Early Sports Specialization: Key to success? Recipe for burnout?

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Northwestern University Feinberg School of Medicine
Medical Director, Institute for Sports Medicine
Benefits of youth sports

- Cardiovascular fitness
- Strength and coordination
- Development of self-esteem
- Peer socialization
- Lower engagement in risk-taking behaviors (e.g. alcohol/drug use, sexual activity)
Youth sports: Current trends

- Early sports specialization
  - Play only one sport, and begin training intensively for that sport at a young age

- Thought to be driven by society’s rewards for sports success:
  - Elite-level travel team selection
  - Collegiate scholarships
  - Olympic/National team selection
  - Professional contracts
Reasons for early specialization

Surveyed 235 athletes in sports medicine clinics

Age range 7-18 yrs (mean age = 13.8 ± 3.0 yrs)

Majority were considered “specialized”
  - 31% played only 1 sport
  - 58% played multiple sports but had a favorite

Mean age when athletes began specialization = 8.1 yrs
Reasons for early specialization

Factors That Drive Youth Specialization

Ajay S. Padaki, MD,† Charles A. Popkin, MD,† Justin L. Hodgins, MD, FRCS,‡
David Kovacevic, MD,§ Thomas Sean Lynch, MD,† and Christopher S. Ahmad, MD*†

Internal factors driving specialization:
- >70% of athletes had collegiate or professional ambitions

External factors driving specialization:
- 30% were told by a coach not to participate in other sports
  - 22% of single sport athletes vs. 8% of multi-sport athletes (p=0.04)
- 22% were told by a parent not to participate in other sports
Survey of 201 parents of patients in pediatric ortho clinic

- 50% encouraged their children to specialize
- 57% hoped their child will play collegiate or professional sports

Parents of highly and moderately specialized athletes were more likely to report directly influencing their children's specialization ($P = .038$) and to expect their children to play collegiately or professionally ($P = .014$).
Odds of success in sports

- Only 0.2% - 0.5% of high school athletes make it to the professional level.
Is early sports specialization necessary for success?

Sports Specialization in Young Athletes: Evidence-Based Recommendations

Neeru Jayanthi, MD,**†† Courtney Pinkham, BS,† Lara Dugas, PhD,‡ Brittany Patrick, MPH,§ and Cynthia LaBella, MD**

October 2012

- Literature search produced only 12 studies
<table>
<thead>
<tr>
<th>Study</th>
<th>Sport(s)</th>
<th>Athletes</th>
<th>Began intensive training before age</th>
<th>Specialize before age 12</th>
<th>Begin intensive training after age 12</th>
<th>Diversify early, specialize after age 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hume 1994</td>
<td>Rhythmic gymnastics</td>
<td>106 across all levels</td>
<td>+</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Law 2007</td>
<td>Rhythmic gymnastics</td>
<td>6 elite</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Helsen 1998</td>
<td>Mens' soccer, Mens' field hockey</td>
<td>33 international</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hodges 1996</td>
<td>Wrestling</td>
<td>21 elite</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soberlak 2003</td>
<td>Mens' ice hockey</td>
<td>4 elite</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carlson 1988</td>
<td>Men's and women's tennis</td>
<td>10 elite</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lidor 2002</td>
<td>Various mens' and womens' sports</td>
<td>63 elite, 78 near-elite</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gullich 2006</td>
<td>Olympic sports</td>
<td>1558 German athletes from Olympic promotion programs</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moesch 2011</td>
<td>Sports measured in cms, gms or secs*</td>
<td>148 elite, 95 near-elite</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baker 2003</td>
<td>Men's and women's field hockey, Men's basketball, Women's netball</td>
<td>15 elite, 13 near-elite</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barynina 1992</td>
<td>Men's and women's swimming</td>
<td>Elite Russian swimmers (number not reported)</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wall 2007</td>
<td>Boys' ice hockey</td>
<td>12 minor league players (avg age 14)</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Is early sports specialization necessary for success?

- For almost all sports studied, elite athletes were more likely to start intensive training after age 12 and also played other sports.

- Rhythmic gymnastics was the only exception
  - Peak performance occurs before full maturation
  - Therefore, intensive training must occur before puberty
Is early sports specialization necessary for success?

- Predictors of success
  - Enjoyment of the sport
  - Intrinsic (self) motivation
  - Good long-term relationship w/ coach
  - Fewer overall demands for success
Is early sports specialization necessary for success?

- These studies have limitations
  - Small subset of sports studied
    - Most focus on physical/aerobic capabilities vs. technical skills
  - Small sample sizes
  - Retrospective design
  - Few athletes specialized before age 12

- Longitudinal research is needed
  - Especially now that trends have changed
Early sports specialization: What are the risks?

- Potential risks of single-sport, year-round training at a young age
  - Unbalanced neuromuscular development
  - Overuse injury
  - Psychological stress
  - Burnout
Early sports specialization: What do the experts say?

- Discourage specialization before puberty
  - Young athletes who participate in a variety of sports have fewer injuries, are more consistent performers, and play sports longer than those who specialize before puberty (Bompa T, 1995)
  - They acknowledge this advice is based on limited data.

“Intensive Training and Sports Specialization in Young Athletes” (AAP Policy, 2000)

“Overuse injuries and burnout in youth sports (AMSSM position statement, 2014)
Sports-Specialized Intensive Training and the Risk of Injury in Young Athletes

A Clinical Case-Control Study

Neeru A. Jayanthi,† MD, Cynthia R. LaBella,‡§ MD, Daniel Fischer,† Jacqueline Pasulka,‡ and Lara R. Dugas, † PhD, MPH
Investigation performed at Loyola University Chicago Stritch School of Medicine, Maywood, Illinois, USA, and Ann & Robert H. Lurie Children’s Hospital of Chicago, Chicago, Illinois, USA
Overall goal

To determine if sports specialization is a risk factor for injury in young athletes, _independent of age and training volume_.

![Young athlete performing gymnastics](image)
Subjects and study design

- **Design:** Case-control study
- **Timeframe:** 2010-2013
- **Subjects:** 7-18 years of age
  - Injured athletes
    - Recruited from 2 sports medicine clinics in Chicago, IL (Loyola Medical Center and Lurie Children’s Hospital)
  - Healthy controls
    - Recruited from affiliated primary care clinics during annual sports physicals or well child care visits
Participants completed surveys to report:
  - Demographics (age, sport, etc)
  - Typical number of hours/week spent in:
    - organized sports
    - PE class
    - free play
  - Sports specialization*
Measuring Sports Specialization

- No universal definition
- No standardized assessment tool

Description from AAP et al:
- “Intense Year-round training in a single sport at the exclusion of other sports”
Measuring sports specialization

- Survey questions (1 point for each “yes”)
  - “Do you spend >75% of your training in one sport?”
  - “Have you quit other sports to focus on one sport?”
  - “Do you train > 8 months/yr for one main sport?”

- 3 points = high specialization
- 2 points = moderate specialization
- ≤1 point = low specialization
Data collection

- **Injury details** from athlete surveys and EMR
  - Acute
  - Overuse
  - Serious overuse
    - Treatment requires > 1 month rest from sport
    - E.g. stress fracture, spondylolysis, OCD
Subject characteristics

- 1,197 subjects
  - Injured athletes  = 837 (70%)
  - Healthy controls  = 360 (30%)
# Subject characteristics

<table>
<thead>
<tr>
<th></th>
<th>Uninjured (N=368)</th>
<th>Injured (N=822)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (%)</td>
<td>55.0%</td>
<td>49.5%</td>
<td>p=0.14</td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>12.9 ± 2.6</td>
<td>14.1 ± 2.1</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>All physical activity(hrs/wk)</td>
<td>17.6 ± 8.9</td>
<td>19.6 ± 9.2</td>
<td>p&lt;0.05</td>
</tr>
<tr>
<td>PE class (hrs/wk)</td>
<td>3.1 ± 1.7</td>
<td>3.1 ± 2.0</td>
<td>p=0.87</td>
</tr>
<tr>
<td>Free play (hrs/wk)</td>
<td>5.7 ± 5.1</td>
<td>5.6 ± 5.5</td>
<td>p=0.58</td>
</tr>
<tr>
<td>Organized sports (hrs/wk)</td>
<td>9.1 ± 6.3</td>
<td>11.2 ± 2.6</td>
<td>p&lt;0.01</td>
</tr>
</tbody>
</table>
Time spent in various physical activities

Uninjured (n=347)  Injured (n=822)

Weekly hours gym  Weekly hours recreation  Weekly hours sports

3.1 ± 1.7  3.1 ± 2.0  9.1 ± 6.3  11.2 ± 2.6
5.7 ± 5.1  5.6 ± 5.5
Injuries reported

- **Total** 846 (100%)
- **Acute/traumatic** 276 (34%)
- **Overuse** 570 (66%)
  - Serious overuse 139/570 (25%)
Degrees of Specialization

Rate of Specialization

- Low: 38%
- Moderate: 34%
- High: 28%

Legend:
- Low
- Moderate
- High
Injury risks associated with sports specialization

Multivariate regression
(adjusts for age, weekly sports hrs)

Odds ratios and 95% confidence intervals

<table>
<thead>
<tr>
<th>Degree of Specialization</th>
<th>All Injury</th>
<th>Overuse</th>
<th>Serious overuse</th>
<th>Acute</th>
</tr>
</thead>
</table>
| Low
0 or 1 point            | reference   | reference| reference       | reference |
| Moderate
2 points            | 1.44        | 1.22     | 2.04            | 1.52   |
|                          | (1.04-0.98) | (0.85-1.75)| (1.18-3.51)   | (1.01-2.29) |
| High
3 points              | 1.58        | 1.50     | 2.25            | 1.19   |
|                          | (1.11-2.24) | (1.01-2.22)| (1.27-3.99)   | (0.75-1.89) |
**Age when started specialization**

- No difference between injured and uninjured

<table>
<thead>
<tr>
<th>Age of specialization</th>
<th>Uninjured (N=368)</th>
<th>Acute (N=276)</th>
<th>Overuse (N=397)</th>
<th>Serious Overuse (N=129)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>11.5 ± 2.6</td>
<td>11.9 ± 2.6</td>
<td>11.8 ± 2.6</td>
<td>11.7 ± 2.3</td>
</tr>
</tbody>
</table>
Conclusions

- There is increased risk for injury in young athletes who specialize in one sport, *independent of age and training volume*.
  - Injury risk increases as degree of specialization increases.

- Proposed contributing factors:
  - Specialized athletes may be more driven to play through pain to achieve their goals (and those of parents, coaches)
  - High repetitions of small set of movement patterns leads to neuromuscular imbalances that increase risk for injury
  - Psychological stress/burn-out may increase risk for injury
Role of sport type

Sports were classified as either “team” or “individual”
  - Team sport = athletes play w/ others at the time of play.
Specialization by sport type

- **Team Sport**
  - Low specialization (1 point): 20%
  - Moderately specialized (2 points): 70%
  - Highly specialization (3 points): 10%

- **Individual Sport**
  - Low specialization (1 point): 10%
  - Moderately specialized (2 points): 80%
  - Highly specialization (3 points): 10%
Team vs. individual sports

- Analyzed athletes (N=313) who played one sport AND trained > 8 mo/yr

- Athletes who specialized in individual sports (vs. team sports):
  - began specializing at a younger age
  - reported higher training volumes
  - accounted for a higher proportion of overuse injuries

<table>
<thead>
<tr>
<th>Table 1. Characteristics of single-sport-specialized athletes (play only one sport and train &gt;8 months/year for this sport) (N = 313) comparing those whose sole sport was a team sport to those whose sole sport was an individual sport.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sole sport = team sport</strong></td>
</tr>
<tr>
<td>Participants, N (%)</td>
</tr>
<tr>
<td>Males, N (%)</td>
</tr>
<tr>
<td>Age, years&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Age started competitive sports, years&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Age started specializing in main sport, years&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Injured, N (%)</td>
</tr>
<tr>
<td>Overuse injury, N (%)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Serious overuse injury, N (%)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Acute injury, N (%)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Weekly sports training hours, mean</td>
</tr>
</tbody>
</table>

<sup>a</sup>ANOVA with Bonferroni correction.
<sup>b</sup>Logistic regression adjusting for age, gender, and weekly sport hours.
Specialization rates by sport

- Tennis (n=149)
- Gymnastics (n=93)
- Dance (n=76)
- Cheerleading (n=56)
- Volleyball (n=163)
- Soccer (n=266)
- Swimming (n=110)
- Basketball (n=413)
- Football (n=222)
- Baseball or Softball (n=308)

Legend:
- Blue: Single sport specialized athletes
- Gray: Athletes reporting participation
Specialization age by sport

![Bar chart showing the average age of specialization for different sports.](image-url)
Limitations of our data-set

- Not population-based
- Retrospective data collection – recall bias
- Selection bias
  - Athletes seeking care from sports medicine specialists are more likely to be highly specialized
  - Overuse injuries more likely in sports medicine clinics
- Since age of specialization was similar for all subjects, we could not determine if age of specialization is a risk factor for injury.
- Wide variety of sports did not allow for sport-type to be included in regression model
Additional studies: Specialization and injury risk

A Prospective Study on the Effect of Sport Specialization on Lower Extremity Injury Rates in High School Athletes

Timothy A. McGuine, PhD, ATC, Eric G. Post, MS, Scott J. Hetzel, MS, M. Alison Brooks, MD, MPH, Stephanie Trigsted, MS, and David R. Bell, PhD, ATC

Investigation performed at the University of Wisconsin–Madison, Madison, Wisconsin, USA

- Participants recruited from 29 WI high schools
- Completed baseline survey to report sport participation/specialization and history of LE injury
- Athletic trainers reported all LEIs that occurred during the school year.
A Prospective Study on the Effect of Sport Specialization on Lower Extremity Injury Rates in High School Athletes

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Investigation performed at the University of Wisconsin–Madison, Madison, Wisconsin, USA

- 1544 participants
  - 50.5% female
  - Mean age = 16.1 ± 1.1 yrs
  - Variety of sports

- Sport specialization
  - Low 59.5%
  - Moderate 27.1%
  - High 13.4%

- Athletes w/ moderate or high specialization were more likely to sustain LEI than those w/ low specialization.
  - Hazard ratios (HR) = 1.51 [95% CI, 1.04-2.20] and 1.85 [95% CI, 1.12-3.06]
Additional studies: Specialization and injury risk

Risk Factors for Lower Extremity Overuse Injuries in Female Youth Soccer Players

John W. O’Kane,† MD, Moni Neradilek,‡ MS, Nayak Polissar,‡ PhD, Lori Sabado,† PT, Allan Tencer,‡ PhD, and Melissa A. Schiff,§‖ MD, MPH

Investigation performed at the University of Washington, Seattle, Washington, USA

- 351 female youth soccer players, aged 12-15 yrs.
- Followed from 2008-2012
- LE overuse injuries identified via weekly emails
- Players were interviewed by phone to obtain data.
- Participating in other physical activities associated with 61% decreased risk of overuse LE injury.
Additional studies: Specialization and injury risk

Sports Specialization is Associated with An Increased Risk of Developing Anterior Knee Pain in Adolescent Female Athletes

Randon Hall, Kim Barber Foss, Timothy E. Hewett, and Gregory D. Myer

Division of Sports Medicine, Cincinnati Children’s Hospital Medical Center, Cincinnati, Ohio

- Retrospective study of 546 female basketball, soccer, and volleyball players aged 12-18.

- Specialization in a single sport increased the relative risk of anterior knee pain by 1.5 fold (95% CI 1.0 to 2.2; p=0.038)
Additional studies: Specialization and injury risk

Sports Specialization and Risk of Injury in Male Youth Soccer Players

David Frome, B.S.,¹ Jamie Burgess, Ph.D.,² George Chiampas, D.O.,¹,³ Jennifer Fokas, B.A.,³ Karen Rychlik, M.S.,¹,² Cynthia LaBella, M.D.¹,²

¹ Northwestern University’s Feinberg School of Medicine ² Ann & Robert H. Lurie Children’s Hospital of Chicago,³ U.S. Soccer

- Surveyed 2123 male youth soccer players re: injury and sports history
  - US Soccer developmental (elite) program
- Specialized = train for soccer > 8 mo/yr; do not play other sports
- Non-specialized = train for soccer > 8 mo/yr; also play other sports

<table>
<thead>
<tr>
<th></th>
<th>Specialized</th>
<th></th>
<th>Non-Specialized</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>1320 (62.2%)</td>
<td>803 (37.8%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>13.7±1.9 (9-18)</td>
<td>12.5±1.4 (7-17)</td>
<td>P=&lt;.0001</td>
<td></td>
</tr>
<tr>
<td># of injuries reported</td>
<td>877</td>
<td>527</td>
<td>P=0.52</td>
<td></td>
</tr>
</tbody>
</table>
756 participants (aged 10–11 yrs at study inception) reported their participation in organized and unorganized PA every 4 mo. for 5 yrs.

Categorized as *early sport samplers*, *early sport specializers*, or *nonparticipants* in year 1

Likelihood that childhood sport profile would predict adolescent sport profile was computed as relative risks.
Compared with early sport specialization and nonparticipation, **early sport sampling** in childhood was associated with a lower likelihood of nonparticipation (0.69, 0.51–0.93) in adolescence.
How much is too much?
What do we advise parents?

CLINICAL REPORT

Overuse Injuries, Overtraining, and Burnout in Child and Adolescent Athletes

Joel S. Brenner, MD, MPH, and the Council on Sports Medicine and Fitness

- Recommendations are based on opinion/expertise.
- Recent data lend support to these recommendations.
AAP recommendations to prevent overtraining and burnout

- Encourage youth to become well-rounded and well-versed in a variety of activities.
- Focus on wellness and teaching athletes to be in tune with their bodies for cues to slow down or alter their training methods.
- Keep workouts interesting and fun with age-appropriate games and training.
If choosing to specialize in one sport:
- Max of 5 days/wk in organized training or competition

- At least 2 to 3 months off per year
  - to let injuries heal
  - to refresh the mind (prevent burnout)
  - to work on strength, conditioning, and proprioception in hopes of reducing injury risk
Goal of youth sports participation should be to promote lifelong physical activity, recreation, and skills of healthy competition that can be used in all facets of future endeavors.
What to advise parents

- Guidelines for health care providers:
  - Obtain a physical activity history (type of activities, frequency, duration).
  - Discuss motivation for participation and advise that it should be child-driven, not adult driven.
  - Promote healthy participation and preventive care measures.
  - Educate parents, athletes, and coaches how to promote fun, skill development, and success for each individual athlete.
How much is too much?