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Current Concept Review

Raising the Young Athlete: Training and Injury Prevention Strategies

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Abstract:
Participation in youth sports is gradually returning to pre-pandemic levels, with nearly two-thirds of children resuming sports at the same or higher levels than before COVID-19 (as of September 2021). While this represents a growing opportunity for increased activity, socialization, and skill development in America's young athletes, we must remain cognizant of the associated risks that threaten their long-term physical and psychological well-being. To optimize the risk-benefit ratio of the increasing involvement in organized sports, current sporting safety recommendations are needed. We sought to provide current concepts on optimal training methods, injury prevention strategies, and stakeholder education programs.

Key Concepts:
- Resistance training consistently improves strength and athletic performance, and it does not affect linear growth of children.
- Multiple-sport participation reduces injury risk without compromising future athletic prospects.
- Neuromuscular training protocols are doubly effective by improving sport performance while also lowering the risk of injury.
- Appropriately scaled-down playing fields and equipment improves the youth sporting experience, potentially fostering life-long sport participation.
- Education programs for parents and coaches likely keep young athletes safer.

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Introduction

According to the State of Play 2021 report, participation in youth sports is increasingly returning to pre-pandemic levels (47% and 17% participating at the same level and higher level than before COVID-19, respectively),[1] and the mean age of entry into organized sports is trending younger.[2] The National Council of Youth Sports reports that over one-fourth of children are involved in just a single sport,[3] reflecting an attitude shift from youth sports as recreation to an adult-driven, structured activity that aims to develop the youth's skill within a specific domain in hopes of achieving future "success."[4] Importantly, there is little to no evidence to support the notion that intense training regimens and sports specialization at a young age are necessary to attain elite performance.[5-7]

The risks of injury, burnout, and long-term health consequences from early sport specialization are of increasing concern for this vulnerable population.[8] Nonetheless, general participation in organized sports affords children numerous benefits to their physical, social, and psychological health.[9] To promote the public health benefit of childhood sport involvement while mitigating potentially harmful training approaches such as early sport specialization, we must address the variables that we can control. Parents, coaches, and players deserve physician led, evidenced-based education on how to safely optimize youth performance through training and injury prevention strategies. Accordingly, we have synthesized current concepts on the effectiveness of common training and injury prevention methods as well as stakeholder interventions to serve as a reference guide when counseling young athletes and their parents.

Pediatric Training Strategies

Resistance Training

Resistance training (RT) (Figure 1) utilizes external weight to provide progressive overload to skeletal muscles, leading to increases in strength and muscle hypertrophy.[10]

Various resistance training modalities have shown to improve agility, balance, speed, reflexes and

Figure 1. *Examples of common resistance training exercises. A) Barbell bench press, B) Barbell back squat, C) Military/Overhead barbell press.*

reactions, and timely coordination.[11] For instance, biweekly RT resulted in improvement of strength, sprint speed (20m), and agility in junior (age 15-17) male soccer players,[12] though these benefits may vary between sports based on training intensity, training volume, and exercise selection.[11] A systematic review and meta-analysis conducted by Lesinski et al. (2016) investigating the impact of RT on physical performance and muscular fitness of young athletes aged 6-18 years found that 1) RT impacts the muscle strength and vertical jump performance to a moderate level, 2) RT has minimal effects on agility, linear sprint, and sport-specific performance of young athletes, 3) the most effective RT program that enhances muscle strength consists of training sessions of >23 weeks, including 6-8 repetition of each set, and 5 sets per exercise, and 4) a training

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intensity level of 80-89% with 3-4 mins of relaxation time between the sets is optimal for improving muscle strength (Table 1).[13]

Another study of prepubertal male soccer players showed that a combination of regular soccer training and low-to-moderate load high-velocity RT (HVRT) is a safe intervention with positive effects on sprint performance, horizontal and vertical jump, and maximal strength compared to soccer training only.[15] Similarly, Taube et al. and Granacher et al. showed that HVRT can improve maximum isometric force, ultimately improving athletic performance.[16,17] Based on these results, coaches should engage young athletes in either high intensity RT or low-to-moderate load HVRT (in addition to their usual training) for enhancing performance.

Historical Concerns of Weight Training

Historically, RT in developing youth was controversial given the perceived risks of musculoskeletal injury and physeal damage, thought to potentially result in stunted growth.[18] However, recent data strongly suggests that RT is a relatively safe practice for young athletes. In a review of RT regimens for over 300 children and adolescents collectively, Milone et al. found the overall injury rate from RT in youth to be low (0.055-0.176 injuries per 100 participant hours) without any reported physeal injuries.[19] Additionally, studies by Melina and Alvarez-San Emeterio et al. found that height changes/growth spurts are unaffected by RT.[20,21] Furthermore, expert consensus supports the use of RT in young athletes. In a survey of 500 sports medicine experts, the average response to the questionnaire "resistance training should be avoided until physeal closure" was that the statement is false.[19] The current body of evidence and expert opinion consensus should help allay concerns of coaches, parents, and athletes who may still fear consequences of RT on linear growth, though of course we caution that any training regimen should be taught by an appropriately trained adult and performed in a manner that prioritizes safety, proper form, and supervision.

Effects of Age on Gains

The neuronal development occurring throughout childhood is necessary for functional development of muscle tissue and physical capabilities.[22] Myer et al. suggest that, given this neuronal bandwidth for motor skill and cognitive plasticity in the pre-adolescent period, participation in integrative neuromuscular training (INT) should begin around ages 7-10 (depending on maturity) for maximal long-term athletic benefit.[23] At a minimum, children should not begin organized sports or training before 6 years of age due to insufficient skills and

Table 1. Sample Resistance Training Program Adapted from Lesinski et al. (2016) and Lawton et al. (2012)[14]

Sample Resistance Training Program		
Monday	**Wednesday**	**Friday**
Back squat	Mid-thigh pull	Arm raises
3-4 minute rest and repeat ×5	3-4 minute rest and repeat ×5	3-4 minute rest and repeat ×5
Push press	Clean pull from floor	Military press
3-4 minute rest and repeat ×5	3-4 minute rest and repeat ×5	3-4 minute rest and repeat ×5
Barbell walking lunge	Bent over row	Barbell split squat
3-4 minute rest and repeat ×5	3-4 minute rest and repeat ×5	3-4 minute rest and repeat ×5
Bench press	Pull-up	Leg Adduction
3-4 minute rest and repeat ×5	3-4 minute rest and repeat ×5	3-4 minute rest and repeat ×5

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attention span necessary for participation.[24] Importantly, INT programming for children should account for their current level of training experience, motor skill, strength, as well as biological and psychosocial maturity.[25] Myer et al. formalized this concept as "training age", suggesting that increasing the training age of young athletes (i.e., engaging in training before and during maturation) is paramount to maximize lasting athletic benefits, as the athletic faculties developed in pre-adolescence will be consolidated and further enhanced with the neuromuscular and hormonal changes throughout puberty.[25]

Sport Specialization

There is no standard definition for sports specialization; however, it is widely accepted to mean "year-round intensive training in a single sport at the exclusion of other sports."[26] There is a growing inclination towards sport specialization,[27] though despite this social phenomenon, a systematic review by Kliethermes et al., (2020) found no evidence of higher performance or career achievement in athletes who focused on a single sport.[28] When injury risk is stratified to the degree of sport specialization, from low to high per the Jayanthi et al. continuum (Table 2), more highly specialized youth athletes have been shown to be at greater risk for injury.[29-31] Additionally, single sport athletes who specialized in sports before 14 years of age were more likely to have a history of injuries (86.9% vs. 71.4%), multiple injuries (64.6% vs. 48.8%), multiple college injuries (17.2% vs. 6.0%), greater total injuries (2.0 vs. 1.0) and require over twice as long away from play from an injury (15.2 vs. 6.5 weeks).[32]

Multi-Sport Participation as a Training Strategy

Contrary to early sport specialization, early diversification allows young athletes to develop the foundations of athleticism by acquiring fundamental skills such as agility, balance, and coordination.[34,35] Engagement in a secondary sport allows young athletes a break from the repetitive movements of their main sport (jumping, hitting, or throwing activities), which limits the risk of overuse injury and allows for diversification of motor skills,[36] improved decision making, and protection against individual sport burnout.[37] Long-term, "early diversifiers" can expect similar outcomes in elite athletics and scholarship opportunities compared to their "early specializer" counterparts. As evidence, a survey of over 700 minor league baseball players revealed that the majority of the athletes specialized in baseball after 16 years and

Table 2. Adapted Jayanthi et al. Sport Specialization Questionnaire and Injury Risk Scale with Miller et al. (2019) Recommended Modifications[33]

Table 2.1: Degree of Specialization Questionnaire	Yes (+1) or No (0)
1. Do you play a single main sport?	
2. Did you quit other sports to focus on a main sport?	
3. Do you train >8 months in a year?	
4. Have you only ever played one sport?*	

Score: 0-1 = Low Specialization, 2 = Moderate Specialization, 3+ = High Specialization.
** Additional question recommended by Miller et al. (2019) for more precise specialization/risk stratification.*

Table 2.2: Degree of Specialization	Total Injury Risk	Overuse Injury Risk	Acute Injury Risk
Low (0-1)	Low	Low	Moderate
Moderate (2)	Moderate	Moderate	Low
High (3+)	High	High	Low

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that during early childhood they engaged in a pattern of sampling several sports.[38] Furthermore, scholarship attainment was shown to be statistically equivalent between early specializers and non-specializers.[27]

Training Sequencing Effects

The order in which different types of training are performed (i.e., sequencing) can impact the young athlete's performance via synergistic effects of training and physical conditioning.[39] A study investigated the sequencing effects of plyometric training and balance (Figure 2A-B) on physical performance of young soccer players (12-13 years) showed that 4 weeks of balance training followed by 4 weeks of plyometric training demonstrated superior performance in the triple hop, balance, and reactive strength when compared to plyometric training followed by balance training.[15] Other recent literature investigates the use of plyometrics before or after sport-specific training. For example, a skating-specific study examined the use of plyometric training before or after the skateSIM (specialized training equipment to improve skating posture and speed, not commercially available) and found greater improvement in skating-sprint performance with plyometrics performed before rather than after the skateSIM.[40] In addition, Ramirez-Campillo et al., studied the sequencing effects of plyometric jump training (PJT) applied before (PJT-B) or after (PJT-A) regular soccer training on measures of physical fitness in young players and showed that PJT-B has larger training-induced effects on physical fitness.[41] Furthermore, plyometric-based neuromuscular training performed before compared to after tennis practice was found to improve sport performance in prepubertal athletes (age, 12.9 ± 0.4 years).[42] Altogether, these studies suggest a clear performance benefit in young athletes when plyometric training is conducted *before* sport-specific training, though more research is needed to determine the optimal sequencing of training elements within a neuromuscular training protocol.

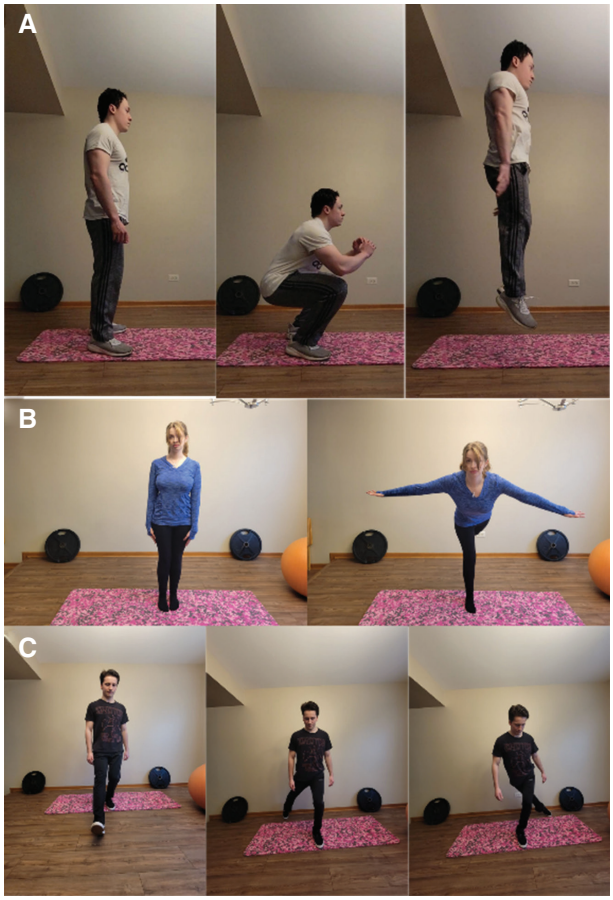

Figure 2. *Various examples of plyometrics and balance exercises. A) Squat-jump, B) Single-leg balance ("airplane" position), C) Y-balance test.*

Balance Training

The correlation-causation vector between strength and balance is not clear and may be a result of synergy between the faculties, both of which are fortunately valuable for young athletes to develop.[43,44] A recent study analyzing the association of dynamic balance and lower limb muscle quality in young athletes (16 ± 1.6 years) found that some isometric strength tests positively correlate with the Y-Balance test (Figure 2C), suggesting that strengthening lower limb muscles may improve dynamic balance.[45] Additionally, balance has a significant impact on sports-specific skills and strength in different sports.[46,47] For instance, in young soccer players balance was found to be positively correlated with back extensor strength (r = 0.48 – 0.79) and power (r = 0.51 – 0.82).[48] While a single balance training protocol is unlikely to satisfy the unique demands of each sport, a recent systematic review by Brachman et al. suggests that balance itself as a skill can be improved with balance programming that lasts for 8 weeks, with two 45-minute sessions per week.[43]

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Injury Prevention in Young Athletes

Risk Factors and Overuse Injuries

In a study of 1483 youth soccer players over three seasons, Kucera et al. found that a prior injury is the principal predictor of future injuries,[49] underscoring the importance of injury prevention as prophylaxis. Understanding the intrinsic and extrinsic factors that comprise total injury risk[50] and targeting interventions toward the most contributory risk factors is widely accepted as a general strategy to mitigate injury risk most effectively.[51] Reducing the risk and incidence of overuse injuries is of particular interest given the close association of this type of injury with sport specialization.[8] As one example, tendinopathies are the most frequent overuse injuries in pediatric athletes,[52] in which repeated tendon strain is the most predictive risk factor for tendinopathic injury.[53,54]

Formal Injury Prevention Programs

Injury prevention programs (IPPs) are becoming more common in youth sports to address high rates of injuries (Figure 3).[55] A recent systematic review by Hanlon et al. found that the FIFA 11s were the most common IPPs in youth soccer and that exercise-based IPPs reduced injury rates in young athletes by up to 46%. They additionally identified the degree to which certain intrinsic risk factors were mitigated by these programs. Of the intrinsic risk factors that improved after the interventions (strength, coordination, posture, balance, and speed), strength improved most consistently (mean improvement: 11.3%).[56] A three-part video produced by

Figure 3. *Examples of common exercises comprising injury prevention programs. A) Plank, B) Side plank, C) Lunge, D) Side lunge.*

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University of Iowa Sports Medicine demonstrates the entire FIFA 11 injury prevention program (Part 1, Part 2, Part 3). Similarly, the "SHRed Injuries Basketball" program was shown to reduce ankle and knee injuries in young basketball players by 36%.[57]

While some IPPs are sport-oriented, others focus on specific anatomy at high-risk for injury. In a study on high school female soccer and basketball players, Campbell et al. found that correcting abnormal movement patterns, such as dynamic knee valgus, is the most effective strategy for preventing anterior cruciate ligament (ACL) injuries.[51] Arundale et al. supports this finding and recommends certain exercises (plyometrics, balance, etc.), external cues, video, or real-time feedback as parts of effective ACL IPPs.[58] Additionally, for prevention of Achilles tendinopathic injuries, programming is optimized with 85-90% maximum voluntary contractions maintained for 3 seconds[59-61] in which the mode of contraction (concentric vs. eccentric) does not appear to play a significant role.[62] Ultimately, we recommend initiating an IPP best suited to the individual needs of the young athlete, and emphasize that adherence to a prevention program is necessary for optimal injury prevention.[63]

Pitch Counts

Although implementing pitch count restrictions on youth athletes in baseball and softball is the most effective way to prevent overuse injuries related to throwing, such as elbow pain and reduced elbow flexion,[64,65] noncompliance remains a significant challenge, especially in tournaments and showcases.[66] Major League Baseball's Pitch Smart guidelines offer age-specific daily pitch count limits and required rest between pitching outings (Table 3),[67] and pitch-equivalent throws such as warmups should be factored with an athlete's official pitch count to better prevent throwing injuries.[68] In particular, youth pitchers competing in warmer-climates need to be monitored more closely for signs of fatigue and arm pain since they are at higher risk for injury due to the heat.[64]

Multimodal Training as a Prevention Strategy

Neuromuscular training (NMT) is defined by Myer et al. (2011) as a training program composed of both general and (sport) specific strength and conditioning exercises. Within this definition is resistance training, dynamic stability, balance, core strength, plyometrics, and agility (Figure 4).[23] Hübscher et al. performed a systematic review concluding that adolescent athletes performing speed, power, and endurance exercises together significantly decreased the risk of lower limb, acute knee, and ankle sprain injuries by nearly 50% on average.[69] Evidence by Hanlon et al. also suggests that in youth soccer players, strength followed by coordination training had the largest contributions to injury prevention, while speed training was least effective.[56] Lastly, NMT has

Table 3. Pitch Count Recommendations

Age	Daily Pitch Maximum	0 Days Rest	1 Days Rest	2 Days Rest	3 Days Rest	4 Days Rest	5 Days Rest
7-8	50	1-20	21-35	36-50	N/A	N/A	N/A
9-10	75	1-20	21-35	36-50	51-65	66-75	N/A
11-12	85	1-20	21-35	36-50	51-65	66-85	N/A
13-14	95	1-20	21-35	36-50	51-65	66-95	N/A
15-16	95	1-30	31-45	46-60	61-75	76-95	N/A
17-18	105	1-30	31-45	46-60	61-80	81-105	N/A
19-22	120	1-30	31-45	46-60	61-80	81-120	106-120

Major League Baseball's Pitch Smart Guidelines for Adolescents Based Upon Age and Days of Rest Between Pitching Outings.

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Figure 4. *Select examples of various types of exercise which may be included in a neuromuscular training (NMT) program. Examples of A) Resistance training (barbell row), B) Balance training (single leg balance), C-D) Core strength and dynamic stability exercises (yoga ball plank and yoga ball hip bridge, respectively). Video demonstrations of NMT plyometric and agility exercises can be found at The University of Calgary Sport Injury Prevention Research Centre (SIPRC) YouTube channel.*

been shown to protect against basketball, volleyball, and soccer injury in both high school and middle school populations[70] and consistently reduces injury risk when implemented during the sport season.[71]

To achieve maximal benefit, the intensity of NMT should be enough to represent the fatigue and conditions that young athletes encounter in competitions, as the neuromuscular system is primed to operate in an economical and safe fashion.[72] However, athletes and coaches should stop the training session if an athlete's form declines due to fatigue to prevent injury, and coaches should provide feedback to athletes after each NMT session to refine their technique.[73] Furthermore, a meta-analysis of ACL injury prevention programs in young female athletes showed that NMT sessions that lasted over 20 minutes and two or more NMT sessions per week (compared to one) were correlated with a decreased ACL injury risk.[74] In summary, an appropriate NMT program is consistent with a young athlete's competition demands and is implemented over a period of at least 20 minutes for at least two sessions per week.

Do Warm-Ups Matter?

Any former high school athlete remembers warm up drills, but did these actually help?

In a randomized control trial, Padua et al. found that NMT warm-up programs, which include aerobic, agility, balance, and strength exercises, lowered the risk of enduring an ankle sprain injury by 32% in adolescent female basketball players.[75] Additionally, plyometrics and exercises that drill rapid changes in direction mitigate losses in agility and endurance incurred during mandatory breaks in sports.[76] Furthermore, the efficacy

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of warm-up NMT programs when supervised only by coaches who received training on implementing these programs compared to physiotherapists produced similar results in a cluster-randomized trial on youth female soccer players.[77] Thus, appropriately trained coaches may oversee NMT warm-up programs for young athletes without requiring additional personnel,[73] and it is overall worthwhile to implement NMT warm-ups for young athletes.

The Role of Rest in Injury Prevention

As caused by repetitive microtraumas without sufficient rest, sport specialization in young athletes engenders an increased risk for overuse injuries, but interestingly, not acute injuries, since these athletes are more likely to engage in highly routinized and repetitive training and competitions.[29] Additionally, Pasulka et al. illustrates that athletes who tend to participate in individual sports compared to team-based sports have a lower proportion of acute injuries and higher rate of overuse injuries, which may be partly explained by the observation that athletes participating in team-based sports train on average 1.5 hours less per week than individual sport athletes.[78] Overall, young athletes should participate in sports-related activities for less than or equal to their age in number of hours per week and take at least 1 to 2 days rest days per week.[29,79] Similarly, limiting the intervals and intensity of sport participation is recommended by the American Medical Society for Sports Medicine in a 2014 position statement. This position statement also recommends that young athletes should take breaks from individual sports every 2 or 3 months.[79] During these breaks, athletes are encouraged to partake in other sports, cross-training, and unstructured free play to build up lifelong sports skills across multiple domains without subjecting themselves to the same microtraumas.[36]

The Value of Free Play

Young athletes who spent more than twice as much time in structured sports training compared to unstructured free play (Figure 5) were more likely to endure overuse injuries.[29] Smucny et al. argues that diversifying forms of activity and training contributes to preventing

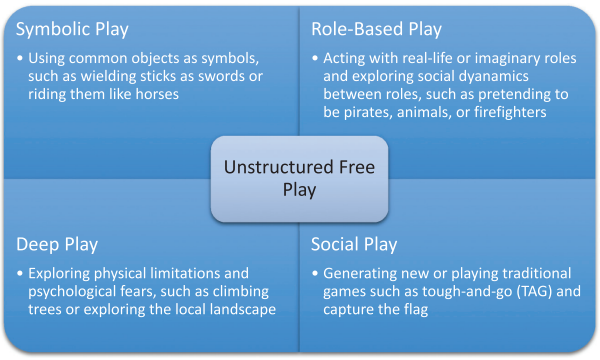

Figure 5. *Unstructured free play among adolescents is child-driven and takes upon multiple forms in which children often combine elements of different types of free play as they wish.*

overuse injuries, particularly in specialized athletes, and this effect on adolescents is enhanced by increasing unstructured free play relative to structured sport.[80] Per its nature, free play among kids without set rules does not revolve around cultivating highly specific sport skills, but rather contributes to "a strong foundation centered around core physical principles, such as flexibility, endurance, and balance."[80] While training for sports develops highly specific skills, free play cultivates general fitness skills. By balancing these two modes of physical engagement, the risk of overuse injury in young athletes is mitigated.[36]

Equipment & Rule Modifications

Rule modification in youth sports aimed to reduce injury risk is focused on mitigating the circumstances that pose excessive danger to athletes. For example, Black et al. found that the injury risk was halved in Canadian youth ice hockey Pee Wee (ages 11 and 12) leagues after a nationwide law eliminated checking (i.e., crashing into) players.[81] Similarly, rule modification measures, such as reducing high-speed player-to-player contact, effectively prevent injury even when restricted to extra-competition contexts such as practices.[82]

Furthermore, practicing with weighted equipment in certain sports is not recommended. For example, weighted baseball throwing is often used to increase pitch velocity during youth (13-18 years old) baseball practice, but this increases the rate of elbow injury.[83]

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Alternatively, a study of 44 youth pitchers (aged 10-17) showed that using lighter baseballs in training increased pitch velocity without significantly increasing injury risk.[84] Additionally, equipment modification to match the abilities and size of youth athletes is a crucial and often overlooked aspect of injury prevention.[85] Equipment scaled to youth athletes allows unencumbered movement and proper proportionality, providing for increased skill acquisition and satisfaction as demonstrated by Buszard et al.[86] Furthermore, using pi ratios to scale court dimensions to fit the abilities of youth athletes, Broadbent et al. remarked that body size appropriate playing fields in youth sports will encourage adolescents to become "life-long participants."[85]

Stakeholder Education Programs

Role of Coach Education Programs

Existing evidence suggests that coaches may have a greater influence on youth sports participation compared to parents and teachers.[87-89] To that end, there is a need to gauge the understanding of coaches regarding the mental health risks of early sports specialization since it can have a long-lasting impact on the pediatric athlete's developmental trajectory.[89] Recommendations written by Bean and associates highlight the need for a fun and motivational training environment by the coaches to foster life skills, develop resilience, and meet the needs of the youth athlete.[90] Overall, it is well known that coaches play a pivotal role in monitoring the physical maturation, cognitive development, and motivation of young athletes, which all play a critical role in the optimal athletic performance during individual events or competitive seasons.[91]

Despite this known importance in the role of coaches, previous reports have suggested that coach awareness regarding recommendations for safe sports participation is limited. For instance, Yukatake et al. administered questionnaires assessing knowledge of pitch limit recommendations for preventing throwing injuries to Japanese baseball coaches. In that cross-sectional study, they found that only 40% of coaches had proper knowledge regarding the official guidelines,[92] with similar results recapitulated in other studies.[93] This suggests a need for more intensive education for coaches regarding guidelines on sports specialization and safe practice/play recommendations to prevent injuries to youth athletes at an early stage in their careers.

Table 4. Summary Recommendations for Coaches and Parents to Permit the Optimal Experience and Development of Their Young Athletes

Coaches SHOULD	**Parents SHOULD**
Create a fun and motivational training environment	Allow child's interests to guide participation
Monitor the physical and cognitive development of young athletes	Support "sport sampling"
Understand their athlete's motivations	Support healthy habits outside of sports like good nutrition and adequate sleep
Know their sport-specific safety guidelines (e.g., pitch limitations for baseball)	Model good sportsmanship at games and events
Coaches SHOULD NOT	**Parents SHOULD NOT**
Adopt a controlling and intolerant coaching style	Force their child into a particular or singular sport
Ignore the safe practice/play recommendations of sports organizations and health professionals	Display poor sportsmanlike behavior (e.g., berating coaches/referees/officials, yelling, starting fights)
Emphasize winning above learning and skill progression	Favor sport participation at the cost of academics and social life

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Role of Parent Education Programs

Parents are key influences in their children's level of sport participation.[94,95] Recently, Logan et al. detailed seven ways parents can positively and effectively support their young athlete's involvement in sport: 1) Let the child's interest determine participation, 2) Be aware of the child's physical and developmental ability and what skills are needed for the organized sports, 3) Support fun, learning, and making progress in skill development, 4) Demonstrate positive support for *participation*, *not for winning*, 5) Support "sport sampling" to develop multiple skills, promote enjoyment, and reduce injury risk, 6) Be aware that organized sports participation alone may not offer enough physical activity for optimal health, and 7) Support good nutrition and adequate sleep.[9] Additionally, Michele LaBotz, MD, and Fellow of the American Academy of Pediatrics (FAAP), recently authored a parent checklist aimed to create a safe environment and prevent abuse in youth sports.[96] Lastly, the Society of Health and Physical Educators (SHAPE) America outlines evidence-based strategies for young athlete parent education programs.[97] Although hard data on the effectiveness of these programs is limited, we agree with the strong foundational evidence and thus recommend the implementation of parental education programs for the optimal young athlete experience.

Summary

Just as youth participation in sports is steadily increasing, so too is the need for practical strategies ensuring their top performance while minimizing risk of injury (both physical and mental). We have summarized current concepts and provided evidence-based recommendations for training, injury prevention, and stakeholder education programs to facilitate these desired outcomes in young athletes.

Additional Links

- *Pitfalls of Pediatric and Adolescent Sports Specialization, JPOSNA® May 2021*
- *Sleep Optimization in the Young Athlete, JPOSNA® August 2021*
- *STOP Sports Injuries, National Council of Youth Sports (ncys.org)*
- *Mandatory Parent Education Programs (shapeamerica.org)*
- *Creating a Safe Environment to Prevent Abuse in Youth Sports: A Parent Checklist, healthychildren.org*

Disclaimer

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