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Original Article

Development of management competencies in students: experimental study

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ABSTRACT

The study investigated the possibility of integrating sports practices into management education. Team sports build a multidimensional set of skills necessary for project management in business, such as leadership, teamwork, and the ability to make quick decisions under uncertainty. Thus, the study authors sought to establish the mechanisms by which team sports affect the development of professionally important qualities in managers, potentially improving professional competencies. The study aimed to identify the key mechanisms behind sports' influence on the development of leadership and management competencies in management students participating in individual and team sports and develop practical recommendations for optimizing educational programs. A longitudinal quasi-experimental study was designed and conducted using a mixed methodological approach based on structured observation, in-depth interviews, and expert assessment to collect the data. The integrated findings provide a holistic picture of the mechanisms through which team sports influence the development of management competencies in management students. Unlike individual sports, team sports create a complex environment for the development of transformational leadership, emotional intelligence, teamwork skills, and effective communication—competencies, critical for modern management given the growing importance of teamwork and project management.

Keywords: Leadership, Management competencies, Students, Team sports

Introduction

Research problem

Contemporary management practice is facing a paradoxical situation: with highly developed digital communications, there is a significant decrease in the effectiveness of direct interpersonal interaction in project teams [1-3]. As reported by Lee and Chelladurai [4], over 60% of today's managers experience significant difficulties organizing face-to-face team interaction in the physical space.

Studies by Johnson *et al*. [5] and Zahra *et al*. [6] demonstrate that the inability to interact effectively in real space, distribute roles and responsibilities, and support teamwork until the result is achieved becomes a critical barrier in performing management functions. According to Kropp *et al*. [7, 8] and Mohamed *et al*. [9], this problem is especially acute for young specialists whose professional development occurred primarily in the digital environment.

As a result, we decided to investigate how this barrier may be removed. A recent study reveals that sporting activities have a

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significant potential for building leadership and management skills [10, 11]. Sports have historically been thought to improve leadership characteristics, but recent research suggests a more nuanced relationship between sports and management competencies [12-14]. Varriale and Briganti [15] discovered that team sports develop a wide range of skills, from teamwork to decision-making under uncertainty.

The comparative study of the impact of individual and team sports on the development of managerial skills is of particular scholarly interest. Kim *et al*. [16] discovered that, whereas individual sports are quite successful in developing personal attributes, team sports had the greatest impact on complex managerial competencies. Wang *et al*. [17, 18] observe that this affect varies depending on the sport and the intensity of training. Therefore, in the context of contemporary education, a study on how sports impact the development of management abilities is pertinent [19, 20]. We must first look at current methods for analyzing this relationship.

Review of approaches

Over the last decade, research has shown that programs aimed at learning behavioral patterns [21, 22] through observation and modeling of successful sports practices are effective in educational settings [5, 23, 24]. Empirical studies also confirm that sports participation is consistently associated with the development of key managerial competencies. Team sports contribute to leadership development, especially in situations where students assume captain or informal leader roles [16, 25]. Sports also improve communication skills through constant verbal and non-verbal interaction in dynamic conditions [26], strengthen strategic planning by requiring anticipation and adaptation [27], and enhance decision-making under uncertainty through competitive experience [16, 28]. In addition, sports promote emotional intelligence and stress tolerance by developing the ability to regulate one's own emotions and understand others in stressful situations [29, 30].

Therefore, we focus on sporting activities in terms of the opportunity to observe and adopt effective leadership behaviors in sports. In this light, it is of particular theoretical and practical importance to study the components of transformational leadership in the context of sports training. Smith *et al*. [13, 31] and Mahardika *et al*. [32] showed that transformational leadership, including the components of idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration, is a key factor in the success of modern management practices. By analyzing these components, it is possible to identify the specific mechanisms through which sporting activities influence the development of leadership qualities [33-35].

Great interest is also drawn to the mechanisms of different leadership styles affecting the effectiveness of teamwork. Wang *et al*. [17] established that service leadership, a special style of management based on prioritizing the interests of the team, positively affects group cohesion and reduces the risk of emotional burnout in athletes. Interestingly, different types of sports vary in their influence on management competencies, which necessitates in-depth research.

Laborde *et al*. [29] discovered that team sports provide a unique environment for developing the ability to recognize the emotions of others, manage group dynamics, and adapt to the changing emotional states of team members. These competencies gain particular importance in modern management practice that relies on the principles of emotional leadership.

Studies by Kim *et al*. [16, 36] and Wang *et al*. [17] report a positive correlation between the amount of time spent doing sports and the level of management skills.

The relevance of this study is determined by the need to systematically investigate the mechanisms through which sports influence leadership and management competencies in the context of modern education and to develop effective methods to incorporate sporting activities in management education [37, 38].

Based on our theoretical analysis, the aim and objectives of the empirical study were formulated, and the key methodological approaches to investigating the influence of sports on management competencies were determined.

The study's theoretical foundation is the concept of social learning with a focus on understanding the mechanisms of gaining management competencies through sports training. Using the theory of transformational leadership, we seek to demonstrate the specifics of leadership development in teamwork.

As a result, our study provides an empirical base for understanding the specific mechanisms of influence. This line of research enabled us to develop practical recommendations on optimizing sporting activities to develop management competencies.

The study aimed to identify key mechanisms behind the influence of sports on personal and management qualities of management students engaged in individual and team sports and develop practical recommendations on optimizing educational programs.

Materials and Methods

Study design and sample

To examine the influence of sports on management competencies among management students, we designed a longitudinal quasi-experimental study using a mixed methodological approach. The study involved 200 management students divided into three groups based on their current sports participation: team sports (TS, n=70), individual sports (IS, n=70), and a control group (CG, n=60) of students not engaged in sports. The sample size was determined based on similar studies [16, 17] and provided sufficient statistical power (0.80) at α=0.05 to detect medium effects (d=0.5).

Three levels of training intensity were examined: high (>6 hours per week), medium (3–6 hours), and low (<3 hours), allowing us to assess the relationship between management skills development and the level of sports engagement [16, 17, 39]. To minimize participant attrition, a 20% correction was applied in

sampling. The study was conducted in accordance with ethical research principles and approved by the university ethics committee.

Structured observations were carried out at the beginning, middle, and end of the study to document behavioral manifestations of management competencies under natural training conditions. To improve reliability, two independent observers specializing in sports psychology and management were recruited [40]. In-depth interviews were conducted to explore students' perceptions of the influence of sports on their management competencies and the mechanisms of this influence [41]. The interview sample (n=45) was formed using maximum variation sampling to include students representing different sports, training intensities, competitive experience, and leadership experience in sports teams.

Expert assessments were also used to obtain objective information on the development of management competencies. The expert group (n=25) included management professors (n=10), sports coaches (n=8), and HR specialists (n=7), all selected based on professional qualifications, at least 5 years of relevant experience, and publication activity in leadership and team interaction research [42, 43].

Data collection methods

The study used a combination of quantitative and qualitative data collection methods. Transformational and transactional leadership were assessed using the Multifactor Leadership Questionnaire (MLQ Form 5X-Short), developed by Bass and Avolio [44] and adapted for the Russian audience, with previously confirmed reliability (Cronbach's α = 0.82–0.92). Management competencies were evaluated using a scale developed for this study and validated in a pilot sample (n=50, Cronbach's α = 0.85), covering communication skills, strategic planning, decision-making, emotional intelligence, and team interaction. Structured observation was conducted using a specially developed observation chart, with reliability supported by two independent observers not involved in teaching the participants. In-depth interviews followed a semi-structured guide exploring students' perceptions of the impact of sports on management competencies. Expert assessment was performed at the beginning and end of the study using a standardized form with 25 criteria grouped into five core competencies.

Research stages

The study was conducted over one academic year (10 months) and consisted of the preparatory stage (1 month), the primary stage (8 months), and the concluding stage with data processing and analysis (1 month).

At the preparatory stage, the groups were formed and all participants underwent initial assessment. During the primary stage, sports activities were integrated into the experimental groups: the TS group participated in volleyball and basketball training and competitions, while the IS group practiced athletics and swimming with equivalent intensity. The CG followed the standard educational program without additional sports activities. Intermediate assessments were conducted three times at 3-month intervals and included competency testing, structured observations, and sample interviews. At the concluding stage, final assessments, in-depth interviews, and data analysis were completed.

The key variables included sport type, training intensity, and indicators of management competencies. Intergroup differences were analyzed using the Kruskal–Wallis test and Mann–Whitney U test with the Bonferroni correction. Changes over time were assessed using the Friedman test and Wilcoxon signed-rank test. Relationships between variables were examined with Spearman's rank correlation coefficient, while the consistency of expert assessments was tested using Kendall's coefficient of concordance. Qualitative data from interviews and observations were analyzed by thematic content analysis with independent double coding to ensure reliability.

Results and Discussion

The analysis of transformational leadership reveals considerable disparities between the study groups. **Table 1** shows the median values of transformational leadership components for each group, as well as the findings of their comparison study.

Table 1. Median values and interquartile range of transformational leadership indicators in the studied groups

Transformational leadership components	TS (n=70)	IS (n=70)	CG (n=60)	H	p
Idealized influence (attributes)	3.45 (3.12–3.78)	3.15 (2.88–3.42)	2.75 (2.42–3.08)	24.56	<0.001
Idealized influence (behaviors)	3.38 (3.05–3.72)	3.08 (2.82–3.35)	2.62 (2.35–2.95)	22.84	<0.001
Inspirational motivation	3.52 (3.25–3.85)	3.22 (2.95–3.48)	2.85 (2.52–3.12)	25.92	<0.001
Intellectual stimulation	3.25 (2.92–3.58)	3.18 (2.85–3.42)	2.72 (2.38–3.05)	19.76	<0.001
Individualized consideration	3.42 (3.15–3.75)	3.12 (2.85–3.38)	2.65 (2.32–2.98)	23.45	<0.001

Note: The data are presented in the format: Me (Q1–Q3), where Me — median, Q1 — first quartile, Q3 — third quartile; H — Kruskal–Wallis test.

The statistical analysis found significant differences between the groups on all components of transformational leadership ($p < 0.001$). In post-hoc analysis using the Mann–Whitney U test with the Bonferroni correction, the highest levels are demonstrated by the TS group, especially on the "Inspirational motivation" and "Individualized consideration" scales.

To assess the dynamics of management competencies development, we conducted a longitudinal analysis using the Wilcoxon signed-rank test. The results are provided in **Table 2**.

Table 2. Dynamics of management competencies development over the academic year

Competency	Group	Initial level	Outcome level (after 8 months)	T	r	p
Communication skills	TS	2.85 (2.52–3.18)	3.72 (3.38–3.95)	82.5	0.68	<0.001
	IS	2.78 (2.45–3.12)	3.35 (3.02–3.68)	124.0	0.54	<0.001
	CG	2.72 (2.38–3.05)	2.95 (2.62–3.28)	245.5	0.32	0.022
Strategic planning	TS	2.76 (2.42–3.10)	3.64 (3.30–3.88)	85.0	0.66	<0.001
	IS	2.70 (2.38–3.05)	3.28 (2.95–3.60)	130.5	0.52	<0.001
	CG	2.68 (2.35–3.00)	2.90 (2.58–3.22)	252.0	0.30	0.025
Decision-making	TS	2.82 (2.48–3.15)	3.68 (3.35–3.92)	78.0	0.71	<0.001
	IS	2.75 (2.42–3.08)	3.32 (2.98–3.65)	118.5	0.58	<0.001
	CG	2.70 (2.35–3.02)	2.92 (2.58–3.25)	238.0	0.35	0.018
Emotional intelligence	TS	2.88 (2.55–3.20)	3.78 (3.44–3.96)	76.5	0.72	<0.001
	IS	2.82 (2.48–3.15)	3.38 (3.05–3.70)	115.0	0.60	<0.001
	CG	2.75 (2.40–3.08)	2.98 (2.65–3.30)	235.5	0.36	0.016
Team interaction	TS	2.90 (2.58–3.22)	3.80 (3.46–3.98)	74.0	0.73	<0.001
	IS	2.76 (2.42–3.10)	3.30 (2.96–3.64)	128.0	0.53	<0.001
	CG	2.74 (2.40–3.06)	2.96 (2.62–3.28)	248.5	0.31	0.024

Note: T — Wilcoxon signed-rank test; r — effect size.

The analysis of dynamics indicates statistically significant improvements in all managerial competencies in all groups, with the largest effect size observed in the TS group ($r = 0.66–0.73$, $p < 0.001$). Especially profound changes are noted in the competencies of "Team interaction" ($r = 0.73$) and "Emotional intelligence" ($r = 0.72$), which confirms the special role of team sports in the development of these aspects of management activities.

Correlation analysis has found significant correlations between various aspects of sports training and the development of management competencies. **Table 3** presents the results of the correlation analysis for the TS and IS groups.

Table 3. Correlations between the intensity of training and the components of management competencies (Spearman's ρ)

Components of management competencies	Training intensity		Experience of team interaction		Experience of competition	
	TS	IS	TS	IS	TS	IS
Transformational leadership	0.68**	0.54**	0.72**	0.48**	0.65**	0.60**
Communication skills	0.65**	0.50**	0.69**	0.45**	0.61**	0.58**
Decision-making	0.63**	0.57**	0.58**	0.42**	0.70**	0.65**
Emotional intelligence	0.59**	0.48**	0.67**	0.44**	0.57**	0.53**
Strategic planning	0.61**	0.56**	0.54**	0.40**	0.63**	0.62**
Team interaction	0.70**	0.52**	0.75**	0.47**	0.64**	0.56**

The conducted analysis reveals that in the TS group, the strongest correlations are between team interaction experience and teamwork skills ($\rho = 0.75$, $p < 0.001$) and between training intensity and team interaction ($\rho = 0.70$, $p < 0.001$). In the IS group, these correlations are noticeably lower ($\rho = 0.47$ and $\rho = 0.52$, respectively).

In both groups, the "decision-making" competency correlates the strongest with the experience of competition (TS: $\rho = 0.70$; IS: $\rho = 0.65$; $p < 0.001$). A similar trend is observed in strategic planning, although the differences between the groups are less pronounced.

Overall, correlation analysis demonstrates statistically significant relationships between all investigated aspects of sports practice and the components of management competencies in both groups, with the strength of these relationships differing depending on the type of sport.

Next, our study analyzed the development of emotional intelligence components in different groups. The results are presented in **Table 4**.

Table 4. Comparative analysis of the development of emotional intelligence components in the studied groups

EI component	TS (n=70)	IS (n=70)	CG (n=60)	H	p
Self-awareness	3.58 (3.25–3.82)	3.32 (3.05–3.65)	2.85 (2.52–3.15)	26.84	<0.001
Self-regulation	3.62 (3.28–3.85)	3.45 (3.12–3.72)	2.78 (2.45–3.12)	28.92	<0.001

Empathy	3.75 (3.42–3.92)	3.28 (2.95–3.58)	2.92 (2.58–3.25)	27.56	<0.001
Social skills	3.82 (3.48–3.95)	3.35 (3.08–3.68)	2.88 (2.55–3.22)	29.45	<0.001

Note: The data are presented in the format: Me (Q1–Q3).

The analysis of emotional intelligence components reveals statistically significant differences between the groups ($p < 0.001$), with the highest scores on the "Social skills" scale in the TS group.

Of particular interest is the analysis of the dynamics of the development of decision-making skills depending on the intensity of sports training. The results are given in **Table 5**.

Table 5. Dynamics of decision-making skills development depending on the intensity of sports training

Training intensity	Initial level	3 months	6 months	9 months	χ^2	p
High (>6 h/week)	2.85 (2.52–3.18)	3.25 (2.92–3.58)	3.58 (3.25–3.82)	3.82 (3.48–3.95)	42.68	<0.001
Medium (3–6 h/week)	2.78 (2.45–3.12)	3.05 (2.72–3.38)	3.32 (2.98–3.65)	3.48 (3.15–3.72)	38.92	<0.001
Low (<3 h/week)	2.72 (2.38–3.05)	2.88 (2.55–3.22)	3.05 (2.72–3.38)	3.18 (2.85–3.52)	32.45	<0.001

Note: χ^2 — Friedman test.

The Friedman test indicates significant differences in the dynamics of decision-making skills between groups with different training intensities ($\chi^2 = 42.68$, $p < 0.001$).

Systematic analysis of in-depth interviews (n=45) identified three main mechanisms through which sports influenced the development of management competencies among management students. The most frequently mentioned mechanism was the improvement of communication skills, reported in 93% of interviews, particularly through the development of verbal and non-verbal interaction and feedback skills. The development of decision-making under uncertainty was noted in 87% of interviews and was associated with the application of competitive experience and the strengthening of strategic thinking. The development of emotional intelligence was identified in 82% of interviews and was mainly linked to better management of group dynamics and stress regulation.

The analysis of structured observation data reveals statistically significant differences between the groups for all observed parameters **(Table 6)**. Students involved in team sports demonstrated higher levels of competencies.

Table 6. Results of post-hoc analysis of inter-group differences in the parameters of management competencies (Mann–Whitney U test with the Bonferroni correction)

Observed parameter	TS vs IS		TS vs CG		IS vs CG	
	U	p	U	p	U	p
Communication skills and emotional intelligence	1,567.5	0.004*	875.0	<0.001*	1,420.5	0.012*
Leadership qualities	1,520.0	0.002*	840.5	<0.001*	1,625.0	0.045
Conflict management skills	1,605.5	0.008*	915.0	<0.001*	1,580.0	0.032*
Decision-making skills	1,486.0	<0.001*	830.0	<0.001*	1,490.5	0.015*
Effectiveness of team interaction	1,320.5	<0.001*	765.0	<0.001*	1,675.0	0.076

Note: * — differences statistically significant at $p < 0.05$ with the Bonferroni correction; TS — team sports, IS — individual sports, CG — control group.

Post-hoc analysis using the Mann–Whitney U test with the Bonferroni correction shows statistically significant differences between all three groups in most of the observed parameters. The most pronounced differences are found between the TS group and the CG across all the parameters under study ($p < 0.001$). The TS and IS groups show statistically significant differences in all parameters, with the largest differences in the indicators of "Effectiveness of team interaction" ($U = 1320.5$, $p < 0.001$) and "Decision-making skills" ($U = 1486.0$, $p < 0.001$). Significant differences are also found between the IS group and the CG for most of the parameters, except for "Effectiveness of team interaction," where the differences are statistically insignificant ($U = 1675.0$, $p = 0.076$).

These results confirm that representatives of the TS group demonstrate the most developed management competencies, especially in team interaction and decision-making, compared to both the IS group and the CG.

To ensure the objectivity of measurements, the consistency of expert opinions was analyzed using Kendall's coefficient of concordance (W). The results showed a high level of agreement across all observed parameters, with W values ranging from 0.75 to 0.85 ($p < 0.001$ in all cases), which confirms the reliability of the expert assessments. The highest consistency was observed for effectiveness of team interaction ($W = 0.85$), followed by communication skills and emotional intelligence ($W = 0.82$) and decision-making skills ($W = 0.80$), while leadership qualities ($W = 0.78$) and conflict management skills ($W = 0.75$) also demonstrated substantial agreement among experts.

To comprehensively assess changes in the level of managerial competencies, we analyzed expert assessments (n=25) made at

the beginning and at the end of the study. The results are presented in **Table 7**.

Table 7. Results of expert assessment of the dynamics of management competencies development (Me(Q1–Q3))

Competency	Group	Start of study	End of study	Z	p
Communication skills	TS	2.75 (2.40–3.10)	3.80 (3.45–4.10)	–3.98	<0.001
	IS	2.70 (2.35–3.05)	3.45 (3.10–3.75)	–3.57	<0.001
	CG	2.65 (2.30–3.00)	3.05 (2.70–3.40)	–2.65	0.008
Leadership qualities	TS	2.80 (2.45–3.15)	3.85 (3.50–4.15)	–4.12	<0.001
	IS	2.75 (2.40–3.10)	3.40 (3.05–3.70)	–3.43	<0.001
	CG	2.70 (2.35–3.05)	3.00 (2.65–3.35)	–2.48	0.013
Decision-making	TS	2.70 (2.35–3.05)	3.75 (3.40–4.05)	–3.95	<0.001
	IS	2.65 (2.30–3.00)	3.35 (3.00–3.65)	–3.51	<0.001
	CG	2.60 (2.25–2.95)	2.95 (2.60–3.30)	–2.42	0.016
Emotional intelligence	TS	2.85 (2.50–3.20)	3.90 (3.55–4.20)	–4.05	<0.001
	IS	2.80 (2.45–3.15)	3.50 (3.15–3.80)	–3.62	<0.001
	CG	2.75 (2.40–3.10)	3.10 (2.75–3.45)	–2.58	0.010
Team interaction	TS	2.90 (2.55–3.25)	3.95 (3.60–4.25)	–4.15	<0.001
	IS	2.75 (2.40–3.10)	3.40 (3.05–3.70)	–3.48	<0.001
	CG	2.70 (2.35–3.05)	3.00 (2.65–3.35)	–2.40	0.016

Note: Z — Wilcoxon signed-rank test.

The analysis of expert assessments indicates statistically significant improvements in all five competencies in all groups ($p < 0.05$). The most pronounced changes are observed in the TS group, where the dynamics of leadership qualities ($Z = –4.12$) and team interaction ($Z = –4.15$) are the greatest. The smallest changes are demonstrated by CG in the parameters of leadership qualities ($Z = –2.48$) and team interaction ($Z = –2.40$). Of particular note is the significant difference between the final scores of the TS and IS groups on emotional intelligence (3.90 vs 3.50) and team interaction (3.95 vs 3.40), which confirms the differentiated influence of different types of sports on management competencies and agrees with the results obtained by other research methods.

The observations confirm that participants in the TS group more often take initiative in group work, coordinate team activities more effectively, and demonstrate better conflict resolution skills than those in the IS group and the CG.

The conducted research allows us to draw several important conclusions about the influence of team sports on management competencies among management students.

First, team sports (volleyball, basketball) foster a qualitatively different type of leadership compared to individual sports. Students in the TS group predominantly demonstrate the development of transformational leadership, which focuses on collective results and team interaction. This is evident from their higher scores on the scales of "inspirational motivation" (3.52 vs. 3.22 in the IS group) and "individualized consideration" (3.42 vs. 3.12). In contrast, students in the IS group show stronger components of transactional leadership, which include personal responsibility, self-discipline, and a focus on individual achievement. As noted by one participant, "In team sports, you learn to lead others and to inspire the team even in moments of failure. It's a completely different type of leadership than when you are only responsible for yourself" (Respondent D., basketball). These differences are consistent with the provisions of Smith *et al*. [13] on the specific mechanisms that shape leadership in different sports.

Second, team sports have a much stronger impact on the development of emotional intelligence, especially its social components [45]. Participants in the TS group show significantly higher scores on "empathy" (3.75 vs. 3.28) and "social skills" (3.82 vs. 3.35) compared to IS. These differences stem from the need to constantly read the emotional state of partners, adapt to group dynamics, and collectively cope with stressful situations in team sports [46]. Qualitative interview data support this conclusion: "Sport teaches you to understand the emotional state of the team. When you see that the team is losing motivation or is stressed out, you need to be able to read it and respond correctly" (Respondent A., basketball team captain). In individual sports, the focus is shifted to self-regulation: "Regular training and competition have helped me learn to control my emotions in stressful situations and to support others" (Respondent P., track and field).

Third, team sports create a unique environment for developing team interaction skills, as demonstrated by both quantitative data (effect size of $r = 0.73$ in TS vs. $r = 0.53$ in IS) and expert assessments (greatest change in "Team interaction" in the TS group: $Z = –4.15$). Unlike individual sports, team sports create natural conditions for mastering various team roles, coordinating joint actions, and developing collective decisions, which is directly applicable to management practice [47]. As one student put it: "Volleyball has taught me to recognize when to take the initiative and when to support the initiative of another. In business this is called situational leadership, and we learn it at every practice" (Respondent V., volleyball).

Fourth, team sports foster better communication skills, especially nonverbal communication and constructive feedback [48, 49]. The correlation between teamwork experience and

communication skills was higher in the TS group (ρ = 0.69) than in the IS group (ρ = 0.45), which is consistent with the findings of researchers [50]. As one participant noted, "In a team, it is important to be able to convey information quickly and clearly. We have learned to communicate even by looks and gestures, which is very helpful in managerial work" (Respondent S., volleyball). Another participant emphasized the role of sport in learning constructive feedback: "Sport has taught me how to give constructive feedback. It is important to be able to point out mistakes in a way that motivates a person and not discourages them" (Respondent L., volleyball team captain).

At the same time, the advantage of team sports over individual sports was less pronounced for decision-making and strategic planning [51, 52]. These competencies were more strongly associated with competitive experience than with sport type, as shown by similar correlations in both groups (ρ = 0.70 and ρ = 0.65 for decision-making; ρ = 0.63 and ρ = 0.62 for strategic planning in TS and IS, respectively). This is reflected in the participants' responses: "At the moment of competition, you are one-on-one with the situation and have to react to changes instantly. It is very similar to making management decisions in a crisis situation" (Respondent K., swimming). At the same time, team sports place greater emphasis on collective decision-making: "During a game, there are often situations where you have to make split-second decisions. This has taught me to quickly analyze the situation and act even when there is not enough information" (Respondent K., volleyball team captain).

The development of strategic thinking is also reflected in the qualitative data: "In team sports, it is important to be able to calculate several steps ahead and anticipate the opponent's actions. These skills have proven very useful in management practice" (Respondent M., basketball).

Training intensity was identified as a significant factor influencing the development of management competencies [53]. The observed threshold effect, with the strongest outcomes at >6 h/week, supports the hypothesis of Varriale and Briganti [15] and highlights the importance of sufficiently intensive sports training in management education. This is also reflected in the respondents' views, as one participant noted that only regular and intensive practice makes the transfer of sports skills to study and work noticeable.

The post-hoc analysis further clarified how different types of sports affect managerial skills. In line with researchers [50], the absence of a statistically significant difference in team interaction between the individual sports group and the control group suggests that teamwork skills are primarily developed through direct participation in team-based activities. This finding has clear practical implications, as team sports create conditions that closely resemble real collaborative environments and therefore provide a more effective context for strengthening students' teamwork skills [54].

Limitations and further research prospects

Despite the comprehensive nature of the study conducted, a few limitations must be noted. First, the study was conducted over one academic year, which may be insufficient to fully explore the long-term effects of sporting activities [55]. Second, we did not control for the influence of other factors such as students' personal and mental characteristics and prior leadership experience [56, 57]. Third, we did not compare the effects of different team sports (e.g., volleyball and basketball) on the development of managerial competencies, which made it impossible to determine whether different team sports develop particular aspects of leadership and managerial skills differently because of their unique dynamics and demands [58].

Promising directions for further research include studying the long-term effects of sports training on the development of management competencies in graduates' professional practice and comparative analysis of different team sports and their particular influence on the development of management skills, as well as a more detailed study of the impact of different sports coaching styles on students' management competencies [59-61].

Practical implications

Our findings have significant practical value for the development of educational programs for managers [62]. In particular, the identified role of team sports and optimal training intensity can be used to integrate elements of sports activities into educational programs [63, 64]. A significant practical implication is that apart from regular training, it is important to provide competitive experience, which builds the skills of decision-making under uncertainty.

Conclusion

Our results demonstrate the need to take a differentiated approach to using different types of sports training. Team sports have proven the most effective in developing transformational leadership, which focuses on inspirational motivation, collective goals, and individualized consideration of team members. This type of leadership is particularly valued by modern organizations where project management and teamwork are practiced. On the other hand, individual sports contribute to transactional leadership focused on personal responsibility, self-management, and intrinsic motivation, which are also crucial for effective management. Team sports also show significant advantage in developing emotional intelligence and communication skills, while individual sports are effective in developing decision-making and strategic planning skills. These findings confirm the need for an integrated approach that combines elements of different types of sports to develop management competencies in a comprehensive manner.

Our study detected a threshold effect with an optimal intensity level of more than 6 hours per week, which should be considered when planning training loads. Importantly, the developed programs need to be balanced, combining theoretical training with regular sports practice, the latter including both training sessions and competitions.

Our results confirm the need to optimize traditional approaches to physical education in universities. Sporting activities should be viewed not only as a means of physical development but also as an effective tool for developing different types of leadership and management competencies, integrated into the overall system of management education. In this, the conscious choice between team and individual sports should be guided by specific goals in developing management competencies and students' professional specialization.

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