Training the Young Baseball Athlete

Understanding the American Development Model and Preparation for Collegiate and Professional Baseball

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DO WE HAVE A PROBLEM?
Why Children Are Abandoning Baseball

Major League Baseball is strong, but the casual young player is vanishing, threatening the sport's future.
Participation Stats

Decline in Participation Rates Among Children ages 6-12 between 2008-2013

Basketball: 3.9% (2008: 3.9%, 2013: 2.7%)
Baseball: 14.4% (2008: 14.4%, 2013: 9.9%)
Soccer: 10.7% (2008: 10.7%, 2013: 7.2%)
Softball: 31.3% (2008: 31.3%, 2013: 26.4%)
Football: 28.6% (2008: 28.6%, 2013: 23.2%)

2009 Team Sports 44.5%
2013 Team Sports 40%

According to Sports & Fitness Industry Association (SFA), children ages 6 to 12 who played team sports regularly fell from 44.5 percent in 2008 to 40 percent in 2013.

<table>
<thead>
<tr>
<th>Sport</th>
<th>2009 (,000)</th>
<th>2014 (,000)</th>
<th>6-17 yr. olds % Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseball</td>
<td>7,012</td>
<td>6,711</td>
<td>-4.30%</td>
</tr>
<tr>
<td>Basketball</td>
<td>10,404</td>
<td>9,964</td>
<td>-4.30%</td>
</tr>
<tr>
<td>Field hockey</td>
<td>438</td>
<td>370</td>
<td>-15.50%</td>
</tr>
<tr>
<td>Football (tackle)</td>
<td>3,952</td>
<td>3,254</td>
<td>-17.90%</td>
</tr>
<tr>
<td>Football (touch)</td>
<td>3,006</td>
<td>2,032</td>
<td>-32.40%</td>
</tr>
<tr>
<td>Gymnastics</td>
<td>2,510</td>
<td>2,809</td>
<td>11.90%</td>
</tr>
<tr>
<td>Ice hockey</td>
<td>517</td>
<td>743</td>
<td>43.70%</td>
</tr>
<tr>
<td>Lacrosse</td>
<td>624</td>
<td>804</td>
<td>28.80%</td>
</tr>
<tr>
<td>Rugby</td>
<td>150</td>
<td>301</td>
<td>100.70%</td>
</tr>
<tr>
<td>Soccer (indoor)</td>
<td>2,456</td>
<td>2,172</td>
<td>-11.80%</td>
</tr>
<tr>
<td>Soccer (outdoor)</td>
<td>8,380</td>
<td>7,856</td>
<td>-6.00%</td>
</tr>
<tr>
<td>Softball (fast-pitch)</td>
<td>968</td>
<td>1,004</td>
<td>1.60%</td>
</tr>
<tr>
<td>Softball (slow-pitch)</td>
<td>1,827</td>
<td>1,822</td>
<td>-0.30%</td>
</tr>
<tr>
<td>Track and field</td>
<td>2,697</td>
<td>2,417</td>
<td>-10.40%</td>
</tr>
<tr>
<td>Volleyball (court)</td>
<td>3,420</td>
<td>2,680</td>
<td>-21.50%</td>
</tr>
<tr>
<td>Volleyball (sand/beach)</td>
<td>632</td>
<td>662</td>
<td>5.10%</td>
</tr>
<tr>
<td>Wrestling</td>
<td>1,385</td>
<td>605</td>
<td>-41.90%</td>
</tr>
</tbody>
</table>

Youth Baseball and Surgery for Overuse Injuries
More teens are undergoing Tommy John surgery for worn-out elbows; don't play year-round or on more than one team at a time, says a leading surgeon
WE LIVE IN CONCERNING TIMES

• The number of UCL Surgeries performed between 2003 and 2014 in New York State increased by 343%, and a disproportionate trend in average annual incidence for patients between 15 and 19 years old was observed.

• In over 1000 baseball players aged 7 to 12 years, 15.9% reported episodes of shoulder pain, while 29.2% reported elbow pain in the throwing arm. The associated risk factors were different for each type of pain. Shoulder pain was associated with increased age while elbow pain was associated with increased age, increased years of baseball experience, and playing catcher.


The Youth Sport Conundrum

Better Performance = More Time Training

Yes... BUT
No Secret Formula - Every Athlete & Every Sport Is Unique
Early Specialization vs Early Initiation vs Early Diversification
THERE ARE OVER 400,000 NCAA® STUDENT-ATHLETES AND MOST OF US WILL GO PRO IN SOMETHING OTHER THAN SPORTS
Probability of Competing In Sports Beyond High School

- **Men's basketball**
  - 541,054 high school players
  - 3.4% will play in college
  - 1.2% of college players drafted by the NBA

- **Football**
  - 1,093,234 high school players
  - 6.5% will play in college
  - 1.6% of college players drafted by the NFL

- **Baseball**
  - 482,629 high school players
  - 6.9% will play in college
  - 8.6% of college players drafted by MLB

- **Women's basketball**
  - 433,344 high school players
  - 3.8% will play in college
  - 0.9% of college players drafted by the WNBA

Source: NCAA
The problem may not be single sport play or even specialization

- Excessive volume
- Lack of all-around skill development
- Lack of enjoyment
- Excessive pressure
- Playing for the wrong reasons
- Goals are focused in the wrong areas (i.e., college scholarships and professional pathway)
- Lack of unstructured and structured play
- Over involved coaches/parents involved in every activity
Single Sport Discussion Has Some Similarities To The Steroid Debate

RISKS EXIST

HOWEVER IT CAN CERTAINLY WORK
Many examples of athletes that have succeeded with *Single Sport Specialization*

- Bryce Harper (Baseball)
- Lionel Messi (Soccer)
- Cristiano Ronaldo (Soccer)
- Serena and Venus Williams (Tennis)
- Andre Agassi (Tennis)
- Tiger Woods (Golf)
Ericsson et al 1993

“...the higher level of attained elite performance, the earlier the age of first exposure as well as the age of starting deliberate practice” (p. 389).
Several selection experiments have confirmed the concept that there is a substantial genetic component to the trainability of exercise performance traits (Bouchard et al. Experimental Physiology, 2012)
Coefficient of Efficiency

Between the ages of 13 -17 Approximately 70% of young athletes quit. Why?

A coefficient of efficiency of less than 100% from childhood sport participation to adolescence sport participation would indicate that certain children have dropped out of a specific sport and are no longer available to train for elite performance in this sport.

Early specialization programs, with their strict emphasis on early selection, skill acquisition, and training during childhood, might reduce their coefficient of efficiency and eliminate someone who, through growth, maturation, and training, would later have developed into an elite level athlete (Wiersma, 2000).
So What Needs To Be Done?
The United States Olympic Committee, in partnership with the National Governing Bodies, created The American Development Model in 2014 to help Americans realize their full athletic potential and utilize sport as a path toward an active and healthy lifestyle.

The model utilizes long-term athlete development concepts to promote sustained physical activity, participation in sport, and Olympic and Paralympic success. These concepts have been tailored to create a framework for developing American youth through sport.
American Development Model (ADM)

- ADM (via the USOC) - http://www.teamusa.org/About-the-USOC/Athlete-Development/American-Development-Model

- ADM Model in Hockey - http://www.admkids.com/
Fundamental Movement Skills
General Youth Strength Training Guidelines

Information adapted from National Strength and Conditioning Association position statement on youth strength training

- Provide qualified instruction and supervision
- Ensure the exercise environment is safe and free of hazards
- Start each training session with a minimum of 5-10 minutes of a dynamic warm-up (including dynamic stretching)
- Begin with relatively light loads and always focus on the correct exercise technique
- Perform 1–3 sets of 6–15 repetitions on a variety of upper-body and lower-body strength exercises
- Include specific exercises that strengthen the abdominal and lower back region
- Focus on symmetrical muscular development and appropriate muscle balance around joints
- Perform 1–3 sets of 3–6 repetitions on a variety of upper- and lower-body power exercises
- Sensibly progress the training program depending on needs, goals, and abilities
- Increase the resistance gradually (5–10%) as strength improves
- Include a structured cool-down period including static stretching
- Listen to individual athlete needs and concerns throughout each session
- Begin resistance training two to three times per week on nonconsecutive days
- Use individualized workout logs to monitor progress
- Keep the program fresh and challenging by systematically varying the training program
- Optimize performance and recovery with healthy nutrition, proper hydration and adequate sleep
- Support and encouragement from instructors and parents will help maintain interest
What Do We Know About Young Pitchers
Key Concept: Kinetic Linkages
481 youth pitchers (aged 9 to 14 years) who were followed for 10 years

- Participants who pitched more than 100 innings in a year were **3.5 times** more likely to be injured (95% confidence interval = 1.16 to 10.44)

- Pitching more than 100 innings in a year significantly increases risk of injury.

- The risk of a youth pitcher sustaining a serious throwing injury within 10 years is 5%.

ASMI Stats on Pitching (Summary)

• Kids who pitched more than 100 innings during a calendar year were 3 $\frac{3}{2}$ times as likely to get injured as pitchers who did less throwing.

• Kids who pitch in games more than eight months a year are 5 times as likely as other pitchers to need surgery.

• Kids who regularly pitched while fatigued — were 36 times (!) as likely as other pitchers to undergo shoulder or elbow surgery.
Significant relationships between bilateral gluteus medius and the force couples about the scapula during all 3 phases of the pitching motion. The results of this study provide important data that improve the understanding of the muscular relationship between the pelvic and scapular stabilizers during the fastball pitch.

Training and rehabilitation programs should consider focusing on lumbopelvic-hip (including Gluteus Medius) and scapular muscle strengthening as well as coordinated strengthening of the pelvic and scapular stabilizers, in baseball pitchers.


**Table 1. Muscle activation correlations.**

<table>
<thead>
<tr>
<th>Gluteus medius</th>
<th>Scapula force couples</th>
<th>Correlation, r</th>
<th>Significance, p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower trapezius</td>
<td>0.32</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td>Serratus anterior</td>
<td>0.18</td>
<td>0.49</td>
</tr>
<tr>
<td></td>
<td>Upper trapezius</td>
<td>0.10</td>
<td>0.71</td>
</tr>
<tr>
<td></td>
<td>Lower trapezius</td>
<td>0.52</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>Serratus anterior</td>
<td>0.68</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Upper trapezius</td>
<td>0.29</td>
<td>0.27</td>
</tr>
<tr>
<td><strong>Phase 2</strong></td>
<td><strong>Contra</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lower trapezius</td>
<td>0.70†</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Serratus anterior</td>
<td>0.56†</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>Upper trapezius</td>
<td>0.71†</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Lower trapezius</td>
<td>0.48†</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>Serratus anterior</td>
<td>0.78†</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Upper trapezius</td>
<td>0.78†</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td><strong>Ipsilateral</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lower trapezius</td>
<td>0.68†</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Serratus anterior</td>
<td>0.12</td>
<td>0.64</td>
</tr>
<tr>
<td></td>
<td>Upper trapezius</td>
<td>0.41</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>Lower trapezius</td>
<td>0.40</td>
<td>0.11</td>
</tr>
<tr>
<td></td>
<td>Serratus anterior</td>
<td>0.23</td>
<td>0.38</td>
</tr>
<tr>
<td></td>
<td>Upper trapezius</td>
<td>0.65†</td>
<td>0.00</td>
</tr>
</tbody>
</table>

*Contralateral = left side/nonthrowing side gluteus medius; ipsilateral = right side/throwing side gluteus medius. †Statistically significant correlation (p < 0.05).
Hip Range of Motion and Optimal Shoulder Function

• In youth baseball pitchers the decrease in hip range of motion also decreases the optimal mechanics of the shoulder.

• Young pitchers that focusing on lower body flexibility, specifically hip flexibility, can benefit their performance on the mound.

• It can be concluded that passive range of motion measures may not translate to dynamic motion of the hip during pitching in youth. Therefore, both aspects of hip range of motion need to be measured and improved.

Static and Dynamic Hip Measurements Do Not Correlate

• Compared dynamic and passive hip range of motion, and the hypothesis that a correlation would exist between the two range of motion measures was rejected.

• Why? Possibility of the lack the neuromuscular control and strength to move dynamically through the full hip range of motion during pitching.
  • Pitching does not necessitate hip movement to the end range of motion. Therefore, it appears that hip range of motion measured passively in the seated position may not accurately reflect the dynamic range of motion of the hips through the progression of the pitch cycle.

Weighted Bats

Most studies show a decrease in bat speed after warming up with a weighted bat. Yet many players still do it. They feel a perception change.

- DeRenne, et al., 1992; Otsuji, et al., 2002; Southard & Groomer, 2003; Montoya, Brown, Coburn, & Zinder, 2009) and/or unchanged swing velocity (Szymanski, Beiser, Bassett, Till, Medlin, Beam, et al., 2011)
10-week pitching training with a 4.4-oz lightweight baseball
- significantly enhanced throwing velocity by ~3.20% & the arm swing velocity by ~5.34% for adolescent players but also did not alter the youth players’ pitching patterns.
Overweight vs Underweight Balls
# Effects of Throwing Overweight and Underweight Baseballs on Throwing Velocity and Accuracy

Rafael F. Escamilla, Keven R. Spurr, Glenn S. Fleisig, Steven W. Bannister, and James R. Andrews

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2. American Sports Medicine Institute, Birmingham, Alabama, USA.

## Table I. Effects of training with overweight and underweight baseballs on throwing velocity and accuracy.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Number of participants</th>
<th>Age level</th>
<th>Duration (w)</th>
<th>Number of throws per week</th>
<th>Baseball weights (oz)</th>
<th>Significant increase in throwing velocity?</th>
<th>Significant change in accuracy?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overweight training</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brose &amp; Hanson[8]</td>
<td>7</td>
<td>College</td>
<td>6</td>
<td>75</td>
<td>10, 160²</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Litwhiler &amp; Hamm[10]</td>
<td>5</td>
<td>College</td>
<td>12</td>
<td>165</td>
<td>7-12</td>
<td>Yes (5 m/s)</td>
<td>No</td>
</tr>
<tr>
<td>Logan et al.[11]</td>
<td>13</td>
<td>College</td>
<td>6</td>
<td>150</td>
<td>40²</td>
<td>Yes (6.5-11.6%)</td>
<td>NM</td>
</tr>
<tr>
<td>Straub[12]</td>
<td>24</td>
<td>High school</td>
<td>6</td>
<td>60</td>
<td>7-17</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>DeRenne et al.[13,14]</td>
<td>5</td>
<td>High school</td>
<td>10</td>
<td>NS</td>
<td>5-6</td>
<td>Yes (6.67 m/s)</td>
<td>NM</td>
</tr>
<tr>
<td>DeRenne et al.[14,15]</td>
<td>10</td>
<td>High school</td>
<td>10</td>
<td>150</td>
<td>5-6</td>
<td>Yes (5.3%)</td>
<td>NM</td>
</tr>
<tr>
<td><strong>Underweight training</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DeRenne et al.[13,14]</td>
<td>5</td>
<td>High school</td>
<td>10</td>
<td>NS</td>
<td>4-5</td>
<td>Yes (1.34 m/s)</td>
<td>NM</td>
</tr>
<tr>
<td>DeRenne et al.[14,15]</td>
<td>10</td>
<td>High school</td>
<td>10</td>
<td>150</td>
<td>4-5</td>
<td>Yes (6.7%)</td>
<td>NM</td>
</tr>
<tr>
<td>DeRenne et al.[14]</td>
<td>17</td>
<td>High school</td>
<td>10</td>
<td>187</td>
<td>4</td>
<td>Yes (3.2%)</td>
<td>NM</td>
</tr>
<tr>
<td><strong>Overweight and underweight integral training</strong></td>
<td>150</td>
<td>High school and college</td>
<td>10</td>
<td>198</td>
<td>4-6</td>
<td>Yes (4-6%)</td>
<td>NM</td>
</tr>
</tbody>
</table>

² Amount of resistance while throwing a baseball attached to a wall pulley.

NM = accuracy not measured in study; NS = number of throws not specified in study.
Important findings from 2000

• 10 of the 11 training studies show that:
  • 6 to 12 weeks of training with overweight or underweight baseballs significantly increased throwing velocity of regulation baseballs.

• Although studies used balls from 5.25oz-17oz, most of the current recommendations are to keep it within 20% of regulation weight
  • 4-5oz for underweight
  • 5-7oz for overweight
Glenohumeral internal rotation deficit (GIRD) indicates a 20° or greater loss of internal rotation of the throwing shoulder compared with the nondominant shoulder.

**Pitchers with total rotational motion deficit greater than 5° had a higher rate of injury.**

TABLE 1

COMPARISON OF POSITION DATA AMONG THROWS*

<table>
<thead>
<tr>
<th></th>
<th>Fastball Pitch (18.4 m)</th>
<th>37-m Throw</th>
<th>55-m Throw</th>
<th>Maximum-Distance Throw</th>
<th>Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foot contact</td>
<td>78 ± 17</td>
<td>79 ± 18</td>
<td>79 ± 18</td>
<td>86 ± 20</td>
<td>a, c, e</td>
</tr>
<tr>
<td>Elbow flexion</td>
<td>53 ± 30</td>
<td>56 ± 28</td>
<td>60 ± 28</td>
<td>58 ± 26</td>
<td></td>
</tr>
<tr>
<td>Shoulder external rotation</td>
<td>96 ± 10</td>
<td>98 ± 10</td>
<td>99 ± 10</td>
<td>98 ± 9</td>
<td></td>
</tr>
<tr>
<td>Shoulder abduction</td>
<td>21 ± 11</td>
<td>19 ± 12</td>
<td>19 ± 11</td>
<td>21 ± 11</td>
<td></td>
</tr>
<tr>
<td>Shoulder horizontal abduction</td>
<td>6 ± 7</td>
<td>13 ± 9</td>
<td>26 ± 8</td>
<td>26 ± 8</td>
<td>a, c, d, e, f</td>
</tr>
<tr>
<td>Pelvis angle</td>
<td>37 ± 12</td>
<td>37 ± 11</td>
<td>39 ± 11</td>
<td>40 ± 11</td>
<td>b, c, d, e, f</td>
</tr>
<tr>
<td>Front knee flexion</td>
<td>47 ± 9</td>
<td>49 ± 9</td>
<td>44 ± 7</td>
<td>42 ± 6</td>
<td></td>
</tr>
<tr>
<td>Stride length &amp; % participants height</td>
<td>80 ± 4</td>
<td>79 ± 6</td>
<td>80 ± 6</td>
<td>80 ± 7</td>
<td></td>
</tr>
<tr>
<td>Foot position, cm</td>
<td>25 ± 12</td>
<td>16 ± 14</td>
<td>15 ± 15</td>
<td>5 ± 8</td>
<td></td>
</tr>
<tr>
<td>Arm cocking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum shoulder flexion</td>
<td>101 ± 11</td>
<td>103 ± 10</td>
<td>104 ± 11</td>
<td>109 ± 10</td>
<td>c, a, f</td>
</tr>
<tr>
<td>Maximum shoulder external rotation</td>
<td>174 ± 10</td>
<td>174 ± 10</td>
<td>176 ± 10</td>
<td>180 ± 11</td>
<td>c, a, d, f, e</td>
</tr>
<tr>
<td>Maximum shoulder horizontal abduction</td>
<td>17 ± 6</td>
<td>13 ± 7</td>
<td>13 ± 7</td>
<td>17 ± 7</td>
<td></td>
</tr>
<tr>
<td>Ball release</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoulder abduction</td>
<td>88 ± 7</td>
<td>89 ± 9</td>
<td>89 ± 9</td>
<td>88 ± 8</td>
<td></td>
</tr>
<tr>
<td>Forward trunk 9H</td>
<td>34 ± 8</td>
<td>27 ± 7</td>
<td>25 ± 7</td>
<td>18 ± 8</td>
<td>a, c, d, f, e</td>
</tr>
<tr>
<td>Lateral trunk tilt</td>
<td>35 ± 13</td>
<td>25 ± 8</td>
<td>24 ± 8</td>
<td>26 ± 7</td>
<td></td>
</tr>
<tr>
<td>Front knee flexion</td>
<td>37 ± 13</td>
<td>36 ± 12</td>
<td>33 ± 13</td>
<td>31 ± 12</td>
<td>b, c, d, e, f</td>
</tr>
</tbody>
</table>

*Values are mean ± SD degrees, except where otherwise indicated.
Analysis of variance revealed significant difference among throws (P < 0.01). Post hoc tests indicated significant differences between (a) pitch and 37-m throw, (b) pitch and 55-m throw, (c) pitch and maximum-distance throw, (d) 37-m and 55-m throws, (c) 55-m and maximum-distance throws, and (f) 37-m and maximum-distance throws.

Throwing as a far as possible (average distance was around 260 feet) has on average 10% more force (torques) at the shoulder than pitching from a mound. It also changed mechanics.

This study was in College Pitchers
Summary

• > 100 innings in one year = 3x greater risk of injury
• Averaging > 80 pitches per game = 4x greater risk of injury
• > 8 months per year = 5x greater risk of injury
• Regularly pitching with arm fatigue = 36x greater risk of injury
• Multisport participation through formative years
• 3 months away from the sport
• Develop overall physical capabilities
Questions

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