

Talent Development in Adolescent Team Sports: A Review

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Traditional talent development pathways for adolescents in team sports follow talent identification procedures based on subjective games ratings and isolated athletic assessment. Most talent development models are exclusive rather than inclusive in nature. Subsequently, talent identification may result in discontentment, premature stratification, or dropout from team sports. Understanding the multidimensional differences among the requirements of adolescent and elite adult athletes could provide more realistic goals for potential talented players. Coach education should include adolescent development, and rewards for team success at the adolescent level should reflect the needs of long-term player development. Effective talent development needs to incorporate physical and psychological maturity, the relative age effect, objective measures of game sense, and athletic prowess. The influences of media and culture on the individual, and the competing time demands between various competitions for player training time should be monitored and mediated where appropriate. Despite the complexity, talent development is a worthy investment in professional team sport.

No clear guidelines exist for the effective development of talented team sports athletes. Talent development issues are global and not exclusive to team sports athletes.¹ The one unifying factor is that because of the many factors associated with growth, development, and maturation, the same strategies employed with elite adult athletes are unlikely to be sustainable in adolescents.

Scope of Review

Literature on adolescent athletes frequently describes identification or detection of talent. Relatively less is known about talent development, particularly in team sports. This review discusses talent development in postpubescent adolescents involved in team sport. To this end, database searches were conducted in Ovid, SPORTDiscus, Web of Knowledge, and the Australian National Sports Information Centre. We also contacted national (Australian) sports organizations and institutes. Search terms were limited to *youth*, *adolescent/adolescence*, *teenage*, *junior*, *talent*, *development*, and *young* for the target group. *Sport*, *soccer*, *football*, *rugby*, *Australian Rules*, *basketball*, *cricket*, and *netball* were the terms entered for the team sports.

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Development Versus Identification

The identification of talented team sports' athletes in their adolescent years is, by its definition, exclusive, rather than inclusive. Talent identification is multifaceted and often expensive, and a successful translation in adult team sports is questionable.² Ideally, talent identification should form part of an initial stage of a dynamic talent development model and pathway.

More than talent identification, talent development presents a number of challenges to the team sports coach. Specifically, day-to-day variations and progressions in skill and in physical and cognitive maturation require regular monitoring for valid performance appraisal. Development models should acknowledge and nurture these progressions. Holistic and progressive approaches in talent development function in contrast to the cross-sectional nature of traditional talent identification programs.

In a substantial review of the use of physical testing in talent detection and sport development,³ four main observations were presented:

1. Physical skill tests can assess athletic ability and have some success in predicting future athletic success in some sports.
2. Most studies on physical skill assessment of elite adolescent athletes are cross-sectional, and lack developmental relevance.
3. Acceptable criteria for maturation are rarely considered in such tests.
4. The nature of physical tests to detect early development in sport transferring to elite-level performances remains obscure.

Physical and biological attributes alone are poor predictors of skill in team sports. In soccer, body size and maturity were not associated with results of skill testing in talented junior squads.⁴ Within Australian Rules Football (ARF), a small relationship between performance measures (20-m sprint, agility, multistage shuttle run, and vertical jump) and future ARF success has been demonstrated.⁵ In agreement with the previous study on soccer, no relationship was found between body size or shape, and ARF career success.⁴ This finding was also consistent with a study on American Football players, in whom no substantial differences were evident in body dimensions of drafted and nondrafted players.⁶ In volleyball, a novel skills battery⁷ was used, as well as traditional physiological and anthropometric tests, to assist in predicting both selection and nonselection in a talent-identified squad.⁸ Of these variables, subjective coach assessment of passing and serving skills were the only significant contributors to team selection, combining for a predictive accuracy of 79%.

Thus, the identification of successful attributes should serve only as a guide, rather than inclusion criteria for elite pathways into team sports. Game sense and decision making should be assessed, preferably during specific games, rather than estimated in athletic performance settings.² The game-inclusive approach is particularly relevant in early adolescence, during which maturation and physical attributes occur with unpredictable timing and tempo.⁹

Talent Development Models

Talent development models vary in content. Recent reviews on talent development for applied settings provide informative summaries of existing models.^{2,10} In this review, we provide a brief summary of models, followed by an alternate hypothetical framework (Figure 1).

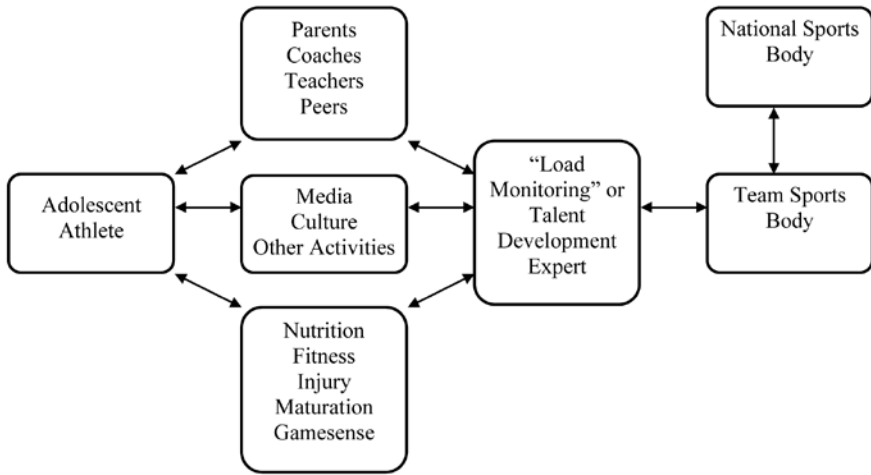


Figure 1 — A proposed new model of talent development for adolescent team sport players.

Reilly and Williams¹¹ suggested two approaches to talent development. First, athletes may succeed in a sport in which they already participate through the progressive attainment of expertise. Second, an athlete may transfer to a new or related sport, excelling in the physical, psychological, and/or physiological attributes required for the new sport. Talent transfer is demonstrated by a report that 28% of Australian senior national athletes had reached their elite status within 4 y of beginning their sport.¹² Furthermore, a talent identification and development case study on the winter Olympic sport of women's skeleton showed a number of athletes successfully transferred from sprint performance testing to international standard competition.¹³ However, talent transfer was reliant on physical measures in closed-chain sports, and as a result, the application of these findings to open-chain team sports talent development may be limited.

A “deliberate practice” talent development model was proposed¹⁴ in which national level achievement could be developed after 10 y of focused, specific practice. According to the deliberate practice model, athletes can only succeed if, from an early age, they are exposed to skill refinement and training specificity. The early exposure model is supported by anecdotal case studies in both individual and team sports. However, given the number of aspiring junior athletes with similar early commitment, the case studies may be interpreted as outliers. The early exposure model has also been criticized for suggesting elite performance would negate any influences of factors such as genetic predisposition, coaching quality, efficacy in commitment, and parental support.¹³ The unpredictable and dynamic nature of team sports, particularly during adolescence, provides few guarantees, even to committed individuals.

Baker et al¹⁵ contend that mastery of an athletic movement is directly related to the number of practice hours undertaken, independent of structure. This notion was taken further¹⁶ by postulating that athletic movement mastery is dependent on accumulating 10,000 training hours. However, this 10,000-hour model does

not dictate task specificity and has been associated with (increased) dropout in elite team sports athletes.¹⁷ The practical framework we have outlined in Figure 1 ignores prescribing precise training hours or regimes. Individualized training is preferred, with the ability to alter programs according to monitoring feedback from talent development specialists who in turn, work with coaches, teachers, and possibly parents.

Martindale et al¹⁸ took a more holistic approach in a review of the talent development literature. Five generic factors positively affecting talent development were identified: long-term aims and methods; wide-ranging coherent messages and support; emphasis on appropriate development rather than early selection; individualized and ongoing development; and integrated, systematic, and holistic development. Despite the appeal of this developmentally appropriate model, it can be scrutinized for a lack of evidence-based validity and difficulties in quantifying some of the influences. Nevertheless, translating these factors into practical environments should be of interest to talent development staff involved in a broad range of team sports.

Talent development is multifactorial and dynamic in nature, with talent altering and adapting according to the environment in which it is nurtured.¹⁹ One such multidisciplinary approach to talent identification in adolescent soccer concluded that elite players differed from semielite players in body shape, aerobic power, agility, sprint time, ego orientation, and anticipation skill.¹¹ This approach suggested more than just physical factors separate elite and semielite players. Cognitive development also appears to offer similar pathways to physical and technical development.²⁰ For example, memory skills typically mature after 16 y of age and can take up to 10 y to develop.²⁰ The importance of cognitive skills in talent development is evident in research distinguishing between levels of performance.²¹⁻²² Further, the rate of learning, represented by speed in the acquisition of new skills, has been identified as an indication of talent.²³ Problems arise when identification of talent occurs before the maturation of cognitive capacity, and when selecting talent fails to consider the capacity to learn

Some talent development models detail both the detection and development of talented athletes. For example, four domains of development (intellectual, creative, socioaffective, and sensorimotor) were established within the Differentiated Model of Giftedness and Talent (DMGT).²⁴ The model begins with a junior possessing “gifts” and ends with a fully developed talented adolescent or adult athlete. This model recognizes several domains that significantly influence dynamic and interactive responses of adolescents in team sports. Despite recent support for the DMGT model,² practical examples are limited.

Varied early learning experiences combined with subsequent specific training hours may represent an ideal environment in which to nurture talent. Engagement in playful, nonspecific behaviors during the early stages of development, followed by more specialized training during later stages of development, may be among the most salient predictors of later skill attainment.²⁵ The playful, nonspecific model is anecdotally supported in Australia by the disproportional success of indigenous players in team sports. Despite the likely absence of structured training in the first two decades of life, young indigenous males remain highly active through social participation in sports-related play. In ARF, for example, 189 players with indigenous heritage have gained senior player status. In the 2009 season, there were

72 indigenous ARF players, representing over 11% of total player numbers.²⁶ By contrast, indigenous Australians represent only 2.5% of the total population.²⁷

The Developmental Model of Sports Participation²⁸ embraces the early, playful, and nonspecific²⁵ model of participation. Specifically, it prescribes participation in a variety of sports during the sampling years (age 6 to 12), a reduced variety during the specializing (age 13 to 15), and substantial investment in a single sport (above 16) years. The Developmental Model of Sports Participation asks team sport athletes not to engage in deliberate practice until at least the specializing years. The Developmental Model of Sports Participation also recognizes the potential influences from interactions with coaches, parents, schools, and peers.

An independent review of National Sport in Australia has recently been critical of under-resourced and poorly articulated talent pathways in junior sport.²⁹ Specific observations included deficits in cooperation between key stakeholders and a lack of strategic, unified support for junior sport participants. Rather than an institute or club-centric approach, a hypothetical framework (Figure 1) with the adolescent athlete as a central focus has been proposed for the purpose of this review. The framework places a stronger emphasis on the holistic and unified management of the adolescent athlete.

Modifying Expectations of Adolescent Team Sports Performance

Expectations of training responses and performances in junior athletes should not be determined by adult standards, even if adolescents appear to function well within elite pathways. Effective pathways may be best served by a more patient approach, by first quantifying the gap between elite junior and elite senior performers, and progressively training toward closing it. Although child-specific training advice is available,³⁰ it is not always applicable to team sports, and can neglect fundamental physiological and maturational factors.²

Research differentiating the age-based physical requirements of team sports is plentiful. Substantially different scores in soccer-specific endurance (Yo YoIR1) and agility tests were found in age- and gender-differentiated elite Spanish soccer players.³¹ Specifically, the 15% difference in male Yo Yo scores, and the 5% difference in agility scores were postulated to reflect differences in training and competition experience. Both the Yo Yo and agility tests were reported to represent, among other variables, explosive strength in the lower limbs³² and soccer-specific intermittent high-speed running ability.³³ Compared with elite junior soccer players, agility was better in elite senior players.¹⁷ However, game-specific ball drills and sprint ability did not differentiate the players in the same study. Other measures of explosive leg strength (vertical jump,³¹ squat jump,³⁴ sprinting ability²⁰) have differentiated between elite senior and junior soccer players of both genders. Even older adolescents (approximately 17 y) are not required to meet the same physical output as adults within the same football code.³⁵

A myriad of intrinsic neurophysiological and intramuscular properties may more likely affect explosive power performances in immature than in mature athletes.³⁶ Such properties remain difficult to quantify in ethically appropriate studies in adolescent athletes. Advanced technologies of intramuscular anaerobic activity³⁷ may improve the understanding of isolated isokinetic performances in the

near future, but their relationship to on-field performances remains questionable. Nevertheless, anaerobically based performances of adolescents appear to lag behind more mature performers, and expectations should remain focused on individual improvement rather than attaining team averages or elite values.

Fundamentally, adolescents achieve similar scores for aerobic capacity (V_{O2peak}) when results are expressed relative to body weight. However, field-based measures are more sensitive in showing incremental improvements in endurance performances that can occur in combination with age and training.³⁸ In male adolescents, increased lean mass may exponentially enhance the capacity for aerobic and anaerobic training. This increase has been described as the trigger hypothesis.³⁸

The potential for adolescents to respond to strength and conditioning is also well established.³⁹ Properly designed and supervised programs are relatively safe and can improve cardiovascular endurance, muscle strength and power, and enhance aspects of health, injury resilience, and performance.³⁹ Progressions within periodized programs should be relatively slow and specifically monitored.

Issues with Current Talent Development Practices in Team Sports

Coaches/sports scientists in charge of elite talent development may be unfamiliar with current research models. The models can often be difficult to translate into practice. The current practice of identifying and developing adolescents likely to be successful in team sports, regardless of the talent development model employed, could be flawed at the identification level. International ice hockey players, for example, did not reach their full potential until their late twenties, indicating that “early” identification and development may not necessarily translate to adulthood performances.⁴⁰

Physical assessments as a base of talent identification not only ignore team interaction, decision making at speed with opposition, and other tactical awareness factors, but also assume that physical traits, such as speed and strength, transfer easily to game-based scenarios. The inclusion of early maturing boys and the exclusion of late developers is a divisive practice that reduces the talent pool for future elite teams. Junior coaches who stratify players on adolescent performance may impose irreversible rejection messages to late developers or slow learners. An inclusive strategy for future early adolescent sporting competitions is required in models of talent development even at the elite level. The framework presented here proposes a strategy in which maturation, injury status, and game sense are considered commensurate with physical fitness (Figure 1). Coaches, teachers, and parents linked with adolescent talent development programs are supported by experts who can provide the coaches, in particular, with another source of information and support. Among many functions, talent development experts would ideally nurture coaches to prioritize players’ goals of self-improvement, ahead of peer comparisons.

The use of performance measures to identify and subsequently develop talent may possibly be counterproductive for long-term talent development.¹⁸ In practice, many coaches—and committees advising/employing these coaches—focus on early adolescent performance results, demonstrating a “win-at-all-costs” mentality that may, in fact, impair future individual performance.¹⁹ Improved body size, speed,

strength, and endurance synonymous with advanced relative maturity can alter talent perception and therefore team selection.⁴⁰ The transient nature of adolescent physical performance is also often neglected when identification is used to predict development.² Analysis of training methods in soccer, for example, showed that game play and coordination activities transferred to conventional assessment tasks such as tests for sprinting and jumping more effectively than did test-specific drills in adolescents.⁴¹

Further complicating current talent development practices is the issue of athlete dropout due to competitive pressures.^{42,43} A more general model, in which high-level competition takes place at later stages of development, may avoid these competition-related problems. Within Australia, the governing body for soccer, Football Federation Australia, has recently mandated small-sided games competition for which no score is recorded until the age of 12 y.⁴⁴ This initiative attempts to provide players with more opportunity to develop “game sense,”⁴⁵ greater exposure to skill execution within a game environment, improve participation numbers through increased enjoyment, and reduce the focus on results-based tactics. The attenuation of competition in football might be difficult to implement and manage when state and national primary school sport championships are played on an annual basis. It is also debatable whether team sports talent development programs focusing on isolated skill development away from competitive situations might mask the critical development of decision making, game tempo adjustment, and tactical awareness.

The integration of school programs within an adolescent talent development pathway is often neglected. Typically, in countries without college-based systems, elite team sports adolescents represent school and club teams at numerous levels. This excessively competitive environment potentially exposes players to high physical and psychological loads. It is not uncommon for adolescent team sports players to exceed 10 training and competitive situations on a weekly basis.⁴⁶ This practice may not only be detrimental to performance and sport retention rates, but also to young people’s health, education, and overall well-being—a point largely overlooked in talent identification literature.⁴⁷ Additionally, most school programs recognize current levels of achievement,⁴⁸ without acknowledgment of future athlete success. The emergence of sporting high schools may provide gifted juniors with a highly specialized environment, preventing exposure to alternate models of talent development, and have the potential to ignore total loads placed on players external to school-based demands. Our framework (Figure 1) addresses this “competition for time” issue by providing an adolescent development specialist within the pathway to assess and adjust, where necessary, total loads placed on talented players. Practically, this may lead to issues of prioritization and possible removal of players from current programs.

Patient development programs inherently lack the funding and support of identification programs. Typically, grant and scholarship funding is directed toward adolescent athletes already selected in representative teams, reinforcing the preference for short-term identification over long-term development.¹⁸ Effective long-term, or longitudinal, athlete monitoring would enable sports practitioners to assess athlete physical, psychological, and skill progress, as well as adjust training loads accordingly. The cost effectiveness of talent development programs relative to long-term investments of funding are, however, infrequently debated.

The Relative Age Effect

Age grouping for selection is a common practice during the developmental years of most team sports. Presumably the intention of age grouping is to “equalize” competition by providing young athletes with, at least chronologically, a level playing field. However, age grouping has led to the predominance of selected players being from the first quartile of the selection year, a phenomena known as the *relative age effect* (RAE).⁴⁹ The RAE is particularly prevalent during the adolescent years, owing to physical characteristics associated with increased chronological age.⁵⁰ An analysis of birth dates in elite Under 14 Spanish soccer players found 79% of players were born in the first half of the year.⁴¹ The RAE was further supported in large studies of elite French,⁵¹ Spanish,⁵² Japanese,⁵³ and European⁵⁴ youth soccer players, for whom substantial discrepancies were found between month of birth (beginning of the year being favorable) and selection in elite academy squads of the players.

A substantial review of 246 studies involving elite male and female European soccer player birth dates also demonstrated a discrepancy in birth dates observed among quartiles of the calendar year, with quartile one providing 31.2% of participants, quartile two (26.1%), quartile three (22.3%), and quartile four (20.6%).⁵⁵ When the studies were categorized according to four levels of skill (recreational, competitive, representative, and elite), differences remained, with the largest difference occurring at the representative level. A decline in the RAE following adolescence is explained by physical maturation levels becoming less variable,⁵⁶ as well as the impact of intersport transfer.^{15,24}

In one of the few longitudinal studies in team sports, elite junior soccer players were monitored over an 11-y period and showed no substantial differences in fitness parameters across birth date quartiles.⁵¹ Although a trend toward superior physical performance in players born in the first quarter was present, no differences in the percentage of players turning professional from any of the birth date quartiles were apparent, once players left a development academy. The absence of substantial differences on exit from the academy implied that once the players had integrated into the academy and received similar training, any physical superiority present in the players was consumed by technical development.

Several suggestions to reduce the RAE have been made, including changing age-group periods⁵⁷ and birth date quotas in team selection.⁴⁹ Perhaps the most relevant suggestion is to change attitudes toward talent identification and development so as to reflect a long-term developmental point of view rather than instant team success.^{16,49,54,58} Practically, this may involve coaches ignoring enhanced physical qualities synonymous with short-term success. Coach education may hold the key to cultural change, but support from significant others such as sporting organizations, club officials, and parents would also be required. In our framework (Figure 1), coaches are supported by talent development experts who are appointed by the governing sporting body to advise on issues such as long-term prospects. This allows for evidenced-based policies, such as those involving RAE, to be discussed and implemented in collaboration with relevant adults and adolescent athletes.

A Holistic Model

Physical discrepancies between successful and unsuccessful team sports require more scrutiny.^{5,6,31,59} The physical development pathway of some team sports, such

as Rugby Union, has been reviewed and prescribed.⁶⁰ However, prescriptions for early, rather than late developing adolescent players are required. Frequently, aspects of talent development such as environmental and psychological influences are neglected.¹⁸ This persists despite individual psychological development and structured development pathways having been identified as critical for preventing dropout and improving participation among adolescent athletes.⁶¹

Existing models of talent development regularly evolve from case studies in closed-chain sports. Research about the strongest markers of development in team sports with less predictable demands is equivocal. Currently, talent development programs follow the results of initial selection criteria derived from isolated testing. Criteria are physically based, neglecting the crucial psychological, maturational, and game play influences on elite team sports success.⁶² Decision making, coachability, leadership, and cognitive competencies need to be considered when constructing talent pathways for team sports. Long-term monitoring of physical and psychological loads needs to occur, with greater sports science involvement in the pathway.⁶³

The framework presented in Figure 1 has the holistic development and welfare of the adolescent team sports player as its focus and accounts for the many influences in this stage of development. It is a framework, rather than a model, allowing it to be adapted to various team sport situations. The framework (Figure 1) identifies the multiple relationships within the team sport talent development pathway, and the proactive and reactive nature of development. Financial considerations are a limitation of this framework, but it is presented in the context of a best practice scenario. Current resources could be redistributed to reflect the priority that talent development requires for long-term cost benefits.

Theoretically, three groups of influence could immediately affect adolescent players. The first group of potential influence relates to performance aspects of nutrition, injury management, and physical/athletic maturation. *Game sense*, defined as sophisticated displays of initiatives during games, is also included in this first group of potential influences because it relates to an athlete's mental maturation within a team sport. The ability to objectively assess game sense remains limited. However, advances in technology now permit effectiveness of team play, and consequences of on-field initiatives to be more objectively assessed. By including potential influences on performance, the framework enhances the traditional identification practices that focus on subjective coach ratings of on-field performances and physical tests.

The second major group of influences within the framework includes culture, media, and other competing activities. The social entrenchment of these influences should be not be underestimated and needs to be understood and, if appropriate, mediated. For example, sports psychologists can assist young athletes to see beyond immediate demands and to set individual long-term goals for performance. Understanding influences is particularly pertinent for players from diverse cultures, of varying maturational status, and for whom opportunities to learn about the game have been lacking. It is possible that early physical maturers can be selected (and succeed at the adolescent level) in team sports despite inappropriate training and nutrition habits. Early success in team sports can lead to unnecessary local community and media pressures detrimental to longevity within the sport. To be more inclusive in development, coaches should work with an adolescent development

specialist who is cognizant of nutritional needs, appropriate injury management practices, and media influences in adolescents.

The third influence in the framework for talent development are the relationships among players, their peers, teammates, teachers, coaches, and parents.⁶⁴ Influences from key people in adolescents' lives are likely to impact players' decision making, motivation, training habits, skill, and game sense development. As players progress, the influence of coaches becomes more prominent.⁶⁵ Coaches, therefore, play a crucial role in team sports and individual talent development. Talent development issues should be included in coach accreditation and updates.⁶⁶ Coach progression at this level should be based on long-term talent development rather than short-term team success. Adolescent longevity and fulfilled potential in a given sport should supersede goals of premierships in junior development.

The evaluation of pathways taken by talented adolescents within each sport could include a load monitoring / adolescent development specialist. This role is the next influence in the framework (Figure 1). The role of this person would include a practical understanding of physiology, biomechanics, nutrition, and other sports science areas relevant to the talent development process. The position facilitates both proactive and reactive processes, while providing an important monitoring role. Monitoring is needed to prioritize the activities of adolescents with a view to fulfilling athletic potential, preventing burnout and injury, and nurturing longevity of sports participation. The vision is as much individual as it is team. This person could be recruited with a combined background of the team sport, and physical education and/or sports science training. Athletes with this suggested background would understand the sport, understand and be respectful of coaching and teaching the sport, and be familiar with holistic approaches to working with adolescents. Practically, the role would involve frequently working on site with coaches and providing support and education at planning and parental meetings. Coordination, monitoring, and education of competing demands (schools, clubs, representative teams) would be inherent in this role. This person would also provide links to a range of sport and medical services with expertise in adolescents. These experts should work interactively with each other and function within a network of sports science/medicine specialists. Various modes of communication can be used on a regular basis to support the specialist and his or her role. This network, combined with evidence-based load-monitoring practices would provide the ideal platform for talent development. Accreditation and ongoing education of the role should be the responsibility of the team sport's governing body.

The responsibility of implementing a holistic approach should rest with each team sport's governing body. Common practices between similar sports would permit wide-scale adaptation of the framework, but each sport should present and critically appraise specific benchmarks for the talent development pathway. Crucially, the responsibility at each stage of this development needs to be outlined.

Finally, the national sporting commissions should provide governance via a code of ethics surrounding talent development. Ideally, the code of ethics has player well-being and longevity, as well as ethical team sport behaviors, as priorities. This code should be peer reviewed, evidence based, and specific to team sports popular with team sports. The code should provide the framework for decision making at every level of participation in team sports by adolescents.

Conclusions

Talent development in team sports is a complex and dynamic interaction of social, performance, and educational factors. The pathway should acknowledge the careful progressions through periodized and educational training programs required for adolescents. The talent development framework presented here centers on an interactive approach, with the players' immediate and long-term welfare central to all programs and actions. The benefits of successful pathways in adolescent team sports extend beyond individuals and their sporting organizations. Talent development in team sports can be viewed as a sound national investment. Responsible talent development in team sports for adolescents does not lie with any single individual within the sports industry and is best accepted as a collective and complex, but worthwhile, challenge.

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