Evidence-Based Framework for the Development of Young Athletes in a National Sports Context

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Abstract

The development of young athletes continues to be a key concern for sports organizations, coaches and policy makers. In Sweden, the public debate on the balance between early talent promotion programs and more inclusive, long-term athlete development models has recently intensified. This discussion reflects the general global tensions within youth sport systems between high performance ambitions and the goal of lifelong sport, as well as other societal goals related to sport. Taking the Swedish context as a starting point, this perspective article explores the challenges and opportunities in integrating early talent promotion with sustainable athlete development frameworks.

While the Swedish case provides the empirical context, the findings and recommendations presented are intended to inform broader international and national debates. We argue that evidence-based youth sport systems can support both elite performance and broader participation goals simultaneously. We propose a nuanced, evidence-based approach that recognizes the complexity of youth athlete development and the importance of aligning scientific evidence with local cultural and organizational contexts. The focus is on creating sport environments that support athlete well-being, intrinsic motivation and diverse opportunities for participation. Rather than prescribing a one-size-fits-all solution, this article highlights principles to help national federations and clubs design systems that promote both elite performance and broad participation. Ultimately, sustainable athlete development requires contextual governance, continuous evaluation and a commitment to promoting both performance goals and the wider benefits of sport.

Key words: Athlete development, Children and youth sport, Sports policy
Talent development, Talent identification

Introduction

Developing young athletes is a key concern for sports coaches, scientists and national sports organizations worldwide. In Sweden, this topic has recently gained renewed attention due to several factors: the declining performances of historically strong national teams [1], the public debate sparked by a Swedish sports journalist's provocative book [2], the media's increasing attention to early selection practices in children and youth sport [3], and the government's request to the Swedish Sports Confederation to "*report on the efforts and results of work against early selection procedures*" [4]. These discussions have highlighted potential tensions between advocates for early engagement in structured elite pathways (early Talent Promotion Programs, TPPs) and advocates for long-term, sustainable development of athletes to promote both sporting expertise and broad participation.

The Swedish sports movement provides an interesting context for examining these tensions. It is organized as an independent, voluntary movement with municipal participation and local clubs forming the basis for all organized sports. The Swedish Sports Confederation comprises 72 member federations (national sports federations) with approximately 18,000 sports clubs and 3.3 million members, representing one third of the population. The democratic "51 percent rule" applies in Swedish sports clubs, which means that at least 51% of the ownership (or voting rights) must be held by Swedish individuals or entities. This ensures member control, prioritizes community ownership and local interests over commercial interests and creates a system that balances competitive ambition with social inclusion, broad participation, and long-term sustainability.

This paper explores the subject of the current public controversy (i.e., the tension between early TPPs and long-term sustainable development of young athletes), but also the broader principles of athlete development, by combining scientific evidence with practical considerations relevant to sports organizations. While the research in this area is extensive, significant challenges remain in implementing evidence-based athlete development frameworks. For example, the recent debate in Sweden has highlighted the potential friction between the traditional values of inclusive participation (i.e., the right for all children to play and develop within sport regardless of ability) and the growing pressure to identify talent earlier and introduce TPPs to accelerate performance development and compete in an increasingly more global "competition for talent." Although both approaches coexist within today's sports systems, they often conflict, and organizations face challenges integrating them into a unified structural framework.

Although we refer to the Swedish context, we believe that the perspectives outlined in this article may also be useful for sports federations and clubs in other countries, as the tension between early TPPs and a broader focus on encouraging as many children and young people as possible to participate in sport is not new [5–8]. However, we emphasize the importance of adapting evidence-informed practices to the unique cultural and structural conditions of each local sports system. As in other areas of public policy, sports organizations must make decisions despite uncertainties. This requires a pragmatic approach, similar to evidence-based

practice models applied in medicine [9], where research evidence, practitioner expertise and participant preferences are taken into account in decision-making. Such frameworks, adapted to the sports context, help to reconcile scientific knowledge with national sports culture, resource constraints and stakeholder priorities [10]. From an investment perspective, improved children and youth sport structures may not only increase the likelihood of developing future elite athletes — and thus the success of national teams and the sustainability of clubs — they are also likely to promote general and long-term public health benefits.

Recognizing the need for both local relevance and global expertise, this paper is authored through collaboration between Swedish sports scientists and internationally recognized experts in athlete development. The aim is to provide evidence-based guidance to national federations and clubs wishing to successfully implement and utilize the framework for children and youth athlete development, while preserving the broader benefits of sport for other societal goals. It is important to acknowledge that while our analysis aims to provide broadly applicable principles, the diversity of sports precludes comprehensive coverage of all sporting contexts. The Swedish debate has focused primarily on team sports, especially soccer and ice hockey, which inevitably shape our perspective. Therefore, this article is primarily concerned with the structures and developmental considerations relevant to these team-based sports, although many principles may be transferable to other contexts with appropriate adaptation.

Athlete development research

Generally, an athlete can be defined as a person who engages in structured exercise or training with the aim of developing and demonstrating physical, technical, tactical and psychological skills relevant to sports performance. Athlete development is shaped by a complex interplay of individual and ecological factors, including genetic predispositions, the training environment, social influences (e.g., coaches, parents, peers) and access to resources. Developmental timelines vary, with different factors influencing athletes at various stages. As a result, sport organizations must conceptualize sport involvement as a system of integrated personal, social, and contextual variables that interact to shape development over time [11].

The concept of "talent" is controversial [12,13]. While defining talent can be complex and contextual, the controversy primarily concerns how to operationalize this concept and develop valid and reliable indicators for those responsible for assessing it. Thus, clarity of terms and organizational alignment (in terms of values, priorities and goals) may be more important than universal agreement on the concept or definition [14]. We define it here as “the potential to develop into an elite senior performer” – simply because it is a practical definition that reflects how both researchers and practitioners commonly frame issues around talent in relation to athlete development. Other terms used in this article, the definitions of which may not be universally agreed, are listed in Table 1.

Table 1. Definition of terms.

World class	Athletes who reach the highest international elite level in their sport, which is at a higher level than the national elite.
Elite	Highest national level in a sport.
Children	Athletes who are 12 years of age and younger.
Youth and junior	Athletes who are between the ages 13–19.
Young athletes	Spans children and youth/junior ages (i.e., up to 19 years).
Early Talent Promotion Programmes (TPPs)	Programs that typically focus on early selection, accelerated performance development and sport-specific specialization from an early age, often limiting access to a select group and minimizing opportunities to participate in multiple sports. With "Early", we mean introduction in childhood years (i.e., before 13 years of age).
Quality coaching	Developmentally appropriate guidance and support that evolves with the needs of the athlete [15]. For children, this primarily means coaches with strong interpersonal skills who create a safe, comfortable and "fun" environment, build positive relationships, promote movement skills and encourage intrinsic motivation. As athletes enter adolescence, quality coaching maintains these basic relationship skills while gradually incorporating more technical expertise, tactical knowledge and sport-specific skills to support the progression of competitive ambitions.

Athlete and/or talent development research — particularly efforts to determine which approaches deliver the best long-term athletic and performance outcomes — is inherently complex. No single study, not even a collection of studies, can provide definitive answers to the broad and difficult questions in this area. The often-idealized methodological approach, a long-term randomized controlled trial, is impractical due to the administrative, logistical (e.g. it is not possible to randomly assign children to different talent development programs according to the RCT design), and ethical considerations associated with tracking an athlete's development under controlled conditions. Furthermore, given the multitude of interacting factors that influence talent development, such an approach is often not even appropriate, as isolating a single determinant may overlook the complex, dynamic nature of athletic development.

As a result, talent development research often relies on observational and retrospective studies. Large observational studies or meta-analyses can provide important evidence to refute certain hypotheses without providing conclusive support in favour of an alternative hypothesis. Nevertheless, sports organizations, coaches and policy makers must make strategic decisions about athlete development despite uncertainty, guided by the most relevant direct and indirect evidence available. In this regard, the convergence (or triangulation) of results from longitudinal studies, quasi-experiments and retrospective analyses is highly relevant when it comes to drawing inferences about the best available knowledge in talent

development research. From this perspective, the strength of conclusions in children and youth sport research comes from the convergence of evidence from different study designs, sports and populations.

Early TPPs

The public controversy over the value of implementing early TPPs centers around different approaches to athlete development that mainly focus on the immediate training environments of children and youth sport instead of focusing on the interactions of various factors that influence engagement over time. However, proponents of structured, early TPPs often rely on the theory of deliberate practice [16], which posits that the practice environment — specifically, control over the type and amount of practice — is the fastest and most solid route to expertise in sport. This "nurture" principle suggests that less specialized long-term pathways do not always provide the necessary conditions for elite development. Concerns include insufficient training quality and volume, a lack of qualified coaches and limited resources that could hinder long-term athlete development. In addition, regional differences in access to training facilities and expertise, as well as increasing global competition in elite sport, have contributed to the formation of TPPs, presumably, to ensure that young athletes receive adequate preparation for the highest levels of competition.

Current TPPs are predominantly based on a linear, deterministic model that assumes that early performance improvement provides a developmental advantage that increases the chances of reaching the elite level, i.e. the ‘step ahead’ effect. Those who are a step ahead of their peers at a young age are able to maintain this advantage over time by achieving high levels of performance earlier and sustaining them for longer. This approach focuses on the early identification of promising athletes in order to allocate additional resources to those who are most likely to maximize them. TPPs tend to advocate for intensive sport-specific training, selective identification procedures, and early performance. The underlying philosophy treats talent development as a predictable cause-and-effect process in which early investment in selected individuals yields a proportional return in the form of elite performance. These perspectives shape program structures, selection criteria, and funding allocations. Critics, however, question these practices and suggest they are detrimental to short-term interest, long-term development, and the well-being of athletes. The debate persists, not least because adopting alternative approaches would significantly impact existing programs, funding structures, and stakeholder interests across the sport ecosystem.

Evidence on TPP Effectiveness

If the assumed linearity and early recruitment advantage of TPPs were consistently superior, we would expect most elite athletes to emerge from these early trajectories. The underlying assumption is that without access to these additional resources and specialized training environments, young athletes would inevitably fall behind in their development. However, the empirical evidence on this issue is mixed. Elite athletes have emerged from a variety of developmental pathways that include both early specialization and broader sampling, suggesting that no single pathway is overwhelmingly superior. In this context, it is important

to distinguish between early engagement — including elements of deliberate practice — and early involvement in formalized TPPs. Structured TPPs can play an important role in later stages, especially in adolescence. So the question is not whether they should be used at all, but when and for whom they are most appropriate. This requires a more nuanced discussion about the timing and necessity of early performance acceleration, rather than a blanket endorsement or rejection of a single model. Such a position is in line with the recommendations of organizations such as the Swedish Sports Confederation, which advises against elite-oriented activities before the age of 13 [17].

This caution is further supported by the inherent difficulty of accurately identifying young athletes with long-term elite potential. The dynamic interaction between personal characteristics (e.g. physical, psychological and technical attributes), task-specific demands, and environmental influences (e.g. coaching quality, training context, social support) introduces considerable variability, both between and within individuals over time, making long-term predictions uncertain and ill-advised [12]. However, an analysis of the development of more than 9,500 European youth and senior international soccer players revealed that between 2002 and 2022, around 75% of senior international players from England, France, Italy, Germany and Spain had previously represented their country at youth level at least once [18]. Similarly, in Swedish men's soccer, the majority (60%) of players in the senior national team moved to a first division club at some point during their junior years [19]. Thus, a large proportion of senior elite athletes are also prominent at some point during their youth years.

Despite this, the prevailing paradigm of athlete selection, which relies predominantly on current performance level, shows a relatively weak predictive correlation with long-term athletic development and senior-level success. In the sports examined to date (including all sports in the Olympic Games), successful juniors and successful seniors appear to be two different populations [20]. Most top juniors do not become top seniors and, more importantly, most top seniors were not top juniors. A comprehensive meta-analysis of over 13,000 athletes (2006–2021) supports this observation and shows that performance in youth has limited predictive value for later success in adulthood [21]. This finding was consistent across different sports, sexes, and geographical contexts and is supported by several other studies with similar results [22]. In fact, research has generally shown (across various sporting domains) that adult world-class athletes typically engaged in more multi-sport training in childhood, began specializing later, invested less time in primary sport-specific training early in their sporting careers, and showed more moderate initial performance development than athletes who were successful at the junior level [23,24]. Although the precise mechanisms behind these relationships are unknown, it is possible that the most talented athletes generally possess inherent genetic traits that predispose them to athletic success across various sports (i.e., they are "sport types"), and that participation in multiple sports a) increases the likelihood that athletes will find a sport that best matches their abilities and interests, b) improves an athlete's overall skills, adaptability and learning capacity, and/or c) reduces the negative consequences associated with early TPP entry. Although survival bias remains a methodological issue — as most studies focus on those who have remained in sport — the

finding that athletic background differs between national and world-class athletes [23] suggests that the effect is not simply an artifact of selective retention.

An obvious problem with early selection is that it reinforces established participation and selection effects such as the relative age effect (RAE) and, especially during puberty, the bias towards early biological maturation [25,26]. These two phenomena are conceptually two different concepts. The relative age effect refers to a skewed distribution in favor of athletes born early in the selection year, while the relative maturity effect describes a bias in favor of athletes who are biologically advanced for their chronological age. Boys who enter puberty early have significant advantages in body size, strength and physique that translate directly into performance advantages in sport [27,28]. A study of the Swedish Soccer Association's selection pyramid revealed significant selection biases that increased at different levels of competition [29]. At the international level, late maturing players were particularly absent. In boys, where these maturity-related selection effects are particularly well documented and pronounced, these maturity biases generally emerge around the age of 12, which coincides with the onset of puberty, and increase with chronological age and level of competition [30].

The fundamental problem is that neither the date of birth nor the timing of maturation *should* predict the potential for athletic success in adulthood. An analysis of Swedish ice hockey high school graduates advancing to the NHL over the past 20 years revealed that the majority were later-than-average maturers in their first year of high school [31]. This is particularly striking when you consider that there was a clear bias towards early maturity in the selection process for the first junior national team (U16). Similar patterns emerge when the relative age effects in NHL selections compared to U16 were examined. The relative age bias was much lower, and the conversion of players born in the 4th quarter was higher than that of players born in the 1st quarter. These results, replicated in several other countries [26,32], show how current selection practices in youth sports exclude potentially talented athletes based on temporary physical and age advantages rather than long-term potential.

To some extent, these limitations are recognized in current early selection procedures, as today's TPPs operate on a high turnover model where the majority of athletes selected do not progress through the system [33]. Research suggest that TPPs have an annual turnover of around 30%, meaning that only around 10% of the original athletes remain in the system over a five-year period [34]. However, contrary to the linear idea and “step ahead thesis” of early TPPs, the probability of reaching elite soccer increases with the recruitment age of the academy players [33]. On average, the players who reached the elite level were recruited later than the average recruitment age. This suggests that early enrollment in a TPP may not be as critical to reaching the elite level as is often assumed, pointing to the need for a more flexible approach to selection models.

The linear thinking described above also seems to be incompatible with the best current knowledge regarding how elite-level adult athletes typically develop. Data from soccer has shown that players who reach the world-class level usually experience multiple deselection events and do not follow a linear path to the elite. A study of German professional soccer

players found an average annual turnover of 25% in the youth academies and 40% in the junior national teams, with a less than 50% probability of staying in the program for three years at any age [34]. The population of professional players was created through repeated selection and deselection processes throughout childhood and adolescence rather than through early identification and continuous nurturing. Similarly, the results of a study of Dutch soccer academies are consistent with this pattern [33], showing that the careers of elite players, especially players who reach the international level, tended to be more atypical than those of players who did not reach the elite level. Research by Gulbin et al. (2013) reinforces this perspective, finding that non-linear trajectories were experienced by the majority of athletes (83.6%), with pure junior to senior developmental linearity evident in less than 7% of cases [35]. This supports the idea that future elite athletes often develop outside of traditional TPPs and that development follows a non-linear path.

However, this contrasts with data from Sweden, where a study of players who reached the national team in men's soccer found that deselection was not as common [19]. Also, when examining all high school ice hockey players in Sweden and tracking those who later reached the highest professional level (i.e., the NHL), it was found that after being cut from a youth national team, it became very difficult to return and eventually reach the NHL [31]. This Swedish data suggests re-selection is difficult in certain contexts, and that the system is not as permeable as it could be given the highly individualized and non-linear pathways to elite. To address these challenges, sports organizations should prioritize strategies that prevent *active* deselection and minimize dropout rates in order to increase the available talent pool [36]. In addition, efforts should be made to mitigate confounding factors that influence the talent identification processes. It is critical to create pathways for *re-entry* into elite programs to ensure that late developers and those who may have been previously overlooked have the opportunity to progress. This approach reduces the reliance on early performance advantages as primary indicators of potential and instead emphasizes a holistic, long-term developmental perspective. Such a framework better accounts for the complex, multi-layered nature of athlete development and recognizes the non-linear trajectories that are often seen in progression to elite performance.

Effects of Current Practices

Despite the limitations highlighted above, many elite organizations maintain early TPPs for young athletes. This may increase the pressure on children to specialize early and is inevitably associated with selection processes. This pressure often stems from the belief of organizations, parents and young athletes that early specialization is necessary for elite performance [37]. Additionally, organizations may be motivated by a fear of missing out on exceptional talent, operating under the assumption that identifying and securing promising athletes early is worth the investment, even if it means that many of them will not ultimately succeed at the elite level. While this approach may serve certain institutional interests in talent acquisition, it raises important questions about whether such systems optimally serve the developmental needs of young athletes overall.

The intensive demands of participating in TPPs can affect young athletes physically, mentally and socially. These demands include an increased training load, rigorous schedules, heightened performance expectations, strong athletic identity formation, limited social interactions and potential disruptions such as changing schools or relocating [38]. These factors can lead to unintended negative consequences such as injuries, feelings of pressure, performance anxiety, academic decline and impaired psychological wellbeing [39].

Currently, there are no empirically determined thresholds that define when cumulative demands have more negative than positive outcomes, or when negative outcomes reach a critical level (and these values may vary depending on the individual and age). Moreover, it is not always clear what a universally 'negative' or 'positive' outcome could be. However, numerous descriptive studies suggest that classically negative outcomes (e.g., overuse injuries or reduced psychological well-being) are more common in early specialization environments [40], with younger athletes being particularly at risk. Considering the limited evidence supporting the necessity and effectiveness of early TPPs, particularly in childhood and in team-based sports, we argue that the risk-benefit balance favors avoiding their implementation for *children*.

In addition to these possible negative health-related outcomes, the current early TPP system may also inadvertently create financial and socio-economic barriers to participation by increasing costs. Research from the Swedish Sports Confederation indicates that there are socioeconomic disparities in sports participation across the country. A survey from 2024 found that households spend on average around SEK 9,400 per year (around $930US) on children's sporting activities, with costs almost doubling between 2003 and 2023 [41]. In many early TPPs, however, these costs are considerably higher. While families whose children participate in multiple sports may face even higher cumulative costs, the financial burden of specialized programs remains a significant barrier, particularly for families of lower socioeconomic status, potentially limiting access to organized sports regardless of the participation model chosen [42].

The socio-economical inequalities can also influence the available pool for athlete selection. Studies of Swedish soccer district team selection at age 15 show that players from higher income backgrounds are over-represented [43]. This could mean that some potential talents are not given the same development opportunities, which, in a smaller country like Sweden, can have a long-term impact on the depth of the talent pool [44]. Despite the Swedish Sports Confederation's ambition to make sports accessible to all, rising costs and selection mechanisms pose a potential challenge to a system where socio-economic factors could influence who can follow the path to elite performance.

Recommendations for Improved TPPs

These research findings highlight a fundamental challenge in athlete development: many traditional practices are based on assumptions that are not aligned with the best available evidence. The generally weak correlation between junior and senior performance calls into question the rationale behind the early (childhood) selection of athletes. Given the uncertainty

of who will reach the elite level, it seems most effective, at least in team sports, to delay selection and prioritize the creation of a supportive developmental environment over early TPP entry. This strategy may not only support the development of world-class athletes, but also promote wider personal and societal benefits such as increased participation, health and well-being through sport.

An obvious challenge with this approach is that resources are not unlimited and there are scenarios where selections may be necessary (and perhaps even important), even in youth sport. However, the most critical consideration for sports organizations should be *when* and *how* selection takes place and understanding the possible negative outcomes/processes associated with these practices. Rather than identifying a narrow athlete pool early on, organizations should ensure and promote development paths that keep opportunities for athletes to participate in competitive sport open, and allow athletes to develop naturally (i.e., without premature exclusion or excessive performance-related demands) and move into, and out of, development environments capable of reacting to their individual needs as they progress to the senior level.

Current evidence suggests multidimensional approaches to selection procedures would have better predictive power than relying solely on competitive performance or other single indicators [45]. However, it is important to note that even these multidimensional approaches have relatively low predictive power. When looking at performance, it is useful to consider the possibility of making adjustments that account for athletes' relative age, biological maturation (including the onset of puberty and growth spurts) and accumulated sport-specific experience. Thus, TPPs should consider incorporating assessment frameworks that acknowledge developmental trajectories in addition to performance metrics, while recognizing the inherent limitations in predicting future athletic success.

As research has highlighted the potential risks and disadvantages of involving children in intensified elite sport at an early age (e.g., increased risk of injury, increased levels of perceived stress and anxiety, and increased risk for dropout) [11,39,46], we recommend a sensible children's sport program that emphasizes accessibility, engagement, retention and the nurturing of sport-specific skills. In such a program, costs are kept as low as possible, and barriers to starting and continuing sport are minimized. This approach is likely to have a positive impact on the development of talent while ensuring that as many children as possible are able to participate in organized sport. Thus, athlete development guided by 'state of the science' can be well aligned with other goals such as broad participation and its associated societal outcomes. It is worth noting, however, that identifying programs that genuinely implement all these aspects can be challenging in practice, despite many claiming to prioritize these elements.

It may be that not all clubs and sporting environments can provide augmented levels of support and resources at a particular stage of an athlete's career to promote his/her/their continued development. Therefore, it is common — and expected — that many of the most talented athletes will eventually change clubs or move to an elite environment. This pathway

has become increasingly important in many sports, and in the Swedish context particularly in soccer, as academy-type TPPs play an increasingly important role in elite development. While these environments may provide better development programs for athletes than in the past, they also carry the typical risks of TPPs mentioned earlier, as well as the risk of being perceived as the *only pathway* into the elite and reinforcing a model of early selection (with all of the consequences discussed previously). Federations and clubs should, therefore, ensure there are additional pathways with various entry points that best support athletes' long-term development.

The recommendation to postpone TPP selection should be accompanied by guidance for TPP stakeholders who work with athletes during their early development. Rather than remaining inactive or feeling that their role is being diminished, TPP staff can focus on strengthening what we refer to later in the article as a "good sporting environment," as well as supporting competitive sports in regional clubs where promising young athletes can be observed and nurtured, by maintaining contact with these athletes, their parents and their home coaches. This approach allows young athletes to develop in their familiar environment, with TPP staff supporting their progress. As the athlete matures, all parties can work together to determine the appropriate time for a potential transition to TPP. Such a strategy addresses concerns about inactivity in the early years and mitigates fears of losing talented athletes to other programs or sports.

Given the potential for TPPs to cause unintended negative consequences, we recommend raising awareness of these possible negative consequences, and creating/maintaining high-quality coach-athlete relationships to promote open communication in key domains (health, academic performance, psychological well-being, training-recovery balance and athletic performance), which can protect against psychophysiological exhaustion [47–49]. Sports organizations and policy makers should also actively work to change the view that early involvement in TPPs is necessary to reach the elite adult level and clearly communicate that this dogma contradicts current evidence-based recommendations for athlete development.

Good sport environments

The changes recommended above increase the likelihood that those with the greatest long-term potential will emerge over time, through a combination of structured development opportunities, a larger “talent pool”, and the natural tendency of athletes to continue or withdraw based on their interests, abilities and progression. In addition to positive performance outcomes, an inclusive and engaging sporting environment encourages participation, enjoyment and personal development by helping young athletes build physical literacy, resilience and a lifelong connection to sport and physical activity.

This approach is also in line with the general principles of youth development and public health objectives. Given the numerous positive effects on the physical and mental health of children and adolescents, sports organizations should ensure that these outcomes are prioritized [50]. Children's sport should be organized with the aim of promoting healthy

physical, sporting and social development. The above recommendations are based on evidence and provide valuable guidance for the design of youth sport systems. Thus, while research does not provide a simple blueprint for the development of elite athletes, it does provide important information that can be used when creating a framework for youth sport development.

As the relationship between TPPs and athletic success is complex and multi-layered, and there is evidence that TPPs represent only one of many possible developmental pathways, it is important to consider the broader sporting environment that surrounds young athletes. While early TPPs often spark debate about their effectiveness and potential drawbacks, the fundamental importance of creating a supportive, developmentally appropriate sporting environment is less controversial. To create evidence-based frameworks for children and youth sport, we need to examine the constellation of psychosocial factors that contribute to long-term engagement and development. In the following sections, we provide recommendations for creating a sporting environment that promotes sustained participation and overall well-being by considering key factors such as motivation, social support and developmentally appropriate challenges.

Motivation

An important factor in promoting prolonged sport participation is fostering a supportive and motivating sporting environment. Understanding the motivation of participants in sport is therefore a critical dimension of sustainable sports development. We can gain meaningful insights on this topic from sports science research that we can use for ‘best practice’. Children and youth repeatedly state that intrinsic motivation and enjoyment (“fun”) are two of the main motives for participating in sport [51,52]. The key motivating factors are consistent with established psychological concepts included in the self-determinaton theory [53], including: 1) autonomy, 2) perceived competence, and 3) sense of belonging. Autonomy refers to athletes' participation being driven by their own interest and not external pressures, alongside their sense of control over training. Perceived competence relates to an athlete's belief in their abilities, which is linked to intrinsic motivation to stay engaged and improve. Sense of belonging encompasses feelings of being valued, accepted, and connected within one’s team or training group, shaped by support from both teammates and coaches [54].

Although these concepts are still somewhat blurry, recent advancements in both research and measurement tools are helping us gain clarity [14]. Sport environments that foster these basic needs — autonomy, competence and belonging — are more likely to produce athletes with high intrinsic motivation. As a result, athletes with high intrinsic motivation are more likely to develop critical skills such as self-regulated learning, where they take the initiative in their development by setting goals that reflect a deep understanding of their specific areas for improvement, monitoring their performance to gain insights into their personal development, adapting their strategies and reflecting on their approach [55]. Recent evidence indicate that a higher degree of individualization, adaptation and athlete co-determination in high performance training improves both training efficiency and long-term performance development [56]. Prioritizing these psychological needs in the sports environment not only

improves immediate motivation, it can lay the foundation for long-term athlete development and sustained participation.

Interest development

Building on self-determination theory, the four-phase model of interest development conceptualizes interest as a series of progressive stages that directly align with research on athlete development [57]. When youth are introduced to a sport, environmental stimuli trigger short-term changes in cognitive and affective states, leading to *triggered situational interest* in the specific sport. This stage is characterized by stimulation, enjoyment, and positive emotions. Continued support from the environment, whether through tasks or individuals involved, may foster a connection to this activity or content, resulting in *sustained situational interest*. During this stage, individuals approach the activity or content with focused attention and persistence over an extended period. An *emerging individual interest* develops when a person begins to seek repeated engagement with the activity or content, independent of external supports. Knowledge is pursued and consolidated, and personal value for the activity or content grows. Eventually, an enduring predisposition to reengage with the activity or content over time leads to a *well-developed individual interest*. Knowledge and value continue to evolve and are largely self-generated; however, individuals acquire the ability to cope with frustration and maintain creative thinking, which may not be evident in the emerging stage.

The research present above suggest that a positive sporting environment should actively support these factors. Aligning the four-phase model of interest development with a developmental perspective, childhood may represent the optimal time to trigger and maintain situational interests, from which individual interests may emerge and develop with continued social and environmental supports, feelings of choice and competence, and internalization of relevant values throughout the adolescence [58]. Sports organizations can do this by fostering competence, a sense of belonging, autonomy, promoting positive relationships between coaches and athletes as well as peer relations between athletes. However, it is important to recognize that factors such as social support and psychological characteristics such as intrinsic motivation and enjoyment are not independent determinants of success. Rather, they act as moderators that can either facilitate or hinder the training and competition process, depending on how they interact with the broader sporting environment and individual circumstances.

Coaching and support network

While motivation and interest development are crucial for the development of athletes, coaching plays a central role in shaping these factors. Positive coaching is likely to play a role at all stages [59,60], but expert coaching is particularly important in the later years of development when advanced technical, tactical and psychological skills need to be refined to support the transition from a promising talent to an elite athlete. To ensure this, federations and clubs should invest in the education of coaches and ensure that the training environment is developmentally appropriate, motivating and supports the long-term development of athletes [61].

For younger athletes, parents and coaches should ideally be trained in interpersonal skills to create a safe, enjoyable environments and foster positive relationships [62]. As athletes mature, the coach needs to combine these basic relationship skills with sport-specific knowledge and technical expertise to support ongoing development. Given the fact that many world-class athletes specialize in their main sport relatively late, coaches may also need adapted methods to effectively identify and fast-track athletes with experience in other sports. However, such approaches are generally lacking in both traditional and modern coach education programs, highlighting a gap in current methodology.

Although the coach is important to support the athlete, there are also other actors that are important in a functioning support network [24]. Research on successful sport environments emphasizes the importance of support from a broader environment - including family, coaches, peers, and support staff — to both support athletic goals [63] and provide opportunities to focus on things outside of sport [64].

Conclusions

Athlete development is a long-term and complex process, shaped by a combination of genetic, environmental, psychological, and training-related factors. The evidence presented in this paper suggests the contradiction between participation-focused, long-term development goals and the aim of producing elite athletes through early TPPs is a false dichotomy. Rather than viewing these approaches as contradictory, we propose that evidence-based youth sport systems can support both elite performance and broader participation goals simultaneously. Developmentally appropriate programs that maintain high participation rates create the necessary foundation from which elite athletes emerge, while visible success in elite sport sparks interest, creates role models and encourages continued participation at all levels. This mutually reinforcing relationship between participation and performance should guide sports organizations in shaping their development pathways. At the same time, promoting opportunities to participate in multiple sports and different levels of competition, training and play, regardless of age, can contribute to both athlete well-being and long-term commitment to sport in various functions.

Both the long-term participation and development of elite athletes also depend on a minimum level of support from a broader environment, as well as quality coaching. Ensuring that athletes experience intrinsic motivation, enjoyment, autonomy, and a sense of belonging within their sporting environments supports both their long-term engagement and development. This also ensures that each stage can promote athletes' competence and skill development.

A key takeaway from the research is that there is no single blueprint for athlete development, but there are general principles that can help improve youth sport structures. Stakeholders and policymakers play a critical role in shaping the structures and policies that govern children and youth sport development. To ensure the most effective and sustainable athlete development models, decision-makers should prioritize evidence-based strategies. This

involves continuously integrating insights from contemporary research, evaluating the effectiveness of existing programs, and adjusting policies to align with evolving scientific understanding and the local sports context.

Recommendations

1. **Keep participation accessible.** Costs and other barriers to participation should be minimized to ensure that as many children as possible have the opportunity to engage in structured sport. This is essential both for athletic development and for promoting long-term physical activity.

2. **Focus on inclusive skill development in childhood.** Avoid early selection and talent identification procedures in childhood. The focus in these early years should be on maximizing engagement, fostering enjoyment, and developing fundamental skills. When selection eventually occurs, it should use a multidimensional approach.

3. **Balance specialized programs with broader competitive opportunities.** The postponement of TPP selection to an older age should be combined with a strengthening of the general competitive and sporting environment in sports clubs outside the TPP environment. This dual approach ensures that athletes developing outside elite pathways still have access to quality training and competitive experiences.

4. **Encourage multisport participation and diversification within sport.** This approach may be more effective for developing short-term interest and motivation, and long-term athletic outcomes, while reducing negative health outcomes.

5. **Create flexible, permeable development systems that accommodate non-linear progression.** Development structures should allow athletes to move between different levels of competition and training environments as they progress, with multiple entry points available at different ages to accommodate late-developing athletes and those following non-traditional routes**.**

6. **Ensure quality coaching.** Federations and clubs should invest in coach education to ensure that training environments are developmentally appropriate, motivating, and supportive of long-term athlete progression.

7. **Create environments that foster intrinsic motivation and enjoyment.** Coaches and sport organizations should prioritize factors such as autonomy, competence, and positive social interactions to increase the chance of prolonged participation and reduce dropout rates.

8. **Integrate Evidence-Based Practices into the decision-making process.** Sports organizations and policymakers should prioritize the integration of evidence-based

practices in their decision-making process. Preferably, these decisions should be made in an environment where clubs critically evaluate their own activities to identify the strategies that work best for them. This process not only allows for tailored and evidence-based decision making, but also promotes continuous improvement of operational practices.

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