



Accumulated Educational Deficit Across Athletic Careers: Quantifying Socio-Professional Risks

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Abstract

Objectives. This study aimed to quantitatively assess the key indicators of Accumulated Educational Deficit (AED): role conflict, constrained developmental horizons, and socio-professional uncertainty across different stages of athletic careers, considering sport-type specificity. The ultimate goal was to substantiate evidence-based preventive support strategies.

Materials and Methods. A cross-sectional observational study was conducted among 250 active athletes representing the national teams of Ukraine (N = 250). Participants were stratified by age (four groups) and sport type (team, cyclic, combat, and technical). Data were collected through a structured sociological survey using 5-point Likert scales. Statistical analysis included descriptive statistics, Pearson's χ^2 test for association, and Cohen's w to estimate the effect size.

Results. The onset of AED intensification was observed in the 19-23 age group, where acute role conflict reached 45.0%. In terms of career duration, the critical phase corresponded to 9-12 years of participation (42.0% reporting substantial developmental constraints). Significant structural heterogeneity was identified: athletes in team sports reported role conflict three times more frequently (60.0%) than athletes in cyclic sports (20.0%). A "delayed awareness" effect was detected, with peak dissatisfaction regarding personal development (37.5%) emerging only after 17-20 years of athletic participation, subsequently translating into explicit professional insecurity among 29.4% of athletes aged 35+. The highest demand for educational grant support was determined in the 19-23 age group (81.0%).

Conclusions. Accumulated Educational Deficit represents a measurable systemic risk embedded within elite sport structures and significantly affects the quality of transition to post-sport life. The findings support the implementation of flexible dual-career models and targeted educational funding mechanisms aligned with international frameworks (e.g., NCAA Degree Completion Awards; Erasmus+ Sport). Such interventions may mitigate long-term socio-professional vulnerability by enabling parallel development of transferable competencies.

Keywords: athletes, athletic transition, dual career, development, educational capital, financial support, social adaptation.

Introduction

The professional trajectories of elite athletes are characterized by prolonged specialization, intensive workload, and substantial temporal investment (Stambulova et al., 2020). While such structural conditions optimize competitive performance, they simultaneously constrain parallel educational and professional development. In response, the Dual Career framework has emerged as a

strategic model aimed at integrating high-performance sport with academic or vocational pathways (Hong & Minikin, 2023). International policy documents formally recognize dual-career support as a prerequisite for balanced personal development and long-term social sustainability (European Commission, 2012; Stambulova et al., 2024).

Despite this institutional recognition, a persistent discrepancy exists between policy rhetoric and structural practice. High-performance sport systems remain predominantly performance-oriented and often lack sufficient flexibility to accommodate educational engagement (Robnik et al., 2022). As a result, athletes experience cumulative strain manifested in elevated burnout rates (Glandorf et al., 2023;

Nuetzel, 2023), psychological instability during transitional phases (Voorheis et al., 2023; Voronova et al., 2024), and socio-professional vulnerability following career termination (Aptsiauri, 2024; Bulatova et al., 2025). Although financial assistance mechanisms—such as NCAA programs in the United States and Erasmus+ Sport initiatives within the European Union—have been developed to mitigate these risks, their structural effectiveness remains uneven.

The existing body of research largely concentrates on two distinct yet interconnected domains. The first concerns the phenomenon of role conflict between athletic and academic identities (Polishchuk et al., 2025; Steele et al., 2020), which has been associated with heightened psychological stress (Trigueros et al., 2019). Notably, financial support does not automatically resolve this tension; in some cases, it may intensify performance expectations without reducing temporal constraints for education (López-Flores et al., 2021). The capacity for successful adaptation during this stage is strongly associated with the level of educational capital accumulated by the athlete (Pryimak, 2025a; Radchenko et al., 2024).

The second domain addresses post-retirement crisis and identity reconstruction following sport termination (Samuel et al., 2023; Ryba et al., 2015). These difficulties are frequently linked to insufficient professional preparation and limited transferability of competencies beyond sport.

Excessive early specialization further compounds this challenge by narrowing developmental trajectories and displacing the acquisition of transferable competencies, including communication skills, critical thinking, self-regulation, and financial literacy (Johansen et al., 2024; Thornhill-Miller et al., 2023). Although sport participation fosters resilience, persistence, and goal orientation (Pierce et al., 2017), the absence of a structured educational foundation restricts the transferability of these attributes to non-sport domains. Empirical evidence indicates that imbalance between sport and education (55.3%) constitutes a dominant challenge during peak competitive phases (Bulatova et al., 2025).

While prior research has predominantly addressed discrete manifestations of adaptation difficulties, limited attention has been devoted to their cumulative and systemic nature. To move beyond episodic interpretations, it is necessary to conceptualize adaptation risk as a longitudinal process embedded within career structures.

In this context, we introduce the construct of Accumulated Educational Deficit (AED). AED is defined as a systemic and progressive process through which prolonged prioritization of athletic performance results in measurable erosion of educational attainment, transferable professional competencies, and social capital. Unlike situational stressors, AED develops incrementally across the athletic lifespan and becomes structurally embedded in career trajectories.

Although previous work has highlighted education as a key determinant of athletes' social adaptation (Pryimak, 2025a), the present study advances the field by operationalizing AED through quantitative indicators—role conflict, constrained developmental horizons, and socio-professional uncertainty. Conceptualizing AED as a measurable construct enables a transition from descriptive analyses of crisis to predictive assessment of structural risk. In this regard, AED represents a cumulative deficit of knowledge, competencies, and social integration resources necessary for sustainable functioning beyond elite sport.

The aim of this study was to empirically validate the construct of Accumulated Educational Deficit (AED) by operationalizing and quantitatively assessing its core indicators—role conflict, constrained developmental horizons, and socio-professional uncertainty—across distinct stages of athletic careers and across sport disciplines. By examining both structural (sport type) and temporal (career stage) dimensions, the study sought to determine whether AED manifests as a patterned and measurable systemic phenomenon rather than as isolated adaptation difficulties.

To test the structural dimension of AED, the following hypotheses were formulated:

H0 (Null hypothesis): The manifestation of role conflict among athletes is independent of sport type.

H1 (Alternative hypothesis): The manifestation of role conflict significantly varies across sport types, indicating structural heterogeneity in the development of Accumulated Educational Deficit.

To examine the temporal dynamics of AED across the athletic lifespan, we further hypothesized:

H2: The highest intensity of role conflict occurs during the peak performance phase (19-23 years).

H3: The highest level of socio-professional uncertainty is observed at the late-career stage (35+ years).

Together, these hypotheses enable a systematic evaluation of AED as a multidimensional construct shaped by both organizational structures and career-stage transitions.

Materials and Methods

Study Participants

This study employed a cross-sectional survey design to investigate the development of educational capital and the manifestation of Accumulated Educational Deficit (AED) among elite athletes.

The sample consisted of 250 active athletes (N = 250) representing national teams of Ukraine across multiple sport disciplines. Participants were recruited on a voluntary basis and were actively competing at the national or international level at the time of data collection.

The sampling framework was intentionally structured to capture critical stages in the formation of AED. More than 70% of respondents belonged to the 14–23 age range, corresponding to early and peak performance phases of athletic careers.

Analyses were conducted using three primary segmentation variables:

Age: 14-18, 19-23, 24-35, and 35+ years;

Sport experience: 0-4, 4-8, 9-12, 17-20, and >20 years;

Sport type: team, cyclic, combat, and technical sports.

Such stratification enabled the examination of both temporal (career-stage) and structural (sport-type) determinants of AED, allowing for a multidimensional analysis of athlete–social environment interactions within the systemic adaptation framework (Pryimak, 2025b).

Study Organization

Data were collected between May and December 2025. The research process included instrument development based on prior theoretical and empirical literature, followed

by administration of an anonymous online questionnaire. The use of an online format ensured confidentiality and reduced potential response bias.

The study was conceptually grounded in a systemic approach to athlete social adaptation, viewing adaptation as a multi-component process shaped by individual characteristics, social environment, and institutional structures. This framework informed the operationalization of Accumulated Educational Deficit (AED) and guided the selection of analytical variables.

A structured sociological survey served as the primary data collection instrument. The questionnaire was designed to capture the core dimensions of AED and included the following domains:

Role conflict – perceived constraints on educational attainment due to sport participation;

Constrained developmental horizons – satisfaction with opportunities for personal and professional development beyond sport;

Socio-professional uncertainty – confidence in successful integration into post-sport professional life;

Subjective support needs – perceived necessity of institutional and financial assistance, including educational grants.

All constructs were measured using 5-point Likert-type scales.

Statistical Analysis

For the quantitative analysis and interpretation of the collected data, methods of mathematical statistics were applied.

Descriptive statistics were used for frequency analysis with the calculation of percentage frequency (P) for each indicator using the formula: $P=(n/N) \times 100\%$, where n denotes the number of observations in a given category and N represents the total number of study participants (N = 250). This approach enabled both qualitative and quantitative assessment of dominant trends in athletes’ perceptions.

Inferential statistics were employed to test hypotheses regarding the presence of relationships between sport type, career stages, and indicators of accumulated educational deficit. Specifically, Pearson’s χ^2 (chi-square) test was used to examine statistically significant associations between categorical variables, calculated using the formula:

$$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

where O_i – represents observed frequencies and E_i – denotes expected frequencies. Degrees of freedom (*df*) for contingency tables were calculated as: $df=(R-1) \times (C-1)$, where R is the number of rows and C is the number of columns.

To determine the practical significance of the identified associations, Cohen’s effect size (*w*) was calculated using the formula:

$$w = \sqrt{\frac{\chi^2}{N}}$$

Effect sizes were interpreted as small (0.1), medium (0.3) or large (0.5).

Statistical data processing was conducted using Microsoft Excel and Statistica software.

Results

The quantitative analysis of Accumulated Educational Deficit (AED) indicators enabled identification of critical stages in its manifestation and the most vulnerable athlete groups.

Role conflict–defined as perceived tension between athletic and educational or future professional roles–demonstrated a clear age- and experience-related pattern. The highest prevalence of acute role conflict was observed in the 19-23 age group (45.0%). A comparable level was identified among athletes with 9-12 years of sport participation (42.0%) (Table 1).

These findings indicate that the intensification of AED coincides with peak competitive demands and the period of highest performance pressure.

Table 1. Dynamics of Constraints on Educational Attainment by Age and Length of Sporting Experience (N = 250)

Response	Age 19-23 years (%) (Peak performance)	Sporting experience 9-12 years (%) (Peak intensity)
Significantly limits	25.0	22.0
Limits to some extent	20.0	20.0
Total acute limitation	45.0	42.0
Almost does not limit	30.0	28.0
Does not limit at all	25.0	30.0
Total	100.0	100.0

To examine the structural dimension of Accumulated Educational Deficit, the association between sport type and role conflict was analyzed.

Pearson’s χ^2 test revealed a statistically significant association between sport type and the intensity of role conflict, leading to rejection of the null hypothesis (H0) and confirming structural heterogeneity in the manifestation of AED.

The highest prevalence of acute role conflict was observed among athletes in team sports, where 60.0% reported significant or moderate educational constraints. In contrast, only 20.0% of athletes in cyclic sports reported comparable levels of role conflict (Table 2).

This threefold difference indicates substantial variability in AED intensity across sport disciplines.

Table 2. Role Conflict: Structural Characteristics of Constraints by Sport Type (N = 250)

Sport type	Significantly limits (%)	Limits to some extent (%)	Total acute limitation (Role Conflict) (%)
Team (game-based) sports	35.0	25.0	60.0
Combat sports	15.0	18.3	33.3
Technical (coordination-based) sports	10.0	15.0	25.0
Cyclic (individual) sports	5.0	15.0	20.0

Constrained developmental horizons were assessed through athletes' satisfaction with opportunities for personal development beyond sport.

The highest level of cumulative dissatisfaction with personal development (e.g., self-education, additional training courses) was observed among athletes with 17-20 years of sporting experience (37.5%) (Table 3).

This pattern indicates a delayed manifestation of perceived educational deficit, with dissatisfaction intensifying at advanced career stages characterized by prolonged specialization.

Table 3. Detailed Distribution of Dissatisfaction with Development Outside Sport by Length of Sporting Experience (N = 250)

Domain of development (ratings 1+2)	Sporting experience 9-12 years (%)	Sporting experience 17-20 years (%) (Peak dissatisfaction)
Personal development (self-education, courses)	28.0	37.5
Development of hobbies and interests	24.6	37.5

Note: The indicator (ratings 1+2) represents the combined share of responses "Not satisfied at all" and "Rather not satisfied."

Socio-professional uncertainty was operationalized through athletes' self-reported confidence in their ability to integrate into post-sport professional life.

At early career stages, the most frequent response was "difficult to say," reaching 45.0% in the 19-23 age group (Table 4). In contrast, at the late-career stage (35+ years), the proportion of athletes reporting explicit professional uncertainty ("not confident" and "rather not confident") increased to 29.4%.

These findings demonstrate a shift from generalized uncertainty in early career phases to more clearly articulated professional insecurity at later stages. This pattern aligns with previous evidence on socio-psychological maladaptation among late-career athletes (Pryimak, 2025c).

Athletes' perceived need for institutional support was assessed through evaluation of educational grant mechanisms.

A high level of demand for financial support for education was identified across age groups, with the strongest expression among younger athletes. Specifically, 70.9% of respondents aged 14-18 years and 81.0% of those aged

19-23 years rated educational grants as "highly necessary" or "critically necessary" (Table 5).

These findings indicate substantial perceived demand for structured educational support during early and peak career stages.

Table 5. Athletes' Assessment of the Need for Grant Support to Improve Adaptation by Age (%) (N = 250)

Age group	Critically necessary, % (5)	Highly necessary, % (4)	Total demand, % (4+5)
Age 14-18	53.0	17.9	70.9
Age 19-23	46.0	35.0	81.0
Age 24-35	35.0	35.0	70.0
Age 35+	30.0	30.0	60.0

Athletes' professional expectations were analyzed in relation to sport type (Table 6).

Among athletes in cyclic sports, preference for a business-oriented career pathway (45.0%) was nearly equivalent to preference for coaching careers (45.0%). In contrast, athletes in team sports predominantly reported intentions to pursue coaching careers (70.0%), with substantially lower interest in business activities.

This distribution suggests variability in post-sport career orientations across sport types and aligns with previous theoretical considerations regarding the diversification of athletes' social roles in contemporary contexts (Pryimak, 2025d).

Discussion

The present study examined athletes' adaptation difficulties through the lens of a cumulative structural process conceptualized as Accumulated Educational Deficit (AED). The findings support the proposed assumption that adaptation challenges are not episodic events but develop progressively across the athletic lifespan. Specifically, the peak of role conflict during the 19-23 age phase (45.0%) and the subsequent increase in explicit socio-professional uncertainty in the 35+ group (29.4%) suggest a longitudinal linkage between early educational constraints and later career vulnerability. This trajectory aligns with the meta-model of adaptation proposed by Samuel et al. (2023), which conceptualizes transition as an extended adaptive process rather than a discrete career endpoint.

The identification of sport type as a structural determinant of AED further extends the existing literature.

Table 4. Athletes' Assessment of Confidence in Their Ability to Assume a New Social Role Outside Sport (N = 250)

Response	Age 14-18 (%)	Age 19-23 (%)	Age 24-35 (%)	Age 35+ (%)
Not confident at all	5.0	8.0	10.0	15.0
Rather not confident	5.5	10.0	15.0	14.4
Direct uncertainty (Total)	10.5	18.0	25.0	29.4
Hard to say (Uncertainty)	40.0	45.0	35.0	25.0
Rather confident	30.0	25.0	30.0	30.0
Fully confident	19.5	12.0	10.0	15.6
Total	100.0	100.0	100.0	100.0

Table 6. Comparison of Athletes' Professional Expectations by Sport Type (N = 250)

Sport type	Coaching, %	Business / Entrepreneurship, %	Public service, %	Other (IT, Culture), %
Team (game-based) sports	70.0	20.0	5.0	5.0
Combat sports	50.0	30.0	10.0	10.0
Technical (coordination-based) sports	40.0	35.0	10.0	15.0
Cyclic (individual) sports	45.0	45.0	5.0	5.0

The significantly higher prevalence of role conflict in team sports (60.0%) compared to other disciplines confirms structural heterogeneity in educational constraints. This finding resonates with Robnik et al. (2022), who highlighted institutional rigidity within team-based sport systems as a limiting factor for educational engagement. Taken together, these results indicate that AED is embedded not only in individual career choices but also in organizational models of sport participation.

The association between competitive intensity (9-12 years of sport experience) and peak perception of educational constraints (42.0%) corroborates the paradox described by López-Flores et al. (2021), whereby increased athletic demands amplify educational displacement. However, the present study advances this perspective by introducing the concept of a "delayed awareness" effect. The peak of dissatisfaction with personal development (37.5%) at 17-20 years of participation suggests that recognition of educational erosion occurs only at advanced career stages. This delayed perception may reflect prolonged identity foreclosure, during which athletes prioritize performance while postponing investment in transferable competencies (Pierce et al., 2017).

Theoretically, this study contributes to the literature by reframing educational imbalance as a measurable systemic risk rather than as a series of isolated psychological crises. By operationalizing AED through quantifiable indicators, the study links competency deficits (Johansen et al., 2024) with subsequent socio-professional vulnerability. This conceptual shift supports the interpretation of AED as a structural predictor of maladaptation.

The findings also carry policy implications. The high demand for educational grants among athletes aged 19-23 (81.0%) indicates that early adulthood represents a critical intervention window. International models, including the NCAA Degree Completion Award program (NCAA, 2024) and Erasmus+ Sport initiatives (European Commission, 2024), demonstrate viable mechanisms for integrating financial support with competency development. Adaptation of such frameworks within national contexts may mitigate long-term vulnerability by providing temporal flexibility for educational engagement. Additionally, the identified entrepreneurial orientation among athletes in cyclic sports (45.0%) suggests the potential effectiveness of targeted business education modules within dual-career systems (Hong & Minikin, 2023).

Several limitations should be acknowledged. The cross-sectional design restricts causal inference, and reliance on self-reported measures may introduce response bias. Future research should employ longitudinal designs to examine whether early mitigation of AED translates into measurable improvements in post-sport income, employment stability, and social integration.

Conclusions

This study examined the dynamics of educational capital among 250 elite athletes and identified structural barriers within the Dual Career framework. The findings indicate that education functions not as a supplementary element but as a central determinant of long-term social sustainability in elite sport. The adaptation difficulties observed at career termination appear to reflect a cumulative process conceptualized as Accumulated Educational Deficit (AED).

The principal conclusions are as follows:

Accumulated Educational Deficit constitutes a measurable systemic phenomenon arising from sustained imbalance between the performance demands of elite sport and educational development. AED reflects the cumulative erosion of educational, transferable, and social capital across the athletic lifespan.

The critical formation phase of AED occurs during early adulthood. The highest level of role conflict was observed in the 19-23 age group (45.0%), and similarly elevated perceptions of educational constraints were recorded among athletes with 9-12 years of sport participation (42.0%), indicating peak vulnerability during periods of maximum competitive intensity.

AED demonstrates structural heterogeneity across sport types. Athletes in team sports exhibited the highest prevalence of role conflict (60.0%), suggesting that organizational characteristics of sport systems contribute to uneven educational constraints.

Perceived developmental limitations intensify at advanced career stages. Dissatisfaction with personal development peaked among athletes with 17-20 years of experience (37.5%), indicating delayed recognition of accumulated educational constraints.

Socio-professional uncertainty increases toward career termination. The proportion of athletes reporting explicit professional insecurity rose from 10.5% at early stages to 29.4% in the 35+ group, highlighting a progressive consolidation of adaptation risk.

Athletes express substantial demand for educational support mechanisms. The perceived necessity of educational grants was highest in the 19-23 age group (81.0%), identifying early adulthood as a strategic intervention window.

Variability in professional expectations across sport types suggests differentiated support needs. In cyclic sports, preference for business-oriented pathways (45.0%) was comparable to coaching intentions, indicating potential for diversified dual-career models.

Overall, the study supports the interpretation of Accumulated Educational Deficit as a structural and measurable risk embedded within elite sport systems. Addressing this deficit requires early, systemic, and

discipline-sensitive support strategies aimed at strengthening transferable competencies throughout the athletic career.

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Ethics Approval

The study was conducted in strict adherence to the Ethical Code of Participants of the Educational Process of the National University of Ukraine on Physical Education and Sport. All procedures followed internationally recognized ethical standards for research involving human participants, ensuring that the privacy rights and confidentiality of all athletes were strictly maintained throughout the anonymous survey process.

Informed Consent

For participants under 18 years of age, written informed consent was obtained from their parents or legal guardians.

Data Availability Statement

The datasets generated and analyzed during the current study are not publicly available due to ethical considerations and the sensitive nature of the data related to national team athletes. The data may be made available from the corresponding author upon reasonable request and subject to approval by the relevant institutional authorities.

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Conflicts of Interest

The authors declare no conflicts of interest.

AI Transparency Statement

No generative artificial intelligence tools were used in the design, data collection, analysis, or preparation of this manuscript. The authors assume full responsibility for the integrity and accuracy of the work.

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Накопичений освітній дефіцит упродовж спортивної кар'єри: кількісна оцінка соціально-професійних ризиків

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; Е – збір коштів

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Мета дослідження. Здійснити комплексну кількісну оцінку показників накопиченого освітнього дефіциту (рольового конфлікту, обмежених горизонтів розвитку та соціально-професійної невпевненості) на різних етапах спортивної кар'єри залежно від специфіки видів спорту для обґрунтування превентивних стратегій підтримки спортсменів.

Матеріали і методи. Проведено обсерваційне кроссекційне дослідження за участю 250 спортсменів національних збірних команд України (N = 250). Вибірку структуровано за віковими групами та типами спорту (ігрові, циклічні, єдиноборства, технічні). Збір даних здійснено методом соціологічного опитування з використанням 5-бальних шкал Лікерта. Статистичний аналіз включав описативну статистику, критерій χ^2 Пірсона та оцінку розміру ефекту (w Коена).

Результати. Встановлено, що формування освітнього дефіциту розпочинається у віковому періоді 19-23 роки, де частка вираженого рольового конфлікту досягає 45,0%. Критичним за тривалістю спортивної кар'єри є інтервал 9-12 років (42,0% обмежень розвитку). Виявлено виражену міжвидову гетерогенність: у спортсменів ігрових видів спорту інтенсивність рольового конфлікту є втричі вищою (60,0%) порівняно з представниками циклічних видів (20,0%). Зафіксовано ефект «відкладеного усвідомлення», який проявляється піком незадоволеності власним розвитком (37,5%) на стадії 17-20 років спортивного стажу. Це супроводжується формуванням соціально-професійної невпевненості у 29,4% спортсменів старших груп. Виявлено високий попит на освітню підтримку серед спортсменів віком 19-23 роки (81,0%).

Висновки. Накопичений освітній дефіцит є системним ризиком, що визначає успішність переходу спортсменів до постспортивної кар'єри. Обґрунтовано необхідність впровадження гнучких моделей дуальної освіти та адресних грантових програм, які забезпечують розвиток універсальних компетентностей паралельно зі спортивною діяльністю.

Ключові слова: спортсмени, подвійна кар'єра, освітній дефіцит, спортивний перехід, соціально-професійна адаптація, освітня підтримка.

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