

Intrinsic Risk Factors

- History of previous injury
- Anatomical alignment
- Muscle imbalances
- Inflexibility
- Muscle weakness
- Instability / laxity



Extrinsic Risk Factors



- Training and recovery
- Equipment
- Poor technique
- Environment

Overuse-Prone Profiles

Males

Tall stature
Endomorph body structure
Less static strength
More explosive strength
Decreased muscle flexibility
High degree of ligamentous laxity
Large Q-angle

Females

Tall stature
Decreased upper extremity strength
Less static strength
More explosive strength
High limb speed
Increased muscle tightness
Increased ligamentous laxity
Greater leg length discrepancy
Pronation
Large Q-angle

Risk Factor Identification

- Arm pain and fatigue $EC=A$ (Lyman 2001, Olsen, 2006)
- Decreased throwing performance $EC=A$ (Lyman, 2001)
- Volume of pitches $EC=A$ (Lyman 2001, 2002; Olsen, 2006)
 - 9-14 year olds: 75 pitches in a game, 600 pitches in a season, and 2000-3000 pitches in a year
 - 15-18 year olds: 90 pitches per game; no more than 2 games per week
- Anatomical factors $EC=C$ (DiFiori, 2002; Lysens, 1989)

Risk Factors for Lower Extremity Injury

- Multi-directional balance
 - Predictive of overall injury risk
 - OR 3.0 (95% CI: 1.5-6.1)
- Physical maturation
 - Boys <14 y/o more likely to sustain LE overuse injury



Suggested Assessment for Runners

Intrinsic

- Standing Q angle
- BMI
- Navicular Drop
- Hip abduction, extension and ER strength
- Menstrual cycle

Extrinsic

- Preseason activity level
- Modify training volumes
- Early and continued participation in ball sports with 360° playing field

Education and Supervision

- Athletes for S&S of overuse $EC=A$ (Lyman 2001, Olsen, 2006)
- Coach certifications $EC=B$ (FIMS, 1998; Caine, 2006; Ransone, 1999; Valovich McLeod, 2008)
 - Sport safety, techniques, psychosocial, health/medical concerns
- Adequate supervision $EC=C$ (FIMS, 1998; ACSM, 1993)
- General knowledge of S&S of overuse $EC=C$ (Hodson, 1999)

Coaching Education Programs

Organization	Web Address
National Athletic Trainers' Association: Sports Safety for Youth Coaches	www.nata.org
National Youth Sports Coaches Association	www.nays.org
American Sports Education Program	www.asep.com
National Center for Sports Safety	www.sportssafetly.org/prepare
American Red Cross	www.redcross.org
National Federation of State High School Associations	www.nfhslearn.com

Sport Alterations

- Limit total volume of physical activity $EC=A$ (Lyman, 2001, 2002; Olsen 2006; Loud, 2005)
- Young pitchers avoid curves & sliders $EC=A$ (Lyman, 2002)
- Pitching limits $EC=A$
 - 9-14 y/o = 75/game and 600/season (Olsen, 2006)
 - HS = 90/game (Andrews, 1996)

Sport Alterations

- 16-20 hours/week of vigorous physical activity
 $EC=A$ (Loud, 2005)
- Only play one overhead throwing sport at a time
 $EC=C$ (Cassas, 2006; Benjamin 2005; Carson, 1998)
- Avoid playing the same sport year round $EC=C$
(Cassas, 2006; Benjamin 2005; Carson, 1998)

Throwing

- Avoid pitching with arm fatigue
- Avoid pitching with arm pain
- Avoid pitching too much – future research needed, but the following general limits are:
 - Avoid pitching more than 80 pitches per game
 - Avoid competitive pitching more than 8 months of the year
 - Avoid pitching more than 2500 pitches in competition per year

Throwing

- Monitor pitchers with the following characteristics closely for injury
 - Those who regularly use anti-inflammatories to “prevent” injuries
 - Regularly starting pitchers
 - Pitchers who throw >85mph
 - Taller and heavier pitchers
 - Pitchers who warm up excessively
 - Pitchers who participate in showcases

Throwing

- 10-year prospective study
 - 9-14 years of age
 - Interviewed annually
- 5% cumulative injury rate
- Pitch ≥ 100 innings per year were 3.5x more likely to be injured
- Pitchers who also played catcher had a trend towards increased risk of injury

Throwing

- High school baseball players account for 13% of patients undergoing UCL reconstruction (Petty, 2004)
- Survey of healthy youth baseball players (Makhni, 2014)
 - 26.6% report prior injury to arm
 - 11% reported playing with pain
 - 44% had arm fatigue sometimes, often or always
 - 53% felt arm pain limited how hard they could throw sometimes, often or always

MLB Pitch Smart

AGE	DAILY MAX (PITCHES IN GAME)	REQUIRED REST (PITCHES)				
		0 Days	1 Days	2 Days	3 Days	4 Days
7-8	50	1-20	21-35	36-50	N/A	N/A
9-10	75	1-20	21-35	36-50	51-65	66+
11-12	85	1-20	21-35	36-50	51-65	66+
13-14	95	1-20	21-35	36-50	51-65	66+
15-16	95	1-30	31-45	46-60	61-75	76+
17-18	105	1-30	31-45	46-60	61-75	76+
19-22	120	1-30	31-45	46-60	61-75	76+

<http://m.mlb.com/pitchsmart/pitching-guidelines/>

App Store > Sports > Abracadabra Health



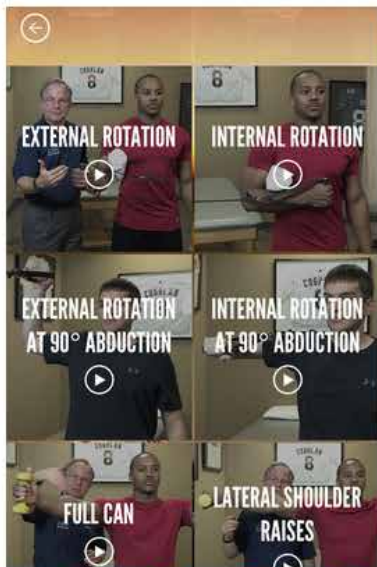
Throw Like a Pro: Throw Faster, Stronger, and Safer with Dr. James Andrews and Dr. Kevin Wilk 4+

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Swimming

Level	Category	Skill Objective	Training Objective	Commitment
1	Sport Preparation (6-9 yrs)	<ul style="list-style-type: none"> Stroke Technique All four strokes 	<ul style="list-style-type: none"> Aerobic development Joy of participation 	<ul style="list-style-type: none"> 2-3 sessions per week 30-60 minutes
2	Basic Skill Development (8-11 yrs)	<ul style="list-style-type: none"> Teaching fundamentals Technique Balance and coordination in the water All strokes, all events Develop athleticism 	<ul style="list-style-type: none"> Continued progressive aerobic development Emphasis on kicking Swim practice skills Self-management and independence 	<ul style="list-style-type: none"> 2-4 sessions per week 30-60 minutes Encourage other activities/sports Intra-squad competition or low pressure competition
3	Basic Training Development (11-14 yrs)	<ul style="list-style-type: none"> Strong foundation in all four strokes No specialization Stretching, calisthenics, own body weight exercise Develop athleticism 	<ul style="list-style-type: none"> Aerobic endurance Maintain good technique on low intensity interval work Focus preparation on 200 IM and 200/500 free Kicking emphasis Learn to compete 	<ul style="list-style-type: none"> 4-6 sessions per week 60-90 minutes Year round participation Encourage other activities/sports while understanding need to meet attendance expectations

Swimming

Level	Category	Skill Objective	Training Objective	Commitment
4	Progressive Training (13-18 yrs)	<ul style="list-style-type: none"> • Maintain and refine technique • Core body conditioning • Additional dryland such as medicine balls, free weights 	<ul style="list-style-type: none"> • Focus switches to training rather than fundamentals • Aerobic/Increased yardage • Introduction to anaerobic threshold work and speed development • Focus on 400 IM and mid-distance freestyle 	<ul style="list-style-type: none"> • 6-10 sessions per week • 90-120 minutes • Year round including LC competition • Commit to swimming • Shorter breaks to minimize deterioration of aerobic base
5	Advanced Training (14 and over)	<ul style="list-style-type: none"> • Attention to detail • Efficiency • Technical precision • Strength training 	<ul style="list-style-type: none"> • Distance based physiological training • All energy systems with heavy aerobic emphasis • Specificity of training for stroke and distance • Still train for and compete in wide variety of events 	<ul style="list-style-type: none"> • 8-10 sessions per week • 90-120 minutes • Year round • High commitment level • Short breaks to minimize deterioration of aerobic base

Training and Conditioning

- Preventative program $EC=A$ (Emery, 2005; Junge, 2002; Olsen, 2005)
 - NM control, balance, coordination, flexibility, strengthening
 - Especially those with history of LE injury
- General fitness program $EC=C$ (ACSM, 1993; DiFiori, 2002; Flynn, 2002; Faignebaum, 2000)
- 1-2 days off per week $EC=C$ (Mountjoy, 2008; Brenner, 2007)
- 10% rule $EC=C$ (ACSM, 1993; Brenner, 2007)

Prevention Programs

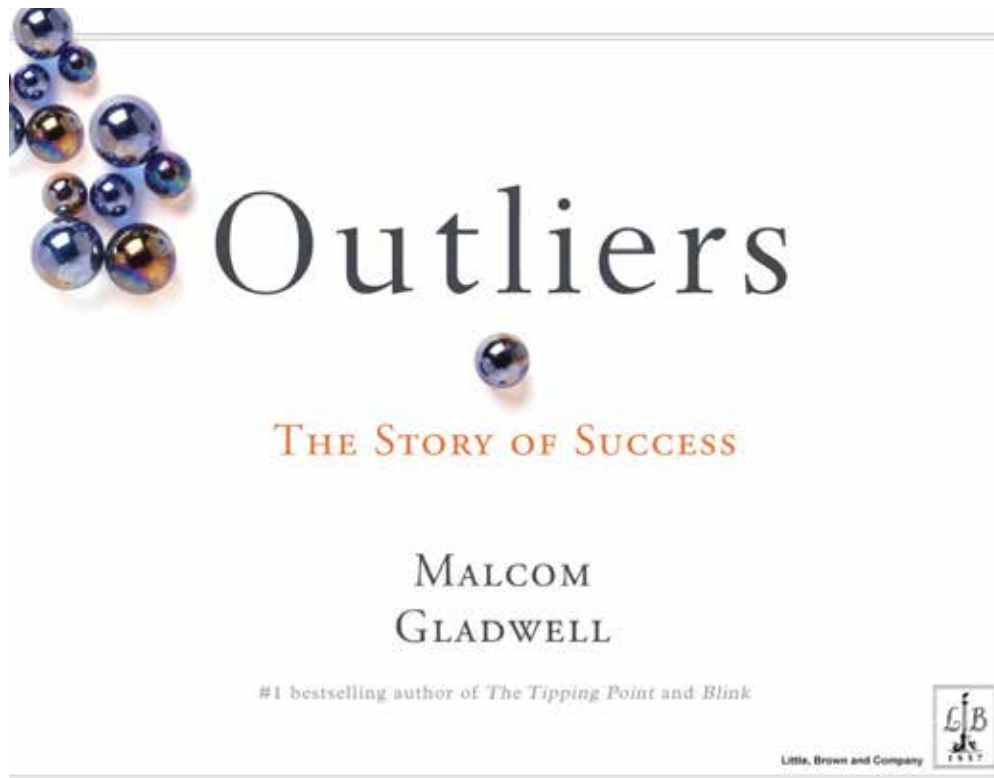
- 19% of injuries were overuse injuries to the knee
- Significant $\bar{}$ in players injured in the intervention group compared to controls for overall injuries, lower limb injuries, as well as acute knee and ankle injuries

	Intervention	Control
Anterior leg pain	5 (27.8%)	20 (51.3%)
Knee pain	5 (27.8%)	6 (15.4%)
Low Back pain	3 (16.7%)	5 (13.8%)

Prevention Programs

- Soccer injuries in youth
 - 37% were overuse
- Total injuries (per player per year)
 - Intervention = .76 (\pm .89) *sig lower than control ($p < .01$),
 - Control = 1.18 (\pm 1.04)
- Overuse injuries –
 - Intervention = .26 (\pm .48) *sig lower than control ($p < .05$),
 - Control = 0.44 (\pm .65)

Early Specialization vs. Sports Sampling



10,000 hours of "deliberate practice" are needed to become world-class in any field

Early Specialization vs. Sports Sampling



Typical Aspects of Early Sports Specialization



Going Pro?

TABLE 2. Estimated percentages of athletes moving from high school to college, high school to professional, and college to professional in several sports in the United States.^a

	Men's Sports					Women's Basketball
	Basketball	Football	Baseball	Ice Hockey	Soccer	
High school athletes						
Total	549,500	983,600	455,300	29,900	321,400	456,900
Seniors	157,000	281,000	130,100	8500	91,800	130,500
College freshman athletes	4500	16,200	7300	1100	5200	4100
High school to college, %	2.9	5.8	5.6	12.9	5.7	3.1
College athletes						
Total	15,700	56,500	25,700	3700	18,200	14,400
Seniors	3500	12,600	5700	800	4100	3200
Athletes drafted	44	250	600	33	76	32
College to professional, %	1.3	2.0	10.5	4.1	1.9	1.0
High school to professional, %	0.03	0.09	0.46	0.39	0.08	0.02

^aAdapted from the National Collegiate Athletic Association (47), percentages are based on estimated data and thus are approximations. Estimates for the professional level are based on athletes drafted; there is no guarantee that they qualified for the playing roster.

TABLE 1
Evidence Regarding Early Sport Specialization to Achieve Elite Status^a

Study	Sport	Athletes	Study Conclusions
Barynina and Vaitsekhovskii ⁵	Swimming	Elite Russian swimmers	Swimmers who specialized before 11 years of age spent less time on a national team and retired earlier than late specializers.
Carlson ⁹	Tennis	10 elite, 10 near-elite	Elite players began intense training and specialized later than near-elites (after 13 years vs 11 years).
Lidor and Lavyan ³⁰	Multiple sports	63 elite, 78 near-elite	Elite athletes were more likely than near-elites to begin intense training after age 12 and were more likely to have played more than 1 sport in their developmental years.
Moesch et al ³⁸	Multiple sports	148 elite, 95 near elite	Elite athletes began intense training at a later age vs near-elites. Near-elites has more hours of training at a young age (9-15 years).
Gullich and Emrich ²⁰	Olympic sports	1558 German athletes, elite and near-elite	Elite athletes began intense training and competition in their sport later than did near-elites. More elites participated in more than 1 sport from age 11 years than did near-elites.

Against Early Specialization

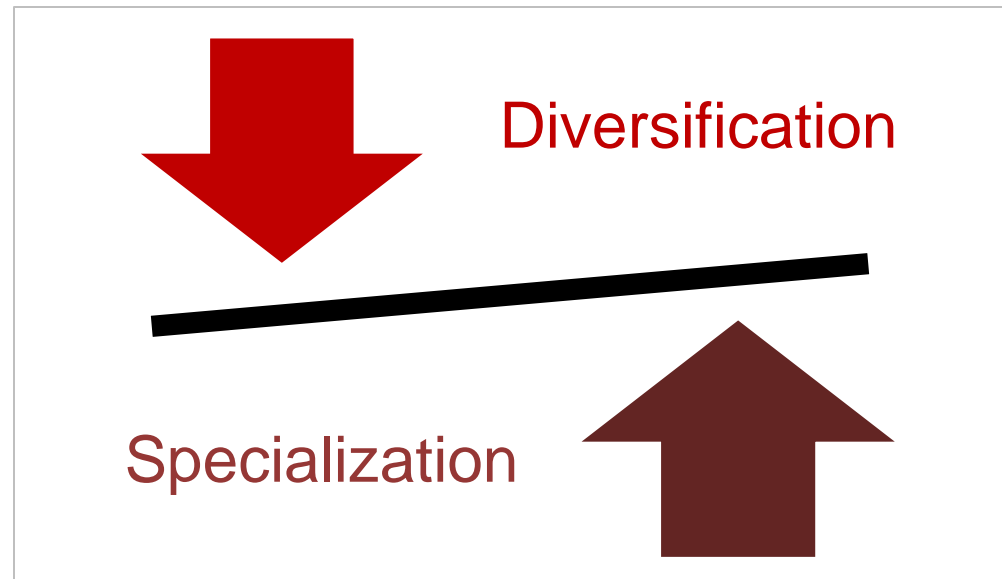
- Avoid overuse injury
- Allow proper rest
- Cross sport skill development
- Maintain interest in sport
- Prevent social isolation
- Prevent burnout
- Prevent overdependence

For Early Specialization

- Gain competitive edge
- Develop and hone skills faster
- Early talent recognition
- Increase opportunity for scholarships or professional contracts

Specialization

- Potential risks
 - Social isolation
 - Burnout
 - Overdependence
 - Manipulation
 - **Injury**
 - Compromised growth and maturation



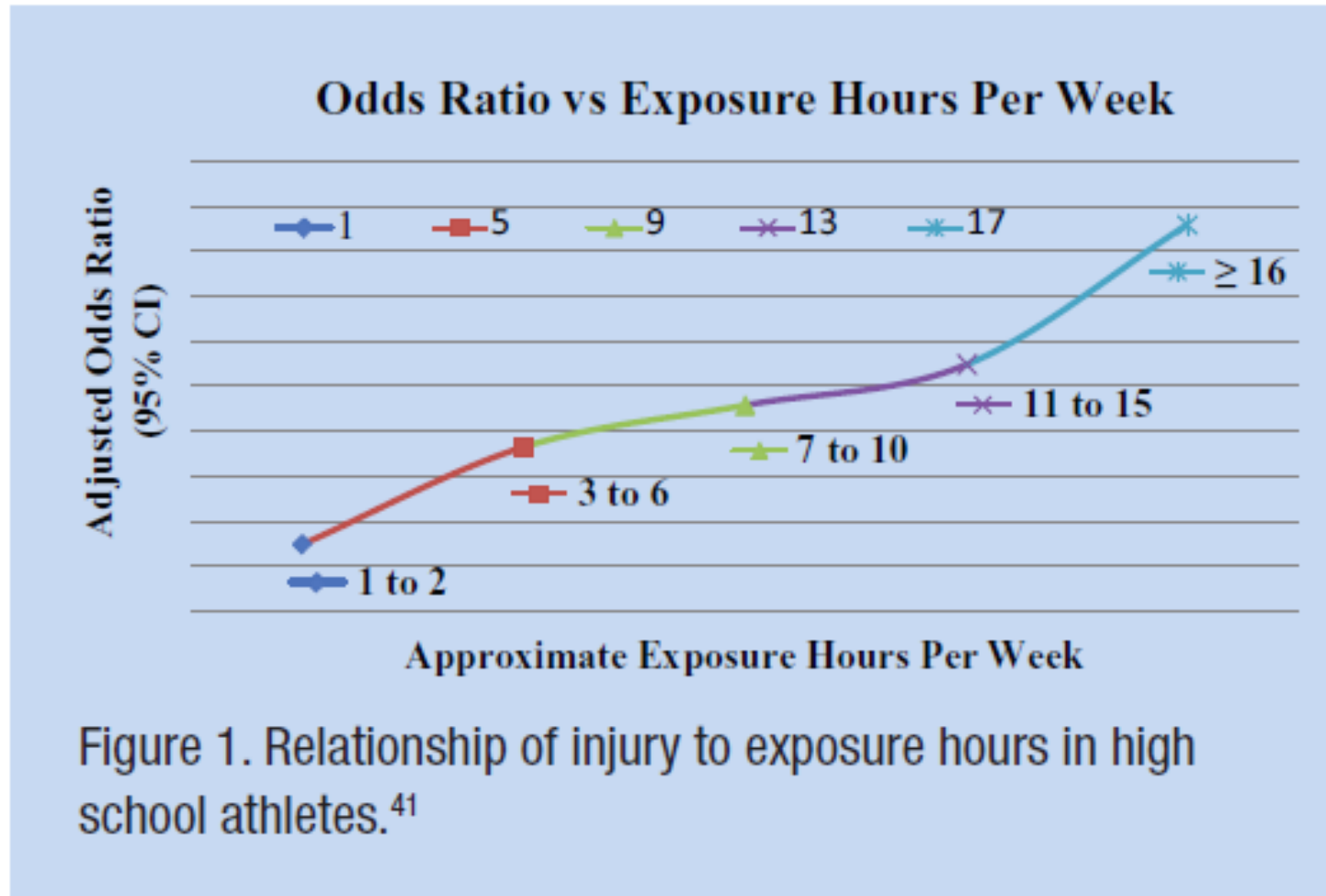
Specialization & Injury Risk

Table 1. Degree of sports specialization and risk of all-cause injuries^a

Degree of Specialization	Risk of Injury	Risk of Serious Overuse Injury	Risk of Acute Injury
Low specialization (0 or 1 of the following): Year-round training (>8 months per year) Chooses a single main sport Quit all sports to focus on 1 sport	Low	Low	Moderate
Moderately specialized (2 of the following): Year-round training (>8 months per year) Chooses a single main sport Quit all sports to focus on 1 sport	Moderate	Moderate	Low
Highly specialized (3/3 of the following): Year round training (>8 months per year) Chooses a single main sport Quit all sports to focus on 1 sport	High	High	Low

^aReproduced with permission from Jayanthi et al.⁴⁰

Specialization & Injury Risk



Specialization & Injury Risk

- Single-sport athletes (Hall, 2015)
 - 4x greater risk of Osgood Schlatter, SLJ, patellar tendinopathy
 - 1.5x greater risk of PFPS
- Sports-specialized training (Jayanthi, 2015)
 - Independent risk for injury (odds ratio [OR], 1.27; 95% CI, 1.07-1.52; $P < .01$)
 - Serious overuse injury (OR, 1.36; 95% CI, 1.08-1.72; $P < .01$)

Specialization & Injury Risk

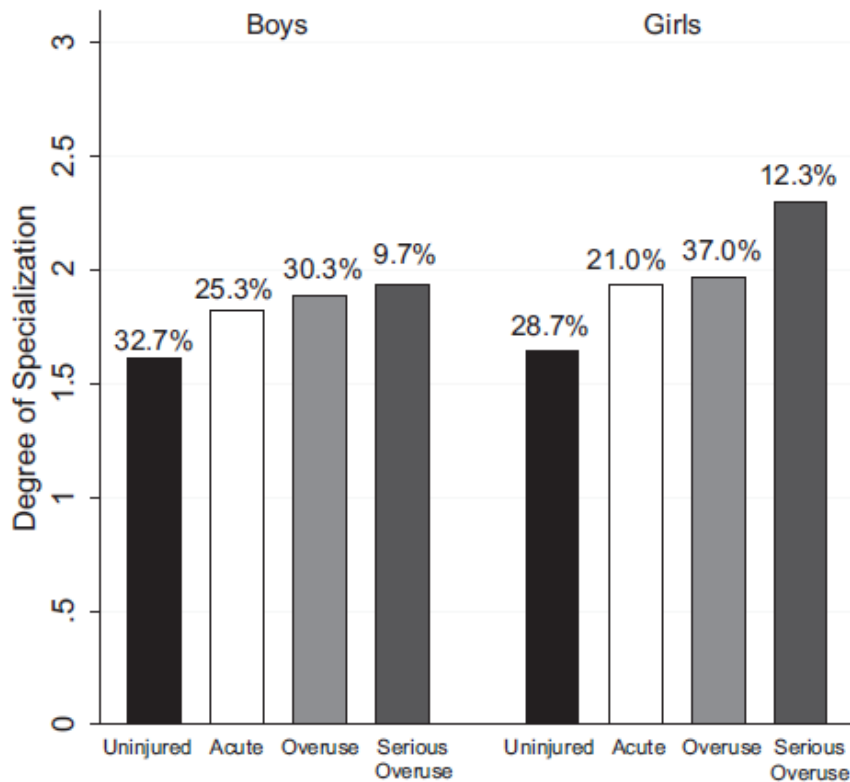


Figure 2. Degree of sports specialization by injury type and sex.

- ↑ risk of injury and serious overuse injury among young athletes who specialize in 1 sport
 - Independent of training volume and age
- Risk of injury, overuse injury, and serious overuse injury
 - Increases as the degree of specialization increases

Table 1. Seven postulates associated with the Developmental Model of Sport Participation^a

Postulate 1	Early diversification (sampling) does not hinder elite sport participation in sports where peak performance is reached after maturation
Postulate 2	Early diversification (sampling) is linked to a longer sport career and has positive implications for long-term sport involvement
Postulate 3	Early diversification (sampling) allows participation in a range of contexts that most favorably affects positive youth development
Postulate 4	High amounts of deliberate play during the sampling years build a solid foundation of intrinsic motivation through involvement in activities that are enjoyable and promote intrinsic regulation
Postulate 5	A high amount of deliberate play during the sampling years establishes a range of motor and cognitive experiences that children can ultimately bring to their principal sport of interest
Postulate 6	Around the end of primary school (around age 13 years), children should have the opportunity to either choose to specialize in their favorite sport or to continue in sport at a recreational level
Postulate 7	Late adolescents (around age 16 years) have developed the physical, cognitive, social, emotional, and motor skills needed to invest their effort into highly specialized training in 1 sport

^aReproduced with permission from Côté et al.⁹

Table 2. Recommendations for stage of specialization and sport^a

Type of Sport	Recommended Stage of Specialization
Gymnastics, diving, figure skating	Early adolescence
Team sports, tennis, golf	Middle adolescence
Endurance sports, track, distance events	Late adolescence

^aAdapted from Jayanthi et al.²⁷

Delayed Specialization

- Encourage multiple sports and activities $EC=C$
(ACSM, 1993; FIMS, 1998)
- Discourage specialization <10 years old $EC=C$
(ACSM, 1993; FIMS, 1998)
- Time off $EC=C$ (Brenner, 2007)

Organizations Against Early Sports Specialization

- National Athletic Trainers' Association
- American Medical Society for Sports Medicine
- American Academy of Pediatrics
- International Society for Sports Psychology
- World Health Organization
- International Federation of Sports Medicine
- National Association for Sports and Physical Education

Evidence for Prevention

$EC=A$

- Sport alterations
- LE prevention programs

$EC=B$

- Risk factor identification
- Education/Supervision

$EC=C$

- Delayed specialization (now B)
- Injury surveillance
- PPE

Evidence for Prevention

$EC=B$

- Limiting participation time
- Monitoring of training workload
- Pre-season conditioning programs
- Neuromuscular training programs

$EC=C$

- Proper sizing of equipment
- Emphasis on skill development rather than competition
- Individual modifications to participation time

Summary Findings

EC=A

- All overuse injuries are not benign
- History of injury is risk factor

EC=B

- Underreported in the literature
- Adolescent females should be assessed for menstrual dysfunction

EC=C

- PPE
- Parent and coach education for sport readiness
- Sport specialization (Now B)
- Address underlying causes of overuse injuries

“Number one is just to gain a passion for running. To love the morning, to love the trail, to love the pace on the track. And if some kid gets really good at it, that’s cool too.” – Pat Tyson, award-winning high school and college cross-country coach*

“Somewhere behind the athlete you’ve become and the hours of practice and the coaches who have pushed you is a little girl who fell in love with the game and never looked back... play for her.” –Mia Hamm, member of United States women’s national soccer team*

“Before kids can play like a pro, they must enjoy playing the game like a kid.” –Steve Locker, national and international soccer player, coach, and author**

Thank You



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