composition and muscle strength in elderly patients with sarcopenia. **Material and Methods**: This study involved 15 patients aged between 60 and 80, who were evaluated initially and after 3 months of training. We used body composition analysis by bioelectrical impedance (BIA), measured grip strength with manual dynamometry, and assessed patients' functional independence using the "Time Up and Go" (TUG) test. The intervention consisted of a resistance exercise program conducted over 12 weeks, with two weekly sessions, tailored to each patient's physical condition and specific needs. **Results**: After the training program, patients showed a significant increase in muscle mass measured by BIA, improved hand grip strength, and a notable decrease in execution time on the TUG test, demonstrating the intervention's effectiveness. **Conclusions**: Resistance training significantly boosts muscle mass and strength in elderly sarcopenic patients. It also improves balance and mobility, which are vital for maintaining independence. Therefore, resistance training should be a core part of prevention and treatment plans for sarcopenic patients.

Keywords: *sarcopenia; resistance training; elderly; body composition; muscle strength; bioimpedance; functional rehabilitation*

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INTRODUCTION

Sarcopenia is a progressive and widespread condition of the muscular system characterized by loss of muscle mass and strength. It is mainly associated with natural aging and has notable functional effects. It impacts the mobility, independence, and quality of life of older adults and increases the risk of falls, fractures, and disabilities (Cruz-Jentoft et al., 2019).

Definitions of sarcopenia have changed over time. The European Working Group on Sarcopenia in Older People (EWGSOP) first defined sarcopenia in 2010 as the gradual and widespread loss of muscle mass and strength. In the 2019 EWGSOP2 update, greater emphasis was placed on the decline in muscle strength as a key diagnostic criterion, since strength is a more reliable indicator of functional impact than merely muscle mass (Cruz-Jentoft et al., 2019; Chen et al, 2020).

The prevalence of sarcopenia varies greatly depending on the population studied and the diagnostic methods used. A 2021 meta-analysis found that among older adults, the prevalence ranged from 10% to 27%, depending on the assessment criteria (Petermann-Rocha et al., 2022). When the assessment used the BIA (Bioelectrical Impedance Analysis) method instead of the DXA (Dual-energy X-ray Absorptiometry) for measuring muscle mass, the estimated prevalence was 10%, according to a 2017 systematic review and meta-analyses (Shafiee et al., 2017).

Other studies in the literature estimate the prevalence of sarcopenia to range from 5% (according to EWGSOP2) to 17% (according to IWGS – International Working Group on Sarcopenia) in the elderly population (Yuan & Larsson, 2023).

Physical inactivity is the main cause of sarcopenia development and progression, with about 3 - 5% being lost every decade after age 30 (Moga et al, 2022).

Additionally, sarcopenia impacts muscle mass and strength, and it complexly influences the overall body. It is often linked with other geriatric syndromes, such as frailty and osteoporosis, and raises the risk of chronic diseases like type 2 diabetes and cardiovascular disease (Beaudart et al., 2017; Tanimura et al., 2023; Chen et al., 2024).

Recent studies indicate that moderate- to high-intensity resistance training programs can greatly improve muscle strength and body composition in older adults diagnosed with sarcopenia (Lopez et al., 2018; Sayer et al, 2024).

Among all the methods tested, resistance training remains the intervention with the strongest evidence of long-term benefits on muscle function and body composition (Beaudart et al., 2017; Chen, 2024).

Purpose

This paper, based on recent scientific evidence, aims to analyze the impact of resistance training on body composition, specifically muscle mass and strength, in patients with sarcopenia.

MATERIAL AND METHODS

For this study, we recruited 15 patients aged between 60 and 80, with a mean age of 70.06 ± 7.42. years. These patients included 7 women aged between 60 and 80 (average age 69 ± 7.65 years) and 8 men aged between 60 and 80 (average age 71 ± 7.59 years).

The study lasted three months at the "Association of Rheumatism Patients in Banat," Timișoara, from October 2024 to January 2025.

The inclusion criteria for the study were: (1) patients over 60 years old; (2) a confirmed diagnosis of primary osteoporosis (T-score ≤ -2.5, assessed by DXA) and reduced handgrip strength according to EWGSOP2 criteria; (3) written consent to participate in the study.

The exclusion criteria were: (1) severe mobility disorders; (2) neurological disorders affecting balance and gait; (2) severe heart disease; (3) hip or knee arthroplasty; (4) inflammatory musculoskeletal disorders; (5) malignant tumors; (6) diabetic neuropathy; (7) cognitive disorders; (8) inability to perform physical exercises.

The assessment methods employed included:

Bioelectrical impedance analysis (BIA) is a non-invasive and accessible method for assessing body composition that measures the human body's resistance to a weak electrical current. This technique depends on the differences in electrical conductivity among biological tissues: muscle tissue, which contains high water and electrolyte levels, conducts electricity more effectively than adipose tissue, which has higher resistance. By using impedance measurements and anthropometric data such as weight, height, gender, and age, it is possible to accurately estimate muscle mass, fat percentage, total hydration, bone mass, and body mass index (BMI) (Toomey et al, 2015).

In the context of sarcopenia diagnosis, BIA is considered a valid method for estimating muscle mass and monitoring responses to treatment, as endorsed by the EWGSOP2 consensus (Cruz-Jentoft et al., 2019). For our study, we utilized a BFC-150 BW device from Star Light.

Hand dynamometry was used to measure handgrip strength. The test was performed on the dominant hand, seated, with the elbow flexed at 90 degrees.

The *Timed Up and Go* (TUG) test is a validated clinical tool used to assess functional mobility and fall risk in older adults. It offers valuable insights into postural balance, reaction time, and movement safety, making it an essential measure for evaluating the physical performance of geriatric patients (Centers for Disease Control and Prevention, www.cdc.gov).

The exercise plan for patients was organized as follows:

In the first four weeks—an accommodation and stabilization phase aimed at activating the core muscles, learning proper technique, boosting confidence in movement, and enhancing balance—followed by a five- to ten-minute warm-up, strength exercises (two sets of 10-12 repetitions), balance exercises, and stretching exercises.

In weeks 5–8, a strength progression phase was implemented to build muscle mass, enhance exercise capacity, and improve stability exercises. This phase included a warm-up, strength training (2-3 sets of 10-12 reps), balance drills, and stretching routines.

Weeks 9-12: A phase dedicated to functional strengthening, aimed at increasing strength, enhancing stability, and practicing dynamic postural control. This phase included warm-ups, strength exercises (3 sets of 10-15 repetitions), balance activities, and stretching.

RESULTS

After finishing the 12-week resistance training program, elderly patients with sarcopenia showed significant improvements in body composition, muscle strength, and functional mobility.

Body composition

Bioimpedance analysis of body composition showed a general increase in muscle mass and decreased body fat percentage. As a result, muscle mass (MM) increased from an initial average of 32.16 ± 5.52% to a final average of 32.94 ± 5.62%, a 0.78% rise from baseline. Body fat decreased from an initial average of 35.26% ± 8.91% to 34.46% ± 8.68% after 12 weeks of training, showing a 0.8% reduction. These changes demonstrate an improvement in body composition, highlighting the effectiveness of resistance training in fighting sarcopenia.

Muscle strength

Measurements with a hand dynamometer showed a significant increase in handgrip strength. As a result, the average muscle strength rose from 18.47 ± 1.7 kgf initially to 22.0 ± 2.21 kgf after the program, a gain of approximately 3.53%.

The "Up and Go" test

Performance on the "Up and Go" test (TUG) demonstrated improved functional mobility. As a result, the average time decreased from 14.19 ± 1.19 seconds to 11.63 ± 0.59 seconds after the intervention, a reduction of 2.56 seconds.

This decrease in the time needed to complete the test shows improved stability, coordination, and functional balance.

The results support the hypothesis that resistance exercises are an effective intervention for improving sarcopenia symptoms. The increase in muscle mass and grip strength, the reduction in body fat, and the improved time on the TUG test show clear and measurable progress in function. These findings align with data reported in the literature (Lopez et al., 2018; Cho et al., 2022; Cruz-Jentoft et al., 2019), confirming the benefits of resistance training for this group of patients.

Additionally, the average values observed indicate not only quantitative progress but also a qualitative improvement in the participants' overall functional condition, further supporting the value of the proposed intervention.

Table 1. Initial and final parameter values studied

Indicator	Initial values (mean)	Final values (mean)	t-test (p)
Muscle mass (%)	32.16	32.94	p =1.19238E-08 p < 0.001
Body fat (%)	35.26	34.46	p = 5.95348E-08 p < 0.001
Grip strength (kgf)	18.47	22	p = 2.35927E-08 p < 0.001
"Up and Go" test	14.19	11.63	p = 2.53589E-08 p < 0.001

After applying the t-test for paired samples, we observed that the training program resulted in highly significant results for the parameters studied. Thus, we found a significant increase in muscle mass and final handgrip strength compared to the initial assessment ($p < 0.001$). After the program's implementation,

the calculated p-value confirmed a statistically significant reduction in body fat percentage. Regarding the TUG test, the p-value was also statistically significant ($p < 0.001$), suggesting a clinically and statistically relevant improvement.

DISCUSSION

The results from this study align with existing data, supporting the idea that resistance training should be a key part of prevention and treatment programs for sarcopenia (Cho et al., 2022; Shen et al., 2023; Kim et al., 2025). Lopez et al. (2018) highlighted in a systematic review that moderate- to high-intensity resistance training is associated with significant gains in muscle mass and strength in older adults. Beaudart et al. (2017) also demonstrated that strength training lowers fall risk and improves mobility, which our study further supports through better TUG test results. The research by Lopez et al. (2018), Cruz-Jentoft et al. (2019), and Beaudart et al. (2017) reinforce these findings, providing additional validation for the intervention used in this study.

The EWGSOP2 consensus (Cruz-Jentoft et al., 2019) clearly emphasizes that physical activity-based interventions, particularly resistance exercises, are essential for preventing and treating sarcopenia, and our data support this recommendation.

The data from our study support existing trends in the literature and emphasize the need to develop standardized intervention protocols that can be broadly used in various clinical and community settings. They highlight the importance of maintaining regular physical activity for healthy aging.

Incorporating resistance training into standard rehabilitation protocols can enhance therapeutic outcomes and lower the costs linked to long-term care. Additionally, promoting these interventions via health education campaigns can increase awareness among the general population and healthcare professionals, thereby fostering a culture of active and independent aging (Chaves et al. 2021).

Our study had several strengths, such as the consistent application of a standardized resistance training protocol to all participants, which enabled comparable and reproducible results; the use of validated methods for assessing sarcopenia (bioimpedance, dynamometry, TUG test); and careful participant selection based on specific inclusion and exclusion criteria. However, the study also has limitations: the small sample size of only 15 participants, which restricts the ability to generalize the findings to the broader elderly population; the lack of a control group, which prevents fully ruling out other factors influencing the results; and the relatively short intervention duration of 12 weeks, which limits the evaluation of long-term effects and the sustainability of the improvements.

From a practical standpoint, the data show that resistance training programs can be successfully carried out in different settings (rehabilitation centers, patient groups, senior communities) without the need for advanced equipment or large financial investment. Additionally, the flexibility of resistance exercises allows programs to be tailored to patients' fitness levels, existing health conditions, and personal preferences, thereby enhancing adherence and the overall effectiveness of the intervention.

Future research should also examine how different types of exercises—such as isometric exercises, functional exercises, and circuit training—individually affect outcomes to find the most effective methods for each patient's profile. Customizing interventions should become standard practice, replacing the uniform "one-size-fits-all" approach used for all patients.

CONCLUSIONS

The results achieved after applying the resistance training program to elderly patients diagnosed with sarcopenia confirm the initial hypothesis of the study. The increase in muscle mass, decrease in body fat percentage, improvement in handgrip strength, and shorter time to complete the "Stand Up and Walk" test demonstrate the intervention's effectiveness.

After the study, we discovered that resistance training significantly boosts muscle mass and strength in elderly patients. The gains in muscle mass and handgrip strength show that strength exercises tailored to patients' functional levels can effectively reverse muscle loss related to sarcopenia.

Secondly, the study showed a significant decrease in body fat percentage at the end of the intervention, indicating a positive effect on overall body composition. This finding is important because a balanced body composition directly affects the risk of chronic diseases and functional decline in older adults.

Another key finding is the improvement in functional mobility, measured by the "Up and Go" (TUG) test, where the completion time was reduced by 2.56 seconds. This development emphasizes the positive impact of strength training on balance, coordination, and mobility, which are crucial for maintaining independence and quality of life in the elderly population.

We believe resistance training is an effective, safe, and accessible way to prevent and manage sarcopenia in older adults. Implementing structured strength training programs can significantly improve overall health, increase functional independence, and enhance quality of life in this population.

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STUDIA UBB EDUCATIO ARTIS GYMN., LXX, 4, 2025, pp. 115-123
(RECOMMENDED CITATION)
DOI:10.24193/subbeag.70(4).35

Quality of Life and Motivations for Physical Activity in Individuals With Parkinson's Disease

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Received 2025 November 06.; Revised 2025 December 20; Accepted 2026 January 05; Available online 2026 January 30; Available print 2026 January 30

ABSTRACT. Parkinson's disease (PD) impacts multiple life domains, with motor and non-motor symptoms affecting Health-Related Quality of Life (HRQOL). Understanding quality of life and motivation for physical activity is essential for targeted rehabilitation. **Objective:** To assess quality of life in PD patients using the PDQ-39 and explore motivational factors for physical activity via the PALMS questionnaire, examining relationships with demographic variables, disease stage, and activity patterns. **Methods:** A cross-sectional study included 40 adults with PD in Cluj-Napoca, Romania, completing PDQ-39 and PALMS questionnaires. Data were analyzed using descriptive statistics, independent t-tests, and Pearson's correlations. **Results:** The mean PDQ-39 Summary Index was 38.51±19.82, indicating moderate impairment. Bodily discomfort, mobility, emotional well-being, and activities of daily living were the most affected domains. Significant differences between Hoehn and Yahr stages II and III were found in multiple domains and the PDQ-39 Summary Index. Longer disease duration (≥10 years) was linked to poorer cognition, communication, bodily discomfort, and overall quality of life. PALMS results showed highest motivation in physical condition and mastery, lowest in competition. Strong correlations existed between PDQ-39 Summary Index and all domains ($r = .711–.832$, $p < .01$), and moderate correlation with disease duration ($r = .414$, $p < .01$). **Conclusions:** PD patients exhibited moderate quality of life impairments influenced by motor

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symptoms, emotional well-being, and discomfort. Physical activity motivation centered on fitness and mastery rather than competition. Disease progression significantly affects quality of life, underscoring the need for personalized physiotherapy and long-term rehabilitation.

Keywords: *Parkinson's disease, quality of life, PDQ-39, PALMS, motivation.*

INTRODUCTION

Parkinson's disease (PD) is a progressive neurodegenerative disorder characterized by the degeneration of dopaminergic neurons in the substantia nigra, resulting in motor symptoms such as tremors, rigidity, bradykinesia, and postural instability (Schrag, 2000). Additionally, non-motor symptoms, including pain, sleep disorders, depression, cognitive decline, and autonomic dysfunction, significantly contribute to overall disability and reduced quality of life (QoL) (Marumoto et al., 2019).

According to the World Health Organization, quality of life is defined as an individual's perception of their position in life concerning cultural, societal, and personal expectations (Kuyken et al., 1995). Health-related quality of life (HRQOL) is a critical outcome in clinical practice and rehabilitation research (Ophey et al., 2018; Soh et al., 2012).

The PDQ-39 is the most extensively utilized disease-specific instrument for evaluating the health-related quality of life (HRQOL) in Parkinson's disease (PD) (Ophey et al., 2018; Chen et al., 2017; Klepac et al., 2007). It encompasses domains such as mobility, activities of daily living, emotional well-being, stigma, social support, cognition, communication, and bodily discomfort (Jenkinson et al., 1997).

Physical activity is widely recognized for its therapeutic benefits in Parkinson's disease (PD), including improvements in motor performance, a reduction in fall risk, mood enhancement, and preservation of functional independence (Canning et al., 2014; Earhart & Falvo, 2013; Kwok et al., 2016; Van Der Kolk & King, 2013). Consequently, understanding patients' motivation to engage in physical activity is essential. The Physical Activity and Leisure Motivation Scale (PALMS) offer a comprehensive assessment of motivational factors, including mastery, physical condition, psychological benefits, social influences, appearance, competition, and enjoyment (Molanorouzi et al., 2014; Roychowdhury, 2018).

Parkinson's disease in Romania presents distinct epidemiological and healthcare challenges, as highlighted by Rosca et al. (2021). The prevalence of Parkinson's disease is increasing, reflecting global trends (Liu & Chan, 2016; Willis et al., 2022). However, Romania faces specific issues related to diagnostic

delays, limited access to specialized care, and insufficient public awareness. These factors contribute to the suboptimal management and quality of life of patients. Additionally, the resource constraints of the Romanian healthcare system impact the availability of advanced therapeutic options and multidisciplinary support essential for comprehensive Parkinson's care. Rosca et al. emphasize the need for improved national strategies focusing on early diagnosis, patient education, and integration of multidisciplinary approaches to address the growing burden of Parkinson's disease in Romania.

Although there is a growing body of international research on quality of life (QoL) and motivation for physical activity in individuals with Parkinson's disease (PD) (Ellingson et al., 2019; Gómez-Esteban et al., 2007), studies specifically targeting the Romanian PD population are still scarce. This study addresses this gap by analyzing the outcomes of the PDQ-39 and PALMS assessments in a group from Cluj-Napoca. 2. Materials and methods

MATERIALS AND METHODS

This preliminary cross-sectional study was conducted between December 2019 and January 2020. A cohort of 40 individuals diagnosed with Parkinson's disease (PD) voluntarily completed the PDQ-39 and PALMS questionnaires during a community event, with subsequent data collection at a medical center.

The demographic profile of the study sample indicates that females constitute 72% of the participants, whereas males account for 28%. The age range of the participants was between 55 and 80 years, with a mean age of 66.48 years and a standard deviation of 6.69. The majority (83 %) resided in urban areas, whereas 17% were from rural areas. Regarding marital status, 55% of the participants were married, 30% were widowed, 10% were divorced, and 5% were single. In terms of educational attainment, 70% had completed high school or post-secondary education, 18% had attained a university degree, and 12% had completed middle school. The distribution of participants across Hoehn and Yahr stages is as follows: 17.5% are at Stage II, 48% are at Stage III, and the stage is unknown for 35% of participants.

Instruments

PDQ-39 questionnaire

The PDQ-39 evaluates eight aspects of quality of life (QoL) using 39 questions on a Likert frequency scale. The scores range from 0 to 100, with higher scores indicating lower QoL. The Total PDQ-39 Summary Index (SI) was determined by averaging the scores of the domains.

PALMS questionnaire

The PALMS tool consists of 40 questions categorized into eight subdomains, each with scores ranging from 5 to 25: Mastery, Physical Condition, Interpersonal Relations, Psychological State, Appearance, Social Expectations, Enjoyment, and Competition.

RESULTS

PDQ-39

The mean PDQ-39 Summary Index (SI) score was 38.51±19.82. The highest levels of impairment were observed in the domains of Bodily discomfort (55.21±19.85), mobility (45.00±27.10), Emotional state (41.04±27.49), and Activities of daily living (ADL) (39.06±25.52). Conversely, the lowest levels of impairment were noted in the areas of Social support (27.92±24.93), communication (30.00±24.45), and stigma (33.44±28.01). Cronbach's Alpha for the PDQ-39 SI was 0.913, indicating excellent reliability.

Table 1. Descriptive PDQ39 questionnaire analysis

Subdomains of PDQ39	N	Min.	Max.	Media	SD
Mobility	40	0	100	45,00	27,10
ADL	40	0	100	39,06	25,52
Emotional state	40	0	100	41,04	27,49
Stigma	40	0	100	33,44	28,01
Social support	40	0	75	27,92	24,93
Cognition	40	0	93,75	36,41	22,95
Communication	40	0	100	30,00	24,45
Bodily discomfort	40	16,67	100	55,21	19,85
PDQ39 SI	40	9,22	90,89	38,51	19,82

Differences by demographic factors

Gender: No significant differences were observed across the domains.

Age (<65 vs. ≥65 years): A significant difference was identified in the mobility domain ($p = .036$), with older adults exhibiting reduced mobility.

Disease duration (<10 vs. ≥10 years): Significant differences were observed in the following domains: cognition ($p = .041$), communication ($p = .029$), Bodily Discomfort ($p = .012$), and PDQ-39 SI ($p = .032$).

Hoehn and Yahr Stage (II vs. III): Significant differences were noted in the following domains: mobility ($p = .004$), Activities of daily living (ADL) ($p = .020$), Social functioning ($p = .045$), cognition ($p = .006$), Bodily discomfort ($p = .002$), and PDQ-39 SI ($p = .006$).

2. PDQ-39 correlations: The PDQ-39 Summary Index (SI) demonstrated strong positive correlations ($p < .01$) with all domains, with correlation coefficients ranging from $r = .711$ to $r = .832$. Additionally, a moderate correlation was observed with the number of years since diagnosis ($r = .414$, $p < .01$).

PALMS

The highest motivational drivers identified were physical condition (21.80 ± 3.47) and mastery (21.08 ± 3.21). Moderate motivations included interpersonal relationships, psychological state, and enjoyment. Competition (12.75 ± 5.19) was the lowest motivation. Cronbach's Alpha for the PALMS total score was 0.949, indicating excellent reliability. Correlations: Strong positive correlations were noted among the subdomains, particularly between mastery and physical condition ($r = .876$, $p < .01$), as well as between enjoyment and psychological state ($r = .791$, $p < .01$). The PALMS total score exhibited strong correlations with all subdomains, with correlation coefficients ranging from $r = .701$ to $r = .860$. 5.

DISCUSSION

This study offers a comprehensive examination of the quality of life (QoL) and motivation for engaging in physical activity among individuals with Parkinson's disease (PD) in Cluj-Napoca. The Parkinson's Disease Questionnaire-39 (PDQ-39) and Physical Activity and Leisure Motivation Scale (PALMS) demonstrated excellent internal consistency, affirming the reliability of our findings.

The PDQ-39 SI revealed moderate impairment of quality of life, with the most significant issues being bodily discomfort and mobility. These findings are consistent with existing research, which indicates that pain, stiffness, and functional limitations heavily impact daily living for individuals with PD (Ellis et al., 2019; Fu et al., 2017; Muslimović et al., 2008).

Disease severity is closely linked to deterioration in quality of life (QoL), indicating a steady decline in motor independence, activities of daily living (ADL), and cognitive functions. Additionally, a longer illness duration correlated with poorer PDQ-39 scores, underscoring the cumulative impact of Parkinson's disease

progression. This study highlighted that the stage of the disease negatively influences the quality of life of patients with Parkinson's disease, especially in tasks requiring motor skills. As the disease progresses, physical independence decreases notably. The research identified significant differences in the average scores between the "Stage 2" and "Stage 3" groups for the following dependent variables: "Mobility" [t(24) = -3.187, p = .004]; "ADL" [t(24) = -2.503, p = .020]; "Social" [t(24) = -2.113, p = .045]; "Cognition" [t(24) = -3.031, p = .006]; "Physical discomfort" [t(24) = -3.478, p = .002] and "PDQ39 SI" [t(24) = -2.988, p = .006]. These findings are supported by other studies in the field (Bonde-Jensen et al., 2024; Han et al., 2021; Reuther et al., 2006; Sławek et al., 2005; Souza et al., 2007).

Notably, social support exhibited the lowest level of impairment, indicating the presence of strong relational networks within this population, which may be attributable to the cultural and familial support structures prevalent in Romania. The motivation for engaging in physical activity was predominantly focused on maintaining physical condition and developing or preserving abilities (i.e., mastery). Additional motivators include enjoyment, interpersonal relationships, and psychological well-being. Competition was identified as the least significant factor, which aligns with findings in older clinical populations.

The strong correlations between the PDQ-39 SI and all PDQ-39 domains underscore the multidimensional nature of life (QoL) decline in Parkinson's disease (PD).

The PALMS correlations emphasize that motivation for physical activity is multifaceted, encompassing physical, emotional, cognitive and social components. Clinical Implications: Physiotherapists should prioritize exercise programs that address mobility, balance, and pain management. Tailored interventions are essential for individuals with advanced disease stages or prolonged disease durations. Motivation profiles suggest that programs emphasizing progress, self-efficacy, and physical improvement are likely to enhance adherence to exercise. Community-based exercise groups may capitalize on interpersonal motivation.

Limitations: This study was constrained by a small sample size (n=40). The cross-sectional nature of this study limits the ability to establish causality. Additionally, recruiting participants from a single geographical area may limit the generalizability of the findings.

CONCLUSION

Individuals with Parkinson's disease in this study exhibited moderate impairment in quality of life (QoL), with the most pronounced difficulties pertaining to mobility and bodily discomfort. The primary motivations for engaging in physical

activity were the desire to maintain physical fitness and enhance personal mastery. The stage and duration of the disease significantly influenced QoL outcomes, underscoring the necessity for individualized, stage-specific physiotherapy. These findings are corroborated by other studies (Reuther et al., 2006; Sławek et al., 2005; Souza et al., 2007).

This study highlights the importance of sustained emphasis on structured physical activity, patient education, and early intervention to preserve functional independence and enhance the well-being of patients with Parkinson's disease. Furthermore, fostering patient motivation through education and support enhances adherence to physical activity regimens, which are essential for maintaining functional independence. Early and continuous intervention strategies, including physiotherapy and counseling, are vital for delaying deterioration and promoting well-being. These insights emphasize the need for multidisciplinary care approaches that adapt to individual patient needs throughout the disease course.

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