



**Long-Term Athlete Development Plan**  
A Long-Term Athlete Development Plan for the sport of Baseball

# Table of Contents

<b>Foreword</b> .....	<b>1</b>
<b>State of the Game</b> .....	<b>3</b>
<b>Why Create a Long-Term Athlete Development Plan?</b> .....	<b>4</b>
<b>LTAD Statement</b> .....	<b>5</b>
<b>LTAD Key Principles</b> .....	<b>6</b>
<b>LTAD Key Definitions</b> .....	<b>6</b>
<b>The Long-Term Athlete Development Plan</b> .....	<b>7</b>
<b>Stage 1: Activate</b> .....	<b>7</b>
<b>Stage 2: Discover</b> .....	<b>9</b>
<b>Stage 3: Progress</b> .....	<b>12</b>
<b>Stage 4: Develop</b> .....	<b>14</b>
<b>Stage 5: Apply</b> .....	<b>17</b>
<b>Stage 6: Excel</b> .....	<b>20</b>
<b>Stage 7: Inspire</b> .....	<b>22</b>
<b>Key Factors Influencing the LTAD</b> .....	<b>23</b>
<b>Summary</b> .....	<b>36</b>
<b>References</b> .....	<b>37</b>

## A Message from Joseph Myers

*Lead Author of the USA Baseball LTAD and Director of Baseball Performance Science for the Tampa Bay Rays*

As the primary steward for the sport in the United States, USA Baseball recognizes and embraces the powerful impact that the sport has on players and fans across their lifespan. Given its role as the governing body of the game, USA Baseball sought to develop a Long-Term Athlete Development Plan (LTAD) that is rooted in scientific literature, in order to provide a roadmap for players, parents, coaches, and administrators to participate, instruct, and govern the sport of baseball. An interdisciplinary working group of leading sport scientists with expertise in coaching, strength and conditioning, neuromuscular control, biomechanics, motor learning, injury prevention, sport psychology, and clinical care of athletes was assembled to develop an evidence-based LTAD aimed to:

- Promote physical literacy, athleticism, and baseball skill development.
- Enhance game enjoyment.
- Improve player retention.
- Ensure psychosocial development and well being of participants.
- Foster talent and game success.
- Promote physical/recreational activity across the lifespan.
- Guide physical training and conditioning.
- Aim to prevent baseball related injury.
- Appreciate baseball as a lifelong sport.

On behalf of the working group, we feel fortunate to have had the opportunity to collaborate with leaders from all across amateur baseball, in order to provide the scientific content to this important project. This collaboration resulted in a program that provides players, coaches, parents, and fans, with a positive, fulfilling experience where talents can be maximized, healthy levels of fitness can be achieved, and ultimately the sport of baseball can be enjoyed for their entire lifetime.

Joseph B. Myers, PhD, ATC

*LTAD Working Group Chair*

*Director of Baseball Performance Science, Tampa Bay Rays Baseball*

The USA Baseball LTAD Working Group includes the following individuals:

- J.D. DeFreese, PhD (University of North Carolina at Chapel Hill)
- Lindsay DiStefano, PhD, ATC (University of Connecticut)
- Avery Faigenbaum, EdD, FACSM, FNCSA (The College of New Jersey)
- Elizabeth Hibberd, PhD, ATC (University of Alabama)
- Joseph B. Myers, PhD, ATC (Tampa Bay Rays Baseball)
- James Onate, PhD, ATC, FNATA (The Ohio State University)
- Brett S. Pexa, MA, ATC (University of North Carolina at Chapel Hill)

In addition to the Working Group, the LTAD was reviewed and edited in part by:

- Carlo Alvarez- Former Director of Sports Performance
- Kyle Boyer- National Development Director, USA Field Hockey
- Rob Butler- Director of Performance, St. Louis Cardinals
- Perry Castellano- Strength and Conditioning Coordinator, Minnesota Twins
- Jon Coyles- Vice President, Drug, Health & Safety Programs, Major League Baseball
- Michael Cuddyer- USA Baseball Develops Contributor; Former Major League Baseball player
- Keith Dugger- Head Athletic Trainer, Colorado Rockies
- Darren Fenster- USA Baseball Develops Contributor; Minor League Manager, Boston Red Sox
- Elliot Hopkins- Director of Sports, Sanctioning and Student Services, National Federation of State High School Associations
- Brendon Huttman- Major League Strength and Conditioning Coach, Pittsburgh Pirates
- David James- Vice President, Youth Programs, Major League Baseball
- Dean Jordan- USA Baseball Develops Contributor; Managing Executive, Global Sports Media Rights at Wasserman Media Group
- Matt Kata- Manager, Youth Baseball Development and Initiatives, Cleveland Indians
- Eric Kibler- USA Baseball Develops Contributor; Retired Head Coach Horizon High School; Arizona High School Athletic Coaches Hall of Fame Member
- Andre Lachance- Develops Director/Women's National Team Manager, Baseball Canada
- Chris Marinak- Executive Vice President, League Economics & Strategy, Major League Baseball
- Del Matthews- Senior Director of Baseball Development, Major League Baseball
- Tim Maxey- Strength and Conditioning Coordinator, Major League Baseball and the Major League Baseball Players Association
- Darrell Miller- Vice President of Youth and Facility Development, Major League Baseball
- Kim Ng- Senior Vice-President for Baseball Operations, Major League Baseball
- Tony Reagins- Senior Vice President for Youth Programs, Major League Baseball
- Skip Schumaker- USA Baseball Develops Contributor; Former Major League Baseball Player
- Dan Schuster- Director of Coach Education, National Federation of State High School Associations
- Mickey Shupin- Specialist, International Game and Market Development, Major League Baseball
- Morgan Sword- Vice President of League Economics and Strategy, Major League Baseball
- Jon Torine- Sports, Physical Education, Health and Safety, Functional Movement Systems
- Dave Turgeon- USA Baseball Develops Contributor; Coordinator of Instruction, Pittsburgh Pirates
- Ricky White- Strength Coach, Pittsburgh Pirates

## State of the Game

Baseball continues to be one of America’s most prominent sports, commonly referred to as our “national pastime.” On the professional level, baseball is a staple of many American lives from April to October every year. Within the amateur ranks, the Sports and Fitness Industry Association’s Single Sport Participation Report on Baseball concluded that 15,804,000 athletes engaged in baseball in 2019. However, the recent trajectory of amateur participation remains inconsistent.

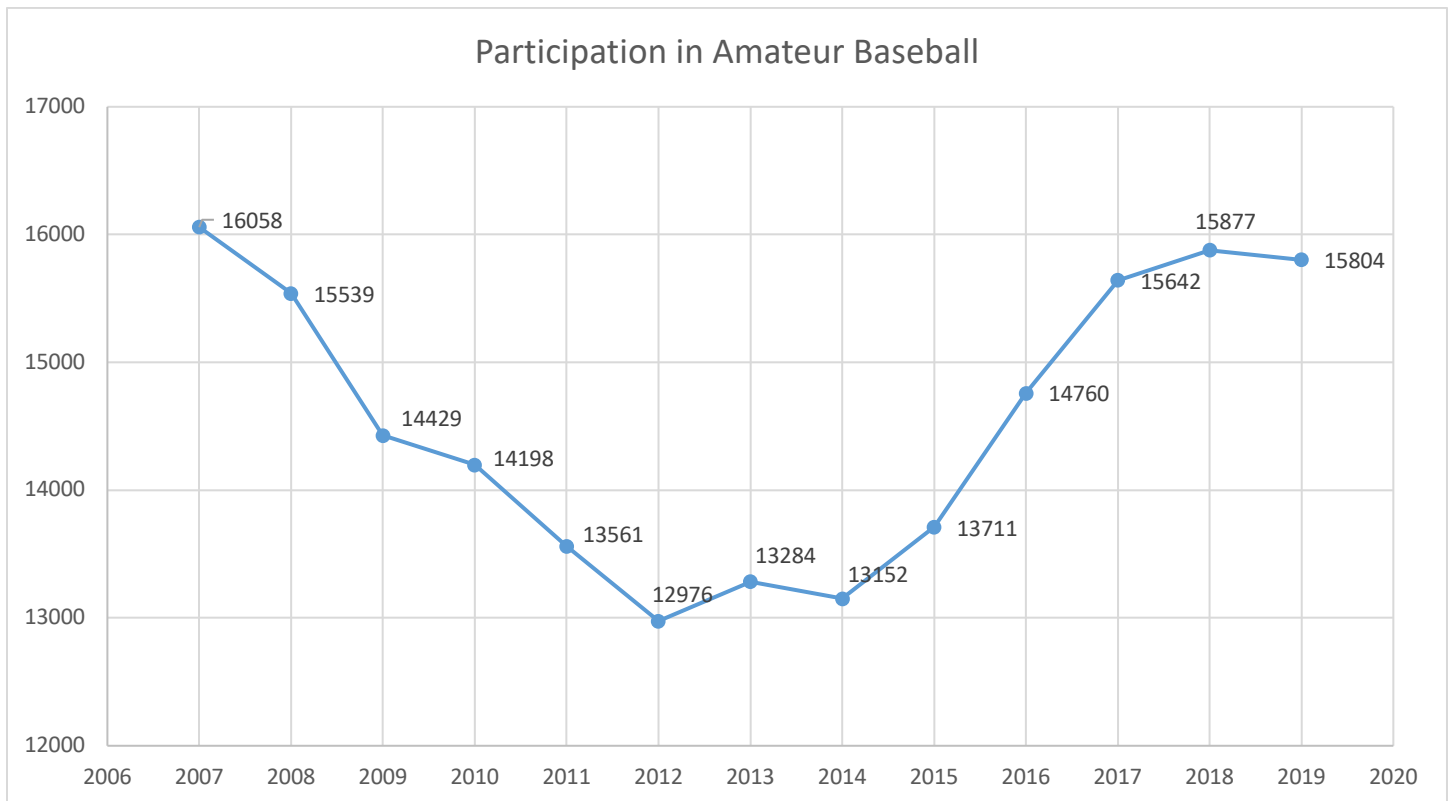
In 2014, USA Baseball conducted an audit of the amateur marketplace and identified several challenges facing the amateur game. Most acutely were the lack of coaching education, lack of structured guidance throughout a player’s childhood and adolescence, and the increasing costs of participation. Additional challenges included early single sport specialization, year-round play, and the disproportionate ratio between development and competition.

### Baseball Participation Totals

2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
16.058	15.539	14.429	14.198	13.561	12.976	13.284	13.152	13.711	14.760	15.642	15.877	15.804

\*Participation numbers are in millions (90).

1 YR Change (%)	5 YR Change (%)	10 YR Change (%)
-0.46	20.16	9.53



## Why Create a Long-Term Athlete Development Plan?

The Long-Term Athlete Development Plan (LTAD) process forces us to critically scrutinize the changing landscape and examines what needs to be done to better position the sport moving forward. This LTAD is influenced by the work of Istvan Balyi and is the culmination of extensive scientific research on childhood development by experts in the field. We believe that the integration and implementation of this LTAD into the baseball culture across the United States will not only help to get our youth back onto the fields, but also positively impact their overall experience within the sport.

Consider this:

- The need to rethink how we organize, operate and execute baseball activity is more relevant now than ever.
- The largest base of knowledge, experience and resources is most closely associated with elite level competition. Informing the volunteer and amateur base of coaches in key developmental stages is essential for the long-term health and proliferation of the sport.
- Better informing the athletes of today lends itself to a more educated coaching generation of tomorrow.
- A broad developmental pathway in baseball has not previously been available to parents.
- The current amateur baseball environment fosters a culture of early single sport specialization that is contrary to relevant surveys and research on the subject as it relates to long-term development.
- Most training and preparation is currently geared towards short-term outcomes associated with winning rather than a long-term process of individual development.
- By maximizing the experiences learned through baseball, the LTAD aims to develop more well-rounded individuals both in sport and in life.

## LTAD Statement

This LTAD has been generated by USA Baseball, with support from Major League Baseball (MLB), to provide a multi-stage developmental pathway for an individual’s life-long experience within the sport. The LTAD plan is a culmination of evidence-based information from the principal contributor group and input from a leadership group consisting of experts from the medical safety industry, MLB league and club executives, and an advisory group inclusive of leaders from across the amateur baseball spectrum. This document has been most directly prepared for the main influencers in an athlete’s life including but not limited to parents, coaches, league administrators, teachers, and the athletes themselves.

### The Long-Term Athlete Development Plan:

- Offers solutions for the entire baseball community.
- Enhances all participants’ experience within the sport.
- Promotes physical literacy and psychosocial development.
- Underscores best practices for player health and safety.
- Encourages age-appropriate skill development progression.
- Prolongs individual engagement through improved infrastructure.
- Promotes lifelong engagement through mentoring and recreational play.

The LTAD recognizes the need to involve all Americans in the developmental pathway, not just the elite athletes, and is made up of a seven-stage framework. Each stage is categorized by a chronological age group, however, an athlete’s skill level may not align with his or her chronological age. Therefore, the skill sets of the individual athlete need to be assessed to determine his or her pathway needs. An athlete can enter into the pathway at any point through his or her progression. In doing so, it may be beneficial to pull recommendations from previous stages of development. Athletes will continue to progress and develop within each individual stage, but the objectives are the underlying drivers of the stages. This framework also allows for athletes to begin an “Advanced Track” within the Develop Stage for 14- to 16-year-olds. Advanced athletes are those who show a high level of aptitude in the sport at their given age. The “Advanced Track” is a pathway of development that allows for elite athletes to dedicate more direct time and energy to training and competition for their high-level progress in the game.

Stage	Chronological Age	Recreational Track	Advanced Track
1	Entry - 7	Activate	
2	7 - 12	Discover	
3	12 - 14	Progress	
4	14 - 16	Develop	Develop
5	16 - 18	Apply	Apply
6	19 +		Excel
7	ANY	Inspire	

## LTAD Key Principles

USA Baseball, as the national governing body for the sport, draws on these key principles when developing initiatives such as the LTAD.

- **Health and Safety** – Provide the best practices to keep athletes active and on the field in order to create an opportunity for long-term development and lifelong fitness activity.
- **Education and Development** – Deliver resources and best practices that empower athletes, parents, coaches, and umpires to make the best decisions for their careers.
- **Grow the Game** – Create opportunities for people to play ball, regardless of ability.
- **Universal Availability** – Remove barriers of entry and provide playing opportunities for athletes everywhere.
- **Competition** – Highlight the many positive teaching moments and life lessons fostered through domestic competition and represent the United States within the international community.

## LTAD Key Definitions

The LTAD utilizes common terms throughout each stage. The major components for each stage are defined as follows.

- **Physical Literacy** – The ability to move with competence and confidence during different types of physical activities that promotes a long-term healthy lifestyle.
- **Physical Development** – Structured and progressive approaches to develop movement skill competency and the physical fitness resources to enhance the experience of training, practicing, and playing.
- **Injury Prevention** – Many injuries in baseball stem from overuse, thus monitoring athletes' fatigue and year-round involvement in sports is crucial.
- **Psychosocial Well-Being** – The ability to motivate oneself, influenced by the psychological needs of autonomy (personal choice or control), competence (success or effectiveness in one's environment) or relatedness (social connection to others, acceptance, belonging).
- **Specialization** – Nearly year-round (typically more than eight months per year), intensive training in a single sport, and excluding participation in other sports.
- **Periodization and Competition** – The timeframes that are used to schedule training, competition, and recovery. Periodization structures the training components into weeks, days and sessions, and is situation-specific, depending on priorities and the time available for training and competition improvement.



# The Long-Term Athlete Development Plan

This document serves as a long-term athlete development plan for the sport of baseball in the United States. As a multi-stage pathway for training, competition, and recovery, the LTAD guides an athlete's experience in sport and physical activity. Through developmentally appropriate programs for all ages, the LTAD aims to increase participation and optimize performance across the sport of baseball.

## Stage 1: Activate

Chronological Age: Entry – 7

**Foster a love for the game by introducing children to the sport of baseball through styles of gameplay that promote fun, creative play and success. Athletes in this stage should be developing basic movement and motor skills via sport sampling. Baseball should also be a means for developing friendships and encouraging other positive peer interaction. Proper warm up and cool downs should be part of the sport experience.**

### Physical Literacy:

- This is a fundamental stage for young athletes to develop basic physical literacy and fundamental movement skills.
- Basic fundamental skills should be taught and mastered before progressing into more complex skills. These fundamental skills should include: overhand throwing, catching, striking the ball, fielding a bouncing ball, running, and dodging. In order to achieve mastery of these skills, a remedial breakdown of specific skills may be required (e.g., rolling a ball at a very slow speed, helping a player swing to make contact with a ball on a tee).
- A modified form of baseball is recommended to increase mastery of basic skills. An example of game modification includes the Fun at Bat program. Specific baseball tasks can continue to be modified throughout this stage in terms of the size of the ball, distances of the bases, format of the game, etc.
- Early stage athletes should see and feel the correct movement pattern (i.e., throwing, catching, hitting) as early and often as possible.
- Demonstrations of appropriate skill performance are encouraged and should be performed by a knowledgeable coach.
- Athletes need to receive ample feedback while learning new skills.
- Early stage athletes should be actively involved in playing and developing skills with minimal boredom or “talking time” (e.g., avoid “single ball, one line” practice time where everyone is standing and awaiting a turn). Having multiple coaches available can help facilitate this with younger athletes.
- Early stage athletes should be introduced initially to closed skills first (e.g., hit off a batting tee) to control external factors before moving on.
- Early stage athletes' cognitive stress levels should be highly managed and easy decision making solutions should be provided.

### Physical Development:

- Children should be introduced to movement and play activities that develop motor skills and muscular strength in a fairly unstructured and exploratory manner. Game-based activities that are fun, engaging and socially stimulating can help young children experience the mere enjoyment of learning new skills and playing with friends. Creative games activities that develop hand-eye coordination (e.g., catch and toss) and body weight management abilities (e.g., hopping, jumping, and tumbling) can serve as the building blocks for more complex activities.

### Injury Prevention:

- Full body warm up before and full body cool down after practice for children to learn healthy habits.

- Participant pitching is discouraged during games.
- No year-round participation in a single sport; take at least four months off from throwing sports.

**Psychosocial Well-Being:**

- Begin to develop intrinsic motivation for lifelong sport and physical activity participation.
- Emphasize enjoyment of physical activity in general and baseball as a great avenue to experience sport enjoyment.
- Focus on modeling and rewarding (with praise, encouragement) positive sport behaviors/successes.
- Develop positive social interactions and communication among teammates, parents and coaches.
- The goal should be to foster a lifetime love of baseball; the emphasis at this age should be on promoting physical activity/baseball enjoyment and intrinsic motivation for movement and skill development.
- Psychological skill development should not be a primary focus, but monitoring athlete stress (by coaches and parents) and explaining the basic concepts of psychological skill development, including healthy goal setting, represents a positive and effective means to promote athlete psychosocial health and performance.
- Sport should be a venue for athletes to develop friendships and positively interact with peers and adults. This will set the stage for broader social development as well as a lifetime love of baseball.

**Specialization:**

- No single sport specialization.
- Sport and activity sampling are highly recommended.

**Periodization and Competition:**

- Parents and coaches should encourage sampling of multiple sports that primarily focus on deliberate play (activities that are intrinsically motivating and are meant to be enjoyed).
- Develop athleticism by playing multiple sports.
- Focus on high amounts of deliberate play.
- Athletes should spend 75 percent of dedicated time to sports training, or participating in deliberate play, and no more than 25 percent of dedicated time to sport should be spent competing.
- Athletes can participate in each sport one to two days per week in season, for no more than four months out of the calendar year at a time.

**Stage 2: Discover**

Chronological Age: 7 – 12

**Basic baseball skills are being fostered and in some cases honed. Athletic movement should become more advanced as speed, agility, balance and general coordination all improve. Athletes should be in an environment where they learn to be motivated to succeed, while continuing positive social development amongst teammates and competitors. Sport sampling and informal or deliberate play continue to promote well-roundedness. Injury awareness, including arm care should be present for the athlete, their coach and parents.**

#### **Physical Literacy:**

- The discover stage for young athletes is to continue basic development of physical literacy and fundamental movement skills, as well as improve agility, balance, coordination, and speed.
- Athletes can move on into beginner open skills (e.g., hit short soft toss from 5-10 feet) to moderate open skills (e.g., hitting controlled front toss or coach pitch) to finally advanced open skills (e.g., hitting live pitching) through a structured approach to skill development based on appropriate progression.
- A modified form of baseball is recommended to increase mastery of basic skills. An example of game modification includes the Fun at Bat program. Specific baseball tasks can continue to be modified throughout this stage in terms of the size of the ball, distances of the bases, format of the game, etc.
- Cognitive stress levels should continue to be managed and easy decision making solutions should be provided (e.g., fielding groundballs and coach tells the player where to throw the ball prior to the play) to allow for athletes to maintain minimal cognitive decision load while focusing on physical skills.
- Middle stage athletes should continue to see and feel the correct movement pattern for each basic skill (i.e., throwing, catching, hitting), but can also expand their basic skills into more technical skills once basic skill mastery is accomplished.
- Advanced skills and activities can be taught through individual practice or integrated into game activities.
- The addition of self-observation and review of their technique can begin to be applied (e.g., “how did that feel hitting?” or “why do you think that throw went to the right instead of on-target?”).
- Continue providing feedback to help athletes self-identify, or identify for themselves when errors are made.
- Athletes should start being actively involved in decision making process to decrease the amount of conceptual abstract ideas and be encouraged to make their own playing decisions while making large amounts of safe mistakes (i.e., no physical harm to themselves or others).

#### **Physical Development:**

- Health- and skill-related fitness qualities should be trained in an integrative manner with a focus towards enhancing competence and confidence in the ability to perform strength-building and skill-enhancing exercises.
- Younger children should be encouraged to engage in less formalized training and unstructured fitness activities, most seven- and eight-year olds are ready for some type of structured strength and conditioning as part of fitness conditioning.
- Early exposure to strength and conditioning programs that are developmentally-appropriate, technique-driven and supervised by qualified professionals will set the stage for even greater gains in physical fitness during adolescence and adulthood.
- While there is no “minimum age” for participation in strength and conditioning activities, participants must be able to following coaching instructions and be able to handle the demands of a training session.
- Athletes should learn basic movement patterns and progress to more complex exercises over time while gaining confidence and competence in their abilities to move with style and precision.

#### **Injury Prevention:**

- Focus on skill acquisition with good mechanics.

- Participate in stretching and tubing injury prevention program before practice and stretching after practice to encourage habit formation and development.
- Acquire throwing skill with mechanics that decrease the stress on the shoulder and elbow.
- Athletes should avoid throwing pitches other than fastballs and change-ups.
- Follow Pitch Smart recommendations for pitching guidelines and required rest.
- Once removed from the mound, pitchers should not return later in the game to pitch again.
- Pitchers should avoid pitching in multiple games on the same day.
- Pitchers should not exceed 60 (seven- to eight-year-olds) or 80 (nine- to 12-year-olds) combined innings pitched in a 12-month period.
- On days pitched, athletes should avoid playing catcher while not pitching.
- Athletes should avoid playing for multiple teams at the same time.
- No year-round participation in a single sport; take at least four months off from throwing every year, with at least two to three of those months being continuous.
- Athletes should participate in a full body-strengthening program to promote symmetrical balance.
- Focus on nutrition for recovery after participation.
- Educate athletes on injuries and how to communicate symptoms to parent/coach.

#### **Psychosocial Well-Being:**

- Begin to develop intrinsic motivation for lifelong sport and physical activity participation.
- Emphasize enjoyment of physical activity in general and baseball as a great avenue to experience sport enjoyment.
- Instill sport competence by providing opportunities for success and highlighting them.
- Minimize use of punishment for incorrect behaviors at this stage.
- Develop positive social interactions and communication among teammates, parents and coaches.
- Continue to develop intrinsic motivation for physical activity/baseball by emphasizing the satisfaction of effort and mastering skills.
- Continue to develop intrinsic motivation for baseball via autonomy supportive coaching methods and emphasizing aspects of baseball individual athletes enjoy.
- Create a mastery motivational climate where individual improvement, effort and skill development are modeled/rewarded.
- Encourage positive peer interactions and teamwork via modeling, reinforcement and communication. (i.e., team sports building).
- Introduce the concept of goal setting reach to attainable team and individual goals.
- Continue to foster positive peer relationships at this critical time when peer acceptance and social comparison are important and prevalent in sport.
- Continue to foster a mastery motivational climate where individual improvement and skill development is modeled/rewarded. All athletes should have opportunities to experience success and have input (i.e., autonomy) into their sport experience regardless of skill level.
- Carefully monitor athlete stress levels and psychological health markers (e.g., anxiety, depression); introduce basic psychological skills to manage stress and aid concentration.
- Promote enjoyment and intrinsic motivation with an emphasis on skill learning, effort and improvement. For ages 10-12, promotion of intrinsic motivation, positive social experiences and enjoyment will promote sport adaptive forms of sport commitment and deter dropout at a time where individual skill levels, success and interests will vary.

- Psychological skill development should not be a primary focus, but monitoring athlete stress (by coaches and parents) and explaining the basic concepts of psychological skill development, including healthy goal setting, represents a positive and effective means to promote athlete psychosocial health and performance.
- Closely monitoring and preventing/managing athlete stress and psychological health will further promote athlete well-being and encourage continued baseball participation.
- For ages eight to nine, competition need not be emphasized, as team building and group goal setting should promote positive baseball experiences and set a template for similar experiences in other sports being sampled. Peer comparison and competition will begin to be more common for athletes ages 10-12. This can be problematic when athletes are still learning skills and can deter motivation and enjoyment if they struggle. For this reason, individual skill development and supportive coach and teammate relationships should be promoted.

#### **Specialization:**

- Continue to strongly discourage single sport specialization – encourage two other sports to grow and cross train. This will serve to promote identity development, social development (exposure to multiple social groups) and discourage burnout and dropout.
- Children should sample a variety of sports and avoid specializing early in a single sport.
- Develop athleticism by playing multiple sports.

#### **Periodization and Competition:**

- Parents and coaches should encourage sampling of multiple sports that primarily focus on deliberate play. Less emphasis should be placed on deliberate practice compared to deliberate play. Some deliberate practice should be included to aid in skill acquisition.
- Athletes should spend 75 percent of dedicated time to sports training, or participating in deliberate play, and no more than 25 percent of dedicated time to sport should be spent competing.
- Athletes can participate in each sport one to two days per week in season, for no more than four months out of the calendar year at a time.

### **Stage 3: Progress**

Chronological/Development Age: 12 – 14

**Skill training is now becoming more specific and should include mechanical elements and awareness. Athletes should be self-motivated and will begin understanding how to self-diagnose aspects of their training and performance. Physical development should be technique driven and age appropriate, and overall wellness should include proper arm care planning. Competency (success or self-improvement) is important in this stage, as is a continued multi-sport approach. While competitive play will increase, more time should still be spent training proportionately.**

#### **Physical Literacy:**

- Athletes can start to become “their own best coach,” and thus able to self-correct errors. In order to do this, the use of expert models for skill demonstration and self-observed feedback should be encouraged. Expert models can include coaches and/or skilled athletes, or even a video of a player performing the skill.
- Continue to be introduced to new closed skills first (e.g., hit off a batting tee to control external factors while making mechanical adjustments, such as changing hand path position for hitting swing) and then progress into open skill environment with new mechanical adjustment.
- Cognitive stress levels should be manipulated in a cautious manner to simulate game experiences during the learning process (e.g., fielding groundballs with game scenarios of a man on second base with one out) to allow for athletes to become comfortable in making cognitive decisions while enacting physical skills.
- Athletes should continue to see and feel the correct movement pattern (i.e., throwing, catching, hitting), but the addition of advanced self-observation using video feedback and detailed review of their technique can begin to be applied.

#### **Physical Development:**

- Early exposure to strength and conditioning programs that are developmentally appropriate, technique-driven and supervised by qualified professionals will set the stage for even greater gains in physical fitness during adolescence and adulthood. While there is no “minimum age” for participation in strength and conditioning activities, participants must be able to follow coaching instructions and be able to handle the demands of a training session.
- Athletes should learn basic movement patterns and progress to more complex exercises over time while gaining confidence and competence in their abilities to move with style and precision.
- Focus on body weight exercises.

#### **Injury Prevention:**

- While pitching, focus on mechanics; athletes can add breaking ball pitches when fastball and changeup mechanics are well developed.
- Athletes should participate in stretching and injury prevention program before practice and stretching after practice.
- Strength and conditioning should emphasize core strength development and body weight exercises.
- Athletes should participate in a full body strengthening program to promote symmetrical balance.
- Follow Pitch Smart recommendations for pitching guidelines and required rest.
- Athletes should avoid pitching in multiple games on the same day.
- Pitchers should not exceed 80 (12-year-olds) or 100 (13-14-year-olds) combined innings pitched in a 12-month period.
- On days pitched, athletes should avoid playing catcher while not pitching.
- Athletes should avoid playing for multiple teams at the same time.
- No year-round participation in a single sport; take at least four months off from throwing every year, with at least two to three of those months being continuous.

- Refrain from using weighted ball throwing programs.
- Focus on nutrition for recovery after participation.

#### **Psychosocial Well-Being:**

- Emphasize enjoyment of physical activity in general and baseball as a great avenue to experience sport enjoyment.
- Continue to develop intrinsic motivation for baseball via autonomy-supportive coaching methods and emphasizing aspects of baseball that individual athletes enjoy.
- Continue to develop intrinsic motivation for baseball and mastery of motivational climates via modeling/reinforcement and promotion of sport competence. When correction is needed, utilize positive approaches to communication.
- Enhance sport commitment by making baseball an enjoyable and cost-effective (when possible) physical activity option. Also, provide athletes with autonomy (i.e., input) into their sport participation decisions.
- Develop leadership skills for individual athletes and promote relatedness (i.e., connection) between athletes and coaches to promote social involvement.
- Continue to monitor athlete stress and markers of psychological health (e.g., anxiety, depression). Promote psychological skills (advanced goal setting, arousal-regulation, concentration drills) to enhance well-being and facilitate performance.
- Educate parents and coaches on factors contributing to sport stress, low motivation and athlete burnout, as well as appropriate ages to consider baseball specialization.
- Excellent time to enhance earlier efforts to promote intrinsic baseball motivation, enjoyment and positive relationships within baseball as a means to promote participation into the high school years. A focus on satisfying athlete needs for competence, autonomy and relatedness in the sport environment will aid this goal.
- Proper education on prevention of elevated athlete stress, low motivation and burnout will help to promote psychosocial well-being and deter dropout.
- Athletes should be allowed to mentally and physically re-charge as appropriate. Structures for travel/select teams should allow athletes to experience other sport and non-sport opportunities. This should also serve to promote multidimensional athlete identities and deter athlete burnout and sport dropout.

#### **Specialization:**

- Athletes should sample a variety of sports and avoid specializing early in a single sport.
- Do not encourage single sport specialization; participation in one other sport is still highly encouraged.

#### **Periodization and Competition:**

- Athletes of higher talent levels and a desire to become an advanced baseball player can reduce involvement in extra sports (compared to the sampling years – up to 12 years of age) and increase deliberate practice. Athletes are still encouraged to continue some deliberate play in other sports.
- Athletes should spend 65 percent of dedicated time to sports training, and no more than 35 percent of dedicated time to sport should be spent competing.
- Athletes can participate in each sport two to three days per week in season, for four to eight months out of the calendar year at a time.

### **Stage 4: Develop**

Chronological/Developmental Age: 14 – 16

The athletes physical and skill development should become increasingly individualized and should cater to their own growth, and be specific to their preferred position(s). Safe training practices should be maintained, and rest and recovery after workouts, practices, and games remain imperative. Fostering a positive social environment that includes opportunity for self-determination for the athlete, and open communication between the athlete, parents and coaches will aid in success on and off the field. In appropriate instances, specialization may occur in this stage, but multi-sport athletics are still encouraged.

#### **Physical Literacy:**

- Athletes are likely experiencing major changes in growth. It is critical that movement quality during skills is maintained during this period. Coaches may need to revisit technique of basic skills (e.g. throwing, running) to ensure athletes maintain optimal performance without increasing injury risk.
- Athletes should continue to see and feel the correct movement pattern (i.e., throwing, catching, hitting), but the addition of advanced self-observation using video feedback and detailed review of their technique can begin to be applied. Video observation and feedback can be readily provided with coach and athlete interaction.
- Athletes can continue to become “their own best coach” – continue self-observation along with expert model information.
- Athletes should lead in decision making process (e.g., deciding to throw the ball home on a ball hit to the pitcher with a man on third base instead of making the easy out at first base) and continue to be encouraged to make their own playing decisions while making large amounts of safe mistakes.
- Athletes should continue refining baseball movement patterns in a closed skills setting first (e.g., new approach for glove positioning when fielding ground balls can be done with the ball stationary) to and then progress into open skill environment.
- Athletes fatigue and cognitive stress levels should be manipulated to simulate game experiences during the learning process (e.g., bottom of the last inning and 3-2 count during batting practice) to allow for refinement and control of cognitive and physical skill interplay.
- Athletes may benefit from more individualized training.
- Training intensity can begin to increase as athletes move through this stage.

#### **Physical Development:**

- Athletes should continue to participate in developmentally appropriate strength and conditioning activities that should be consistent with the specific demands of each player’s position.
- Total body fitness, muscular strength and motor skill competency remain key components of sport training programs for performance enhancement and injury reduction.
- Having the ability to express total body power safely within a spectrum of movement competencies that include acceleration and deceleration, pushing and pulling, and jumping and landing will provide the best opportunity for a player to exceed expectations on the field and tolerate the unpredictable impact forces experienced in high action sport activities.
- Adolescents who are not exposed to well-designed strength and conditioning program early in life will have more difficulty mastering movement skill and will be ill-prepared for advanced training.
- Coaches should have practical experience instructing resistance training exercises and conditioning activities to youth. In addition, coaches should be sensitive to inter-individual differences in physical development and fitness abilities between athletes of the same age.

#### **Injury Prevention:**



- While pitching, continue focusing on mechanics. Athletes can continue to add pitches when consistent mechanics with previously learned pitches are demonstrated.
- Stretching and injury prevention program before practice and stretching after practice.
- Strength and conditioning should emphasize core control development.
- Athletes should partake in full body training programs, not just strengthening programs, to promote symmetrical balance.
- Follow Pitch Smart recommendations for pitching guidelines and required rest.
- Pitchers should avoid pitching in multiple games on the same day.
- Pitchers should not exceed 100 combined innings pitched in a 12-month period.
- On days pitched, athletes should avoid playing catcher while not pitching.
- Athletes should avoid playing for multiple teams at the same time.
- No year-round participation in a single sport; take at least four months off from throwing every year, with at least two to three of those months being continuous.
- Use weighted ball throwing programs with caution.
- Focus on nutrition for recovery after participation.

#### **Psychosocial Well-Being:**

- Despite increases in competition level, continue to foster more self-determined forms of motivation by promoting athlete feelings of autonomy, competence and relatedness in their baseball experiences.
- Utilize autonomy-supportive coaching methods to develop a mastery oriented motivational climate, which supports effort/persistence.
- Encourage development of positive and cooperative relationships among athletes, parents and coaches via parent and coach training and athlete communication skills development.
- Educate parents and coaches on factors contributing to sport stress, low motivation and athlete burnout as well as appropriate ages to consider baseball specialization.
- Continue education on psychological skill development. Consult with a certified sport psychology consultant and/or trained mental health professionals for needs beyond education (i.e., clinical mental health issues).
- Excellent time to enhance earlier efforts to promote intrinsic baseball motivation, enjoyment and positive relationships within baseball as a means promote participation into the high school years. A focus on satisfying athlete needs for competence, autonomy and relatedness in the sport environment will aid this goal.
- Teaching athletes key psychological skills will aid in the management of stress and psychosocial well-being and facilitate concentration and performance.
- Athletes should be allowed to mentally and physically re-charge as appropriate. Structures for travel/select teams should allow athletes to experience other sport and non-sport opportunities. This should also serve to promote multidimensional athlete identities and deter athlete burnout and sport dropout.

#### **Specialization:**

- While single sport specialization may begin, it should be delayed as late as possible within this stage.
- Participation in one other sport is highly encouraged.
- Other recreational activities and sports continue to be an important factor in overall health and well-being.

#### **Periodization and Competition:**

- Recreational and advanced level athletes continue to play multiple sports that include elements of deliberate play and practice, for the promotion of fitness and enjoyment.

- Athletes of higher talent and a desire to become an advanced baseball player can invest their time in one sport (i.e., baseball) with others sports supplementing their training for their primary sport.
- Baseball can be the primary sport, but athletes should play other sports as well.
- Balance deliberate play with deliberate practice.
- Ensure game enjoyment.
- Athletes should spend 65 percent of dedicated time to sports training, or participating in deliberate play, and no more than 35 percent of dedicated time to sport should be spent competing.
- Athletes can participate in each sport three to four days per week in season, for four to eight months out of the calendar year at a time.

## **ADVANCED TRACK**

**Athletes who demonstrate an advanced level of development within the sport may wish to further dedicate themselves to their progression towards the upper echelons of the game. While maintaining a well-rounded approach, athlete training should further focus on position specific skills and mechanics. Baseball specialized athletes may spend added time throughout the year training and competing but should be even more alert to overuse related injuries, especially connected to throwing. Mentors should be aware that while these athletes may be gifted in sport, they are often on par with their peers' mental and social development. See "Develop" stage for additional markers.**

### **Physical Literacy, Physical development, Injury Prevention, Psychosocial Well-Being:**

- Athletes may be permitted at this stage to be placed on more of an advanced track for their sport development. However, while they may be showing advanced baseball skill sets and aptitude it is important to be mindful that they may be on the same physical and mental level as their peers who are not elite athletes. Continuing to meet their maturational needs in these areas is important while simultaneously pushing athletes towards advanced levels of play.

### **Specialization:**

- Allow single sport specialization if coaches, parents and athletes agree it is appropriate but it should not be a requirement of leagues/teams (i.e., breaks and cross-training should be considered).
- There are still many benefits to multisport participation.
- Athletes can begin identifying at primary skill set (infield, outfield, catcher, pitcher) where more, but not all, of skill development can be focused.
- Being a well-rounded, versatile athlete in several positions is recommended.

### **Periodization and Competition:**

- Time spent training versus competing should be equal.
- Athletes can spend four to five days per week in season training or competing.
- Athletes can spend four to eight months of the calendar year training and competing.

## Stage 5: Apply

Chronological/Developmental Age: 16 – 18

**Training and practices should be working towards team and individual optimization. Athletes should be able to use self-observation to identify mechanical and other skill deficiencies. Strength and conditioning activities should be athlete specific and should maintain an approach that ensures total body fitness, muscular strength and motor skill competency. Athletes should maintain an individualized arm care program, especially as the amount of competition increases over time. Single sport specialization among advanced athletes may occur. The promotion of positive developmental environments within teams and personal training settings remains important.**

### Physical Literacy:

- Athletes' fatigue and cognitive stress levels should be manipulated to simulate game experiences during the learning process (e.g., bottom of the last inning and 3-2 count during batting practice) to allow for refinement and control of cognitive and physical skill interplay.
- Athletes may benefit from more individualized training.
- Training intensity can begin to increase as athletes move through this stage.
- Athletes should maintain and seek expert enhancement of correct movement patterns through advanced self-observation (e.g., video feedback) and continue detailed review of their techniques. Video observation and feedback can be readily provided with coach and athlete interaction.
- Athletes should have a large databank of cognitive experiences and information to continue to be “their own best coach” – continual self-observation along with expert model information should be continually accessible.
- Athletes should lead in decision-making process (e.g., deciding to throw the ball home on a ball hit to pitcher with a man on third base instead of taking easy out at first base).

### Physical Development:

- Athletes should continue to participate in developmentally appropriate strength and conditioning activities that should be consistent with the specific demands of each player's position.
- Total body fitness, muscular strength and motor skill competency remain key components of sport training programs for performance enhancement and injury reduction.
- Having the ability to express total body power safely within a spectrum of movement competencies that include acceleration and deceleration, pushing and pulling, and jumping and landing will provide the best opportunity for a player to exceed expectations on the field and tolerate the unpredictable impact forces experienced in high action sport activities.
- Adolescents who are not exposed to well-designed strength and conditioning program early in life will have more difficulty mastering movement skill and will be ill-prepared for advanced training.
- Coaches should have practical experience instructing resistance training exercises and conditioning activities to youth. In addition, coaches should be sensitive to inter-individual differences in physical development and fitness abilities between athletes of the same age.

### Injury Prevention:

- While pitching, continue to focus on maintaining and repeating pitching mechanics.
- Stretching and injury prevention program before practice and stretching after practice to prevent adaptation of physical characteristics.
- Strength and conditioning should emphasize core control maintenance and development.
- Athletes should partake in full body training programs, not just strengthening programs, to promote symmetrical balance.

- Position-specific strength and conditioning programs can be added to the strength and conditioning program.
- Monitor workload, changes in performance, changes in mechanics, and subjective measures of fatigue.
- Follow Pitch Smart recommendations for pitching guidelines and required rest.
- Pitchers should avoid pitching in multiple games on the same day.
- Pitchers should not exceed 100 combined innings pitched in a 12-month period.
- On days pitched, athletes should avoid playing catcher while not pitching.
- Athletes should avoid playing for multiple teams at the same time.
- No year-round participation in a single sport; take at least four months off from throwing every year, with at least two to three of those months being continuous.
- Use weighted ball throwing programs with caution.
- Focus on nutrition for recovery after participation.

### **Psychosocial Well-Being:**

- Despite increases in competition level, continue to foster more self-determined (i.e., intrinsic) forms of motivation by promoting athlete feelings of autonomy, competence and relatedness in their baseball experiences.
- Utilize autonomy-supportive coaching methods to develop a mastery oriented motivational climate.
- Encourage development of positive and cooperative relationships among athletes, parents and coaches via parent and coach training and athlete communication skills development.
- Educate parents and coaches on factors contributing to sport stress, low motivation and athlete burnout and appropriate ages to consider baseball specialization.
- Continue education on psychological skill development. Consult with a certified sport psychology consultant and/or trained mental health professionals for needs beyond education (i.e., clinical mental health issues).
- Excellent time to enhance earlier efforts to promote intrinsic baseball motivation, enjoyment and positive relationships within baseball as a means promote participation into the high school years. A focus on satisfying athlete needs for competence, autonomy and relatedness in the sport environment will aid this goal.
- Teaching athletes key psychological skills will aid in the management of stress and psychosocial well-being and facilitate concentration and performance.
- Competition levels are likely to increase for non-recreational athletes in both the 15-16 and 17-18 age groups. Yet, coaching methods should still remain positive and enhance athlete motivation via promotion of autonomy, competence and relatedness. Coach and parental education is key to monitoring and promoting athlete well-being. Athletes will likely have developed physically, cognitively and socially between these two age groups. However, programming recommendations are largely similar for these age groups.

### **Specialization:**

- Allow single sport specialization as appropriate when athlete, coach and parents agree it is appropriate. Training breaks and cross training should be utilized as needed if single sport specialization is pursued.
- Other recreational activities and sports continue to be an important factor in overall health and well-being.

### **Periodization and Competition:**

- Athletes of higher talent and a desire to become elite baseball players can invest their time in one sport (i.e., baseball) with others sports supplementing their training for their primary sport.)
- Advanced level baseball.
- Significant amount of deliberate practice and game improvement should be included.
- Reduce but not eliminate multisport participation.
- Ensure game enjoyment.

- Athletes should spend 65 percent of dedicated time to sports training, or participating in deliberate play, and no more than 35 percent of dedicated time to sport should be spent competing.
- Athletes can participate in each sport four to five days per week in season, for four to eight months out of the calendar year at a time.

## **ADVANCED TRACK**

**Advanced level athletes within this stage are those who are likely to graduate to the Excel stage, and will play either at the collegiate or professional levels. While those outcomes may motivate the athlete, a process based development plan should be maintained that promotes a well-rounded approach to the physical, mental and social sides of the sport. Single sport specialization in this stage is more likely to occur, although it is not mandatory for baseball advancement. Increased competition levels, mean an increased focus should be paid to total body wellness and arm care. Skill specific training should be advanced with the athlete possessing a base of knowledge in individual and situational play. See “Apply” stage for additional markers.**

### **Physical Literacy, Physical development, Injury Prevention, Psychosocial Well-Being:**

- Avoid athlete overuse and burnout.
- This is the stage for which the pursuit of college scholarships and Major League Baseball draft status has the ability to overshadow long-term developmental goals.
- Athletes should continue to experience enjoyment from playing the game while pursuing personal objectives.

### **Specialization:**

- Allow single sport specialization if coaches, parents and athletes agree it is appropriate but it should not be a requirement of leagues/teams (i.e., breaks and cross-training should be considered).
- Single sport specialization of advanced athletes in this stage is more likely to occur.
- There are still many benefits to multisport participation.

### **Periodization and Competition:**

- Slightly more time can be devoted to competing versus training.
- Athletes can spend four to five days per week in season training or competing.
- Athletes can spend eight months of the calendar year training and competing.

## Stage 6: Excel

### ***Advanced Track Athletes Only***

Chronological Age: 19 +

**Athletes in this stage are maximizing their physical, psychosocial, and skill specific preparation and performance. Mastery of all individualized mechanical functions and team related situational plays are being worked on as a daily occurrence in practice and in games. Physical competencies should be optimized with athletes training to move and think at levels approaching their personal best. Coaches within this stage should be experts within their specific field. Single sport specialization is highly likely, but other recreational sports can aid in overall well-being as allowable. Position specific training and nutritional guides should be implemented to support the challenging practice and competition schedules athletes will endure.**

#### **Physical Literacy:**

- Athletes should maintain and seek expert enhancement of correct movement patterns through advanced self-observation (e.g. video feedback) and continue detailed review of their techniques.
- Athletes should have a large databank of cognitive experiences and information to continue to be “their own best coach” – continual self-observation along with expert model information should be continually accessible.
- Athletes should lead in decision making process (e.g., deciding to throw the ball home on a ball hit to pitcher with a man on third base instead of taking easy out at first base) and continue to be encouraged to make their own playing decisions while continually trying to minimize cognitive and physical mistakes.
- Continue refining baseball movement patterns in a closed skills setting first.
- Athletes fatigue and cognitive stress levels should be highly manipulated to simulate game experiences during the learning process (e.g., scrimmage games, simulated games, live game situations) to allow for refinement and control of cognitive and physical skill interplay in continual expert motor learning.
- Athletes should work closely with the available training and medical teams to insure well-round professional approach to the game and overall well-being.

#### **Physical development:**

- Having the ability to express total body power safely within a spectrum of movement competencies that include acceleration and deceleration, pushing and pulling, and jumping and landing will provide the best opportunity for a player to exceed expectations on the field and tolerate the unpredictable impact forces experienced in high action sport activities.

#### **Injury Prevention:**

- While pitching, continue to focus on maintaining and repeating pitching mechanics.
- Stretching and injury prevention program before practice and stretching after practice to prevent adaptation of physical characteristics.
- Strength and conditioning should emphasize core control maintenance and development.
- Athletes should partake in full body training programs, not just strengthening programs, to promote symmetrical balance.
- Addition of position-specific strength and conditioning programs.
- Monitor workload, changes in performance, changes in mechanics, and subjective measures of fatigue.
- Follow Pitch Smart recommendations for pitching guidelines and required rest.
- Pitchers should avoid pitching in multiple games on the same day.
- On days pitched, athletes should avoid playing catcher while not pitching.
- Athletes should avoid playing for multiple teams at the same time.

- No year-round participation; take at least four months off from throwing every year, with at least two to three of those months being continuous.
- Use weighted ball throwing programs with caution.
- Focus on nutrition for recovery after participation.
- Athletes can use recovery therapeutic agents.

#### **Psychosocial Well-Being:**

- Continue to promote self-determined motivation for and enjoyment of baseball in both recreational and competitive environments.
- Continue to monitor athlete psychological health and psychological skill development for high-level athletes continuing to play competitively.
- Encourage lifelong learning for recreational athletes as well as baseball play as a means to promote physical activity and psychosocial development.
- Foster development of lifelong friendships and mentoring relationships both in and out of the sport of baseball.
- Encourage mentorship/involvement with younger athletes at this age to simulate the role we want baseball participants to play in the next age group. Develop baseball competence, autonomy and relatedness in both mentors and mentees.
- Re-emphasis on athlete education about sport stress, burnout and guidelines for single sport specialization.
- Self-determined motivation and enjoyment are keys for continued interest/participation across the lifespan.
- Psychological health monitoring and psychological skill development should be a priority for those continuing to play competitively.
- Should be encouraged to get involved via mentoring as a means to facilitate future baseball involvement. Lifelong education will facilitate healthy experiences for these athletes as well as future youth baseball athletes.

#### **Specialization:**

- Highly advanced and competitive sport settings will tend to promote single sport specialization in this stage. Single sport specialization of advanced athletes in this stage is more likely to occur.
- As is permissible within the competitive environment, other recreational activities and sports can continue to be an important factor in overall health and well-being.
- Allow single sport specialization if coaches, parents and athletes agree it is appropriate but it should not be a requirement of leagues/teams (i.e., breaks and cross-training should be considered).
- There are still many benefits to multisport participation.

#### **Periodization and Competition:**

- Athletes should focus on training more so than competing.
- Athletes should participate in sports three or more times a week for health benefits.
- Include participation in sports as part of the year round health regimen.
- Athletes should spend 70 percent of dedicated time to sports training, or participating in deliberate play, and 30 percent of dedicated time to sport should be spent competing.
- Time spent training and competing can be dependent upon the collegiate or professional level of play.

## Stage 7: Inspire

Chronological Age: Any

**This stage of development can be accessed at any point after the Activate stage. Those who inspire within the game continue to participate in a bat and ball sport to foster a healthy lifestyle. Athletes should remain involved in any capacity, whether it is as a player, coach, umpire, or volunteer. Participation in gameplay either at baseball recreational levels or on the softball field is encouraged. Developing a love and mentoring future generations through positive experiences in baseball allows athletes to pass on the many great life lessons learned through the game.**

### **Active Participation:**

- All adults should avoid inactivity. Some physical activity is better than none, and adults who participate in any amount of physical activity gain some of the health benefits that physical activity offers.
- Adults (ages 18+) should get at least two and a half hours (150 minutes) each week of moderate-intensity aerobic physical activity, or an hour and fifteen minutes (75 minutes) a week of vigorous-intensity aerobic physical activity.
- Along with aerobic activities, adults should also do strengthening activities at least two days a week.
- For additional health benefits, adults should try to increase aerobic physical activity to five hours (300 minutes) a week, or two and a half hours (150 minutes) a week of vigorous-intensity aerobic physical activity.
- Aerobic activities require moderate physical effort and include, but are not limited to: biking slowly, canoeing, ballroom dancing, general gardening, using a manual wheelchair, arm cycling, walking briskly, and water aerobics. Examples of vigorous activities include playing baseball, jumping rope, running, swimming, or playing other sports.
- Muscle-strengthening activities exercise the major muscle groups (legs, hips, back, chest, shoulders, and arms) and include, but are not limited to: lifting weights, push-ups, sit-ups, and working with resistance bands.
- Bone-strengthening activities promote bone growth and strength by producing a force on the bones. Most aerobic and muscle-strengthening activities are also bone-strengthening activities (3).

### **Mentorship and Engagement:**

- Continue to enjoy baseball as a casual fan.
- Give back to the game by becoming a coach, umpire, instructor, volunteer, or mentor.
- Seek out education within baseball, for example coaching or umpire education.
- Education is important so that positive experiences can be facilitated for these athletes that may one day be in the position to promote healthy baseball participation for other youth or adolescent baseball athletes.
- Re-emphasize the need to foster intrinsic motivation and enjoyment of baseball in athletes, team, and mentees.

## Key Factors Influencing the LTAD

**There are six key factors influencing the LTAD:**

1. Physical Literacy and Skill Acquisition



2. Physical development
3. Injury Prevention
4. Psychosocial Well-Being
5. Specialization
6. Periodization and Competition

## **1. Physical Literacy and Skill Acquisition**

Baseball offers a valuable opportunity for individuals to be physically active across a lifespan. For children, baseball provides a unique exposure to a variety of fundamental movement skills that can be transferred to other sports and activities to ensure physical literacy, the ability to play other sports, and long-term athletic development. Physical literacy is frequently defined as the ability to move with competence and confidence during different types of physical activities. In order to optimize growth and athletic potential, baseball instruction should be tailored to the developmental ability of each child. Children develop mastery of movement control, or sport ability, at different rates and stages of maturation. This is critical to understand because without this mastery of basic fundamental skills, children may not progress in the sport or skill, become injured, and/or choose to leave baseball, and possibly all sports.

The term “fundamental movement skill” is frequently used to describe common motor activities that are the underlying framework for basic movements and complex sport and movement skills. Examples of these fundamental movement skills include walking, running, jumping, hopping, skipping, catching, and throwing. Physical and cognitive maturation are important for the development of these skills, but the environment via practice opportunities and social encouragement also influence whether or not these skills are effectively developed (8). As fundamental skills are attained, they are gradually combined and progressed to become more advanced sport skills (8). Sometimes children have difficulty acquiring these skills and these problems may differ between individuals, but are usually due to incomplete modeling of movements of other individuals, initial success with an incorrect movement, lack of motivation, inappropriate or scarce learning opportunities, or problems with sensorimotor integration (8).

In comparison to other sports, baseball has a unique ability to help children develop a wide variety of fundamental movement skills based on the nature of the sport. For example, catching, running, jumping, overhand throwing, leaping, dodging, forehand strike and two-hand side-arm strike are all fundamental motor skills that can be addressed during baseball. Once mastered, these fundamental movements can be further advanced into sport-specific skills, such as throwing, batting, sliding, diving, and shuffling during baseball. A child needs to be able to strike a stationary object (tee-ball) consistently before moving to a moving object (coach pitch). Mastery of fundamental movements is critical for all children because it is associated with physical activity participation and improved health and well-being in children (8, 9).

Physical education is not compulsory for all children or a large part of many children’s education curriculums. Consequently, if not for sport, many children will not be taught these skills by anyone. Gallahue (8) noted this failure in skill development might be because many people believe children will automatically learn these fundamental skills and do not need to be taught. Acquisition and development of fundamental motor skills needs to be an important objective of society, because possessing these skills leads to improved physical activity levels and increased participation in games and sports. (8, 10, 12) A failure to reach competency in a variety of the fundamental motor skills will cause limited proficiencies of sport specific skills (8). Youth participation in developmentally appropriate sport activities has been recommended to encourage future participation in sports and physical activity throughout a lifetime (8, 11).

An important consideration that baseball instructors should understand is their role as “teachers of movement or skill development.” Coaches and parents need to be involved in the process of skill acquisition and athletic development, not

just as passive instructors. Coaches and parents need to understand what is appropriate technique and movement quality, as well as how to provide effective instruction and feedback. The ability for a baseball instructor to understand the role of the motor learning process for movement skill acquisition is paramount to being able to provide quality coaching for baseball athletes of all ages.

### ***Performance vs. Learning***

The main difference between learning and performance is that learning is considered to be relatively permanent and stays relatively constant over time. Performance, on the other hand, is the behavioral act of executing a skill at a specific time in a specific situation. In the baseball instruction setting, an example of the distinction between performance effects and learning effects can be seen when evaluating a ballplayer's hitting capability. An immediate batting instruction goal could be for the batter to hit line drives to the opposite field. The instructor has the ballplayer perform numerous drills to influence the ballplayer's ability to hit line drives to the opposite field. At the end of the session, the instructor sees the ballplayer leave the field being able to consistently hit line drives to the opposite field with sound hitting technique. The question here is: Has the ballplayer acquired a good swing pattern that transfers to learning to hit in real game situations or is the ballplayer just performing well during practice drills? The answer cannot be known because the only assessment of performance was done during the practice situation, which involved assistance from the instructor. The more critical analysis should take place later on in the day or over the course of the next few days in a natural game environment (especially in a situation when the ballplayer does not suspect they are being observed and that they should be "performing" proper hitting technique). By making these later observations, the instructor analyzes the retention and transfer effects of the instruction, which is the key markers of learning, rather than the performance effects observed during the practice session. These later observations will allow the instructor to more accurately estimate their success as a "teacher of movement," while also analyzing the ballplayer's stage of learning the intended skill.

### ***Stages of Motor Learning Theory***

Fitts and Posner (13) described a theory related to the stages of motor learning that people go through when learning a new movement task. They suggested that there are three main stages involved in motor learning: (1) cognitive, (2) associative, and (3) autonomous. The first phase of learning, according to Fitts and Posner, is the cognitive stage of learning. The cognitive stage is associated with the learner initially developing an understanding of the requirements of the movement task and initially developing strategies that can be used to carry out the task. Fitts and Posner (13) theorized that this initial stage required a high degree of cognitive activity (e.g., attention, memory) and that a learner often experiments with a variety of movement strategies resulting in large movement variability. The cognitive stage is marked with a large amount of variability, but it also is noted for large improvements in learning as a result of the beginning stages of learning. The second phase of learning, according to Fitts and Posner (13), the associative stage, is when the learner has selected the best strategy for movement from the cognitive stage and now begins to refine the movement skill. The variability in performance tends to decrease in the associative stage and improvement also occurs at a much slower rate. The associative stage may vary in duration (e.g., days, week, or months) and is dependent upon both skill and learner characteristics. The final stage of motor learning, according to Fitts and Posner (13), is the autonomous or "automatic" stage. The final autonomous stage is defined by Fitts and Posner (13) as the "automaticity of skill" and requires little attentional demand for performance. In the final stage of motor learning, Fitts and Posner (13) state that learners can begin to devote their attention to other aspects of the movement (e.g., recognizing and hitting a curveball to the opposite field or seeing a runner break for home plate while preparing to field a ground ball). Individuals may move between the associative or autonomous stage dependent on numerous motor skill learning parameters (e.g., practice schedule, feedback, task demands), thus an individual can always enhance or reduce the automaticity of the movement task and attempt to achieve consistent optimal movement skills (e.g., baseball pitching, hitting, fielding). Caution should be taken, as repetition of the exact same movement pattern might cause suboptimal learning compared to allowing the utilization of movement pattern variation, which stimulates the nervous system to create optimal solutions for

unanticipated events more effectively (14). A combination of directed practice and variability in movement patterns is optimal for learning new skills.

### ***Attentional Focus***

Instructions from coaches/parents oftentimes start off with information focused on internal aspects of movement (e.g., keep elbow higher, move feet wider, and snap your wrist). These aspects of instruction are termed internal focus of attention and can help to start the guidance of movement, but oftentimes fall short in longer-term motor learning. Conversely, drawing a learner's attention towards an outcome or effect of the movement (e.g., pull the cloud down as you throw, exchange your shoulders as you swing through the ball, land light as a feather when stepping to swing) are considered external focus of attention instructions which have demonstrated improved motor learning capabilities in the long-term. Review of the motor learning research has shown that external focus of attention instructions helps to accelerate the initial stages of the learning process by facilitating the development of movement strategies to produce effective movement patterns (15, 16). A typical external focus of attention concept utilization in baseball is the use of a batting tee for hitting mechanics. The external focus of the swing is to hit the ball on the tee towards the opposing team as contrasted to an internal focus of attention concerning hand and elbow placement in swinging a bat. Initial learners can be guided through visual feedback, but oftentimes the physical movement pattern exploration relative to the external focus of attention allows for the learner to create efficient movement tasks to complete the intended goals. Advanced learners can flow back and forth between internal and external attentional foci, but a majority of the learning process is aided by external focus of attention.

Physical literacy can be defined in many different ways. The Aspen Institute and Project Play defines physical literacy as the ability, confidence, and desire to be physically active for life. The Functional Movement Systems program defines physical literacy as competency, complexity, and capacity for physical activity. Sport Canada has developed the following basic movement skills for all sports as:

#### **Locomotor Skills:**

- Boosting
- Climbing
- Galloping
- Gliding
- Jumping
- Leaping
- Running
- Skipping
- Sliding
- Swimming
- Swinging

#### **Object Control Skills:**

- Sending
  - Kicking
  - Punting
  - Rolling
  - Striking
  - Throwing
- Receiving

- Catching
- Stopping
- Trapping
- Traveling with
  - Dribbling (feet)
  - Dribbling (hands)
  - Dribbling (stick)
- Receiving and Sending
  - Striking (bat)
  - Striking (racquet)
  - Striking (stick)
  - Volleying (limbs)

**Balance Movements:**

- Balancing
- Dodging
- Floating
- Landing
- Ready position
- Sinking/Falling
- Spinning
- Stopping
- Stretching
- Swinging
- Twisting

**2. Physical Development**

While there are increasing opportunities to participate in more competitive sport environments at younger ages, in order to perform at an elite level and withstand the mounting demands of training and competition, young baseball athletes must be prepared for their sport. Inadequate or inappropriate preparation during the initial sport preparation stage contributes to compromised skill development, injury, burnout, dropout and unrealized talent potential (17). Player Development Model frameworks should recognize the multidimensional nature of athletic development and the critical importance of physical fitness for each developmental phase (18, 19). A certain level of force production and force attenuation is required to perform all athletic movements, and therefore preparatory physical development should be considered foundational to long-term athletic development (35). At present, leading fitness and sports medicine organizations support participation in youth physical development programs that are consistent with the needs and abilities of young athletes (20).

Despite global physical activity recommendations, a corollary of modern day lifestyles is a lower level of muscular fitness and motor skill competency among school age youth (21-23). Without preventive measures that target deficits in muscular strength, a growing number of aspiring young athletes may not be prepared for the demands of sports practice and games (24). Since participation in organized youth sports does not ensure a suitable level of general fitness that is consistent with sustainable performance at an elite level (25, 26), a structured and progressive approach is needed to develop movement skill competency and muscular strength in young athletes. Clearly, participation in youth baseball should evolve out of general preparatory conditioning and instructional practice sessions that enhance general physical fitness.

Sport participation with strength and conditioning can enhance athletic performance, reduce the incidence of sports-related injuries and improve markers of health (19, 20, and 27). Stronger young athletes will be better prepared to learn complex movements, master sport tactics and withstand the demands of long-term sports training and competition (19). From a public health perspective, early exposure to strength and conditioning that emphasize the development of muscular strength and movement skill competency can serve as a foundation for regular participation in physical activity as an ongoing lifestyle choice (18, 35, and 29).

In order to foster positive physical development, maintain adherence to the training programs and optimize long-term adaptations, youth strength and conditioning programs should be sensibly progressed and manipulated over time. Young baseball athletes who are not exposed to this type of training will inevitably need to address technical flaws and neuromuscular deficiencies as part of injury rehabilitation or athletic development later in their sport careers. Moreover, young athletes who engage in intensive year-round training in one sport early in life are more likely to suffer sports-related injuries (30). There is an unparalleled opportunity early in life to target strength development and promote multisport participation to set the stage for enhanced athletic development later in life.

Effective and integrative approaches to long-term athletic development should include the qualified prescription of strength and conditioning programs that are designed to address individual limitations in an attempt to make youth sport more engaging, enjoyable and safe (17, 31). The direct result of sustained participation in developmentally appropriate strength and conditioning programs is the improvement in a wide range of athletic capabilities. Since a certain level of muscular strength is needed to throw, jump and sprint proficiently, the importance of strength and conditioning for young baseball athletes should not be overlooked. Just like reading and writing, the development of muscular strength and motor skills can be enhanced with regular practice, meaningful feedback and qualified instruction.

Owing to the high degree of neuromuscular “plasticity” during preadolescence, the effects of physical development on motor skill performance appear to be more pronounced in children than adolescents (32, 33). Consequently, young baseball athletes need regular opportunities to develop sufficient levels of muscular strength and movement skill competency. The dynamic relationship among muscular strength, motor skill proficiency and athletic performance will likely be reinforced over time, which is consistent with the existence of a positive feedback loop. Without opportunities to gain confidence and competence in their physical abilities early in life, young athletes will be less likely to reach their athletic potential later in life and more likely to experience negative health outcomes.

Training-induced adaptations to physical development are influenced by the neuroplasticity at each stage of development, in addition to the design of the training program and quality of instruction. Different types of strength and conditioning have proven to be effective, although the training intensity and volume are important considerations (34, 35). Significant positive correlations have been found between gains in motor performance skills and the mean intensity (% 1 repetition maximum) of the training program (32). Therefore, once beginners develop proper form and technique with light loads, the amount of resistance should be gradually increased as participants gain confidence and competence in their physical abilities. The minimal dose of training required to elicit the desired effect is different in untrained and trained youth, and therefore it is important to consider each player’s strength and conditioning experience when designing training programs.

Existing research indicates that regular participation in integrative strength and conditioning programs can elicit performance improvements in muscular strength, muscular power, running velocity, change of direction speed, dynamic balance and flexibility in children and adolescents (35,36). Other researchers reported favorable improvements in throwing velocity (41, 42) and torso rotational and sequential hip-torso-arm rotational strength (43) following several weeks of supervised physical development in young baseball athletes. Integrative training includes general and specific

exercises that improve muscular fitness and enhance a range of physical qualities including fundamental movement skills (36). Naturally, as muscular strength and skill proficiency improve, the load and complexity of the strength and conditioning program should be consistent with the training experience and technical abilities of young athletes. This is where the art and science of developing youth strength and conditioning programs come into play because the principles of pediatric exercise science need to be balanced with effective coaching in order to enhance a player's physical, social, cognitive and emotional well-being (28). Inappropriate coaching approaches and extreme conditioning protocols can result in overtraining, injury and burnout. Qualified professionals who are well versed in physical development and skilled in teaching and communicating with young athletes should design and implement youth strength and conditioning programs.

### **3. Injury Prevention**

While catastrophic injury in baseball is rare, other less severe injuries have a more common occurrence, even among young athletes. These injuries, such as bruises, cuts, scrapes and other minor injuries are often understood. However, there is significant attention focused on chronic and overuse injuries occurring in the sport of baseball across all age groups. There are many injuries that a baseball player may experience and various mechanisms for how these injuries can occur (91).

#### ***Common Youth Injuries***

For youth baseball injuries, because there is no overall surveillance mechanism to capture exposure, these data are presented as relative frequencies of injuries that have occurred between January 1994 and February 2015. The youth data provided are from accident insurance claims data broken out into two age categories: ages 5-12 and ages 13-19. These data may reflect more severe injuries as they are from accident claims data, but do describe patterns of injury occurring in youth baseball. These data do not include exposure to risk of injury or overall injury prevalence out of all participants over the course of a season.

- For ages 5-12, the leading activities engaged in while injured in order of frequency include fielding batted ball, catching thrown ball, batting, sliding, running and catching pitched ball.
- For ages 13-19, the leading activities engaged in while injured in order of frequency include fielding batted ball, sliding, batting, catching thrown ball, running and pitching.
- For ages 5-12, the most common injury types in order of frequency are fracture, bruise/contusion, joint sprain/strain, dental, cut/scrape and concussion.
- For ages 13-19, the most common injury types in order of frequency are fracture, bruise/contusion, joint sprain/strain, cut/scrape, dental and dislocation.
- For both age groups, the most common locations of injury occurrence in order of frequency are infield, home plate and outfield.
- For both age groups, injuries were more common in games than in practices.

In addition to the claims data, literature around throwing related injuries among youth has also suggested that a much higher percentage of youth baseball pitchers are suffering chronic, overuse injuries and having surgery (91).

#### ***Common High School Injuries***

The high school baseball injury data presented here are a summary of the most recent injury pattern data available through high school injury surveillance systems. As exposure to risk is captured in these types of studies, we are able to estimate incidence rate (how many injuries occur per so many exposures to injury risk) and prevalence (what proportion of the population suffers an injury).

- In general, the overall injury rate (how many injuries per exposure to a risk in baseball) is relatively low in high school baseball compared to other sports.

- A slightly higher percentage of injuries in high school baseball occur among position players compared to pitchers; however, many position players also pitch across a baseball season,
- The shoulder and the elbow are the most commonly injured body parts.
- Shoulder injuries are more common in the earlier parts of the season than in the later part of the season.
- Elbow injuries are more common toward the end of the season.
- The most common injury types are ligament sprains and muscle strains
- Most injuries in high school baseball are considered mild (fewer than seven days lost to participation); however, approximately 10 percent of injuries in baseball require surgery and/or result in medical disqualification for a season.
- Although rare, injuries resulting from being hit by a batted ball are more likely to result in surgery (91)

Many baseball injuries are due to overuse of the throwing arm. Monitoring throwing activities, especially among pitchers, may aid in decreasing the relative frequency and occurrence of these types of injuries. There are many valid resources for aiding parents, coaches, and athletes in injury prevention including education programs, pitch count limits, and training programs that may aid in preventing injuries in baseball, these can be found through the Amateur Resource Center and Pitch Smart websites (91).

### ***Pitching Injuries***

While all positions present some risk, pitchers account for 73 percent of injuries in high school baseball athletes, of which approximately 38 percent require surgery (37). In a longitudinal evaluation, five percent of adolescent baseball pitchers developed a shoulder or elbow injury that resulted in surgery or retirement from sport (38). In youth baseball, almost half of all pitchers report elbow or shoulder pain at some point during a baseball season (39, 40). With baseball, especially pitching, a large number of injuries and lost time is attributed to upper extremity injuries such as impingement, rotator cuff injury, shoulder instability, labral tears, and elbow ulnar collateral ligament injury (48, 39-45).

### ***Pitching Mechanics***

Pitching mechanics are critical to injury prevention, independent of pitch type, and considerable time should be spent teaching mechanics that decrease the stress on the shoulder and elbow for both decreased injury risk and improve performance. The pitching motion is a complex movement that generates tremendous force and places significant strain on the soft-tissue restraints of the upper extremity (46).

Interestingly, some of the pitching mechanics that have been reported to increase elbow joint stress also are associated with greater throwing velocity. Specifically, greater shoulder external rotation range of motion was found in collegiate pitchers who were classified as high-velocity pitchers (mean >85mph) compared to low-velocity pitchers (mean <76.5 mph) (47). Greater shoulder external rotation has been hypothesized to increase the stored elastic energy of the internal rotators and improve the stretch-shortening cycle increasing the concentric strength of the internal rotators during the acceleration phase of pitching thus ultimately increasing pitching velocity (47). In addition, excessive contralateral trunk tilt has been associated with greater pitching velocity (47). The authors of this study suggest that with increased contralateral trunk tilt indirectly increases maximum shoulder external rotation, which results in a greater pitching velocity. Continued research is needed in order to maximize performance, while minimizing injury risk.

Davis et al (48) identified 5 parameters that can be evaluated on video analysis: leading with the hips, hand on-top position, arm in throwing position (elbow at max height at stride foot contact), closed-shoulder position, and stride foot toward home plate. Youth pitchers who perform three or more of these parameters correctly display lower elbow valgus load, thus decreasing the stress on the UCL and lower humeral internal rotation torque decreasing stress on the shoulder passive and dynamic restraints (48). In addition, serial evaluations at all levels of baseball can also serve as indicators of

changes that are occurring in the pitching motion due to fatigue or injury and may provide valuable information to the coach and clinician.

**Pitch Count**

Repetitive throwing causing microtrauma without adequate time for recovery has been proposed as a risk factor for upper extremity injuries (39, 49, and 50). High pitch counts are often blamed for injury in the media and among parents of younger athletes. In youth baseball athletes, higher pitch counts have been associated with increased risk for shoulder and elbow pain (39, 40). Olsen et al (51) saw that higher number of warm-up pitches, more innings pitched per game, more pitches thrown per game, and pitching eight or more months out of the year were associated with a higher risk of elbow injuries in youth baseball pitchers. In a group of 9-12 year old pitchers, the risk of should pain increased 15 percent for every 10 additional pitches thrown and pitchers who threw more than 75 pitches per outing were three times more likely to experience shoulder pain those who pitched 1-24 pitches (40). The risk of elbow pain increased six percent for every 10 pitches thrown, and pitchers who threw more than 75 pitches per outing were 1.5 times more likely to experience shoulder pain those who pitched 1-24 pitches (40).

The USA Baseball Medical and Safety Advisory Board and American Sports Medicine Institute combined research evidence with clinical expertise to create participation recommendations for youth and high school baseball athletes in the Pitch Smart Guidelines (52). These guidelines specify outing pitching limits, as well as rest and recovery periods. Work by USA Baseball Medical and Safety Advisory board and American Sports Medicine Institution have identified outing, weekly, and season guidelines for youth and adolescent baseball athletes (53, 54). These organizations also recommend that youth pitchers have inning restrictions in a year and take at least two to four months off from baseball participation each year. It is imperative that parents and coaches track the number of pitches that their athlete is throwing. These guidelines are of cumulative load and are not team specific.

AGE	DAILY MAX (PITCHES)	REQUIRED REST					
		0 Days	1 Day	2 Days	3 Days	4 Days	5 Days
7-8	50	1-20	21-35	36-50	--	--	--
9-10	75	1-20	21-35	36-50	51-65	66+	--
11-12	85	1-20	21-35	36-30	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	61-80	81+	--
19-22	120	1-30	31-45	46-60	61-80	81-105	106+

**4. Psychosocial Well-Being**

Participating in baseball across the lifespan represents a key activity that can promote lifetime physical fitness as well as psychosocial development. When approached properly, baseball athletes can gain much from lifelong participation including development of: 1) social skills and peer relationships, 2) physical competence and psychological well-being and 3) enjoyment of and intrinsic motivation for participation in competitive and/or recreationally baseball for a lifetime. When considering a player’s maturation within the sport, efforts should be made to prevent burnout and minimize dropout so young athletes may gain these benefits. Beyond injury prevention and maturation concerns discussed in other



sections, baseball specialization decisions should be made thoughtfully relative to psychosocial well-being based on the guidelines described below.

More self-determined forms of motivation are driven by individual choice rather than from internal pressures, like guilt, or external pressures such as reward, punishment or expectations from others. Intrinsic motivation, participation in the sport/activity because of love/enjoyment of it, is the most self-determined form of motivation. Therefore, efforts to promote either intrinsic motivation or more self-determined motivation can promote psychosocial well-being for athletes. Self-determination theory (SDT) further explains motivation to be influenced by the psychological needs of autonomy (personal choice or control), competence (success or effectiveness in one's environment) or relatedness (social connection to others, acceptance, belonging). When athletes feel these needs are met within their social sport environments more self-determined, and potentially intrinsic, forms of motivation are expected. Such feelings could be instilled in athletes by behaviors and strategies utilized by coaches, parents, administrators or teammates to help satisfy these needs. This leads to the most adaptive psychosocial outcomes for athletes. SDT provides an extremely useful framework to guide this section because it highlights key environmental factors, which can be changed to enhance athlete motivation, psychosocial health and, ultimately, long-term sport involvement.

Sport represents an environment where feelings of competence can impact youth and adolescent self-esteem (55). Sport commitment represents a key means by which to understand athlete sport experiences including healthy participation as well as more negative outcomes like burnout or dropout. Researchers (56) proposed that outcomes of burnout and dropout result from athlete feelings regarding the rewards and costs of sport participation when accounting for enjoyment level and attractiveness of other sports or activities. Using this theory, a sport scientist (57) examined patterns of athletic identity and commitment and found that athletes reporting higher burnout scores, reported lower sport enjoyment, fewer benefits, fewer attractive alternatives to sport and less control over their sport experience. They also reported higher sport costs, more investments, higher social constraints (demands) and a unidimensional sport identity. Though not all athletes experiencing this pattern of commitment will burn out and ultimately dropout. Preventing such a pattern could promote more positive athlete sport experiences and prevent dropout. Promoting a more positively social environment including athlete enjoyment and developing of other aspects of athlete identity beyond sport could facilitate this aim.

Athlete burnout is one of many psychological health variables that should be considered when promoting the health and well-being of athletes. Athlete burnout is characterized by emotional/physical exhaustion, reduced accomplishment and sport devaluation (58). One reason that burnout is so important to prevent/manage is that it is associated with other key variables of sport participation. An integrated model of athlete burnout (59) explains that burnout is associated with described (57) maladaptive patterns of sport commitment, sport stress, mood disturbances, low social support, low sport autonomy and coping skills, and is influenced by the motivational climate (i.e., coach or other environmental influences) associated with sport training/competition. Thus, positively influencing any of these variables could serve to prevent burnout as well as sport stress and potentially mood disturbances. Research supports that coping behaviors are negatively associated with burnout (60) and, therefore, could be promoted as a means to manage or prevent the occurrence of symptoms. Moreover, social support from teammates may represent a key factor in ensuring burnout and stress prevention as a means to promote athlete psychosocial well-being (61). Education about important aspects of psychological health, including sport stress, athlete burnout and mood-related outcomes in sport (depression, anxiety) further serves to aid in their prevention. Beyond individual athlete efforts, coaches, parents and administrators also have potential to positively influence athlete psychological health and well-being.

### ***Social Environment and Autonomy Supportive Coaching***

Guided by theory, research and clinical judgment, the sport-based social environment can be utilized to positively impact the development of athlete social and motivational experiences. Coaches represent a key member of this environment with the ability to positively influence athlete psychosocial health and motivation. Autonomy supportive coaching

behaviors, including training decisions, how feedback is provided and coaching style, have been shown to positively influence athlete self-determined motivation (62) and psychological needs of autonomy, competence and relatedness (63). Thus, coaches have potential to positively impact athlete motivation and psychological health by utilizing facets of autonomy supportive coaching. Mageau and Vallerand (64) have described examples of autonomy supportive coaching behaviors including: 1) providing athletes choices within coach-directed rules and limits, 2) providing athletes a rationale for tasks and limits, 3) acknowledging athletes' feelings and perspectives on key issues, 4) providing athletes with opportunities for initiative taking, 5) providing feedback which supports athlete competence, 6) avoiding unnecessary criticism and controlling statements and behaviors, and 7) promoting task/mastery involvement and preventing ego-involvement among athletes. Involved parents could benefit by using similar strategies relative to the baseball participation of their children. Ultimately, autonomy supportive behaviors directed towards USA Baseball athletes will have important positive implications for burnout prevention, as well as for the psychological health and well-being of baseball athletes across the lifespan.

### ***Psychological Health Monitoring and Psychological Skills Training***

From the perspective of individual athletes, psychological skills training (also known as mental skills training) represents an important tool to deter sport stress and other negative psychological outcomes (burnout) and promote positive outcomes of psychological health (motivation, enjoyment) and performance. Psychological skills include goal setting, arousal-regulation, visualization/imagery, concentration/mindfulness techniques and coping skill development, among others. Education on the basics of such techniques can be provided from a variety of sources including trained coaches or administrators, particularly at very young ages. However, advanced training, implementation and evaluation of psychological skills programs for athletes should be conducted by a certified sport psychology consultant and take into account developmental differences based on the ages of the athletes being worked with (65). Clinical issues related to athlete mental health (e.g. clinical anxiety or depression, substance use) require work with an appropriately clinically trained and licensed psychologist or psychiatrist. Collectively, psychological skill development represents an important means to positively impact athlete psychological health and well-being and potentially facilitate optimal performance.

It is important to remember that just because youth athletes look like (and occasionally act like) small adults does not mean that they are adults. They still think like children/adolescents and their thoughts regarding their early sport experiences may not be the same as those of their parents/coaches. Accordingly, their psychosocial health should be monitored appropriately whether they choose to specialize in baseball or not. These efforts will involve inclusion of administrators, coaches, parents and athletes themselves.

## **5. Specialization**

Sports specialization is defined as near year round (typically greater than 8 months per year), intensive training in a single sport, and excluding participation in other sports (6, 67, 68). While single sport specialization can be a pathway to achieve elite status (67-70), early sport specialization is also linked to player burnout (4, 7, 71-75) and increased injury risk (4, 67, 68, 71, 72, 74-79) often leading many athletes to cease participation in the game (4, 5, 7, 67, 69, 71, 74, 76, 80-85). Thus, early specialization is not conducive to fostering talent while promoting lifelong participation and enjoyment of the sport of baseball (67, 68).

One of the most pressing issues relative to athlete psychosocial health is sport specialization (66). From a psychosocial standpoint, discouraging specialization until athletes mature cognitively and emotionally supports healthy social and identity development via exposure to multiple sport environments (e.g., coaches) and social groups (e.g., teammates). Thus, specialization should be discouraged until at least age 14. Beyond this age, specialization could be permitted, though it should be carefully monitored and never be required of an athlete (but rather be the result of a decision the athlete is actively involved in making). For ages 14 and older, specialization will not necessarily harm social or identity development; but at the same time, is not necessary to facilitate peak performance and should be monitored carefully. To allow for healthy social and identity development as well as to prevent low motivation, burnout and ultimately dropout, specialization should be permitted (but not required) for baseball athletes who are physically and mentally prepared to do so.

There is a misconception that the only way athletes become elite in any sport is through early specialization. It has been recognized that there are two pathways to achieve a high level of performance: through early specialization and through early sampling (1). All sports can be classified as either early or late specialization. Early specialization sports, such as gymnastics, diving, and figure skating, take a great deal of specific training and development to succeed. However, most sports are late specialization sports. Baseball, football, basketball, and soccer all fall into the late specialization category. The difference between the two is that early specialization sports require complex skills to be learned before maturation since they cannot be mastered if taught afterwards, whereas late specialization sports allow for athletes to learn sport-specific skills at later ages.

While early engagement in baseball is encouraged, specialization should not take place until athletes are developmentally matured. Specializing too early in a late specialization sport can lead to:

- Lack of agility, balance, and coordination
- Poor basic movements and fundamental sports skills
- Overuse injuries
- Early burnout, or mental fatigue from playing the same sport
- Premature retirement from training and competition

Contrary to early specialization, early sampling focuses on aiding in the general developmental needs of children through participation in many different activities (1). This allows children to engage in a wide range of physical movements that may not be able to be developed as well during sport specific training.

Children are encouraged to participate in and sample multiple sports during their important developmental years (from entry into the sport through at least age 14) rather than specializing in a single sport. Sampling involves both participation in multiple sports and focusing primarily on deliberate play when participating in those sports. While deliberate play should be the emphasis, some deliberate practice (conducted in a manner that contributes to sport performance), should be included to contribute both skill building and physical fitness.

Sampling as an alternative to single sport specialization has been shown to facilitate athletic prowess and ultimately obtaining elite status as well as often requiring less sport specific practice to acquire expertise (86). Partaking in a variety of sports allows participants to experience a number of different physical, cognitive, affective, and psychosocial environments, and experience different social interactions with peers and adults (76, 83, and 87). Additionally, early sampling followed by eventual specialization leads to more sport enjoyment, lower injury risk, and longer participation (73, 80, and 85). Finally, taking a deliberate play sampling approach during childhood resulted in increased physical activity as an adult, thus foster lifelong engagement and physical activity (88). Ultimately, early diversification and sampling is linked to longer sport career and long-term sport involvement (89).

A large part of early sampling is deliberate play. Deliberate play is defined as an activity that is intrinsically motivating and is meant to be enjoyed, such as playing whiffle ball (2). These activities allow for children to try a variety of movements while learning how to handle different athletic situations (1). Early specialization programs infrequently incorporate deliberate play, which can be detrimental to an athlete. Instead, early specialization programs focus on deliberate practice, which are extrinsically motivated activities focused on sport-specific skill acquisition that can lack enjoyment, like repetitively fielding groundballs (2). Research has shown that deliberate play between the ages of 6-12 correlates positively with baseball specific training after the age of 13, while the high volume of deliberate practice in early specialization programs lead to higher dropout rates (1).

Evidence exists that suggests early sampling is an effective method to reach elite levels in baseball. A study published in The Journal of Clinical Sport Psychology supports that early sampling is a strong pathway to take for athletes (1). The voluntary study surveyed 708 minor league professional baseball athletes that were trying out for their major league team during spring training. It was found that these athletes, who had a mean age of 22.85, played an average of 2.48 sports during the ages of 11-14 (1). While 98% of the athletes surveyed during this age range played baseball, it was observed that the mean age that athletes specialized in baseball was 15.52 (1). The combination of playing multiple sports at a young age and waiting until the 14-16 developmental age years to specialize in baseball allowed for these athletes to see success later on within the professional level.

## 6. Periodization and Competition

RECREATIONAL TRACK					
LTAD Stage	Age	Training	Competition	Days per Week in Season	Months of Calendar Year
Activate	Entry to 7	75%	25%	1-2	4 months
Discover	7 to 12	75%	25%	1-2	4 months
Progress	12 to 14	65%	35%	2-3	4 to 8 months
Develop	14 to 16	65%	35%	3-4	4 to 8 months
Apply	16 to 18	65%	35%	4-5	4 to 8 months
Inspire	ANY	70%	30%	At leisure (>3x per week for health benefits)	Include participation as part of year round health regiment

ADVANCED TRACK					
LTAD Stage	Age	Training	Competition	Days per Week in Season	Months of Calendar Year
Develop	14 to 16	50%	50%	4-5	4 to 8 months
Apply	16 to 18	45%	55%	4-5	8 months
Excel	19 +	College/Pro level dependent	College/Pro level dependent	College/Pro level dependent	College/Pro level dependent

Periodization refers to the timeframes that are used to schedule training, competition, and recovery. Periodization structures the training components into weeks, days and sessions, and is situation-specific, depending on priorities and the time available for training and competition improvement. In the LTAD context, periodization connects the stage the athlete is in to the requirements of that stage.

The balance of training and competition, or deliberate play and deliberate practice, is crucial in each stage of the LTAD. Deliberate play is defined as developmental physical activities that are intrinsically motivating, provide immediate gratification, and are specifically designed to maximize enjoyment (2). Deliberate play activities typically occur between the ages of 6 and 14, and include classic neighborhood pickup games, such as backyard baseball and street basketball. These games are usually comprised of small-sided teams with flexible, peer-defined rules. Deliberate practice is defined as highly structured practice undertaken with the specific purpose of improving performance. In addition, deliberate practice is characterized as requiring sustained cognitive and/or physical effort, being solely directed toward positive skill development and error correction, and not necessarily being inherently enjoyable (2).

Appropriate use of periodization and competition can aid in building confidence in athletes at all levels. The ratios of time dedicated to deliberate play to time dedicated to deliberate practice differ in each developmental stage to allow for an increased opportunity for success. The younger stages, such as Activate and Discover, should be training (or participating in deliberate play) for 75 percent of the time, over one to two days per week in season. Young athletes should be permitted to participate in deliberate play as much as possible with the focus of fostering confidence, ability, and desire to participate in physical activity. Over-competition and under-training in these stages can result in a lack of basic skills and fitness.

After the age of 14, athletes can begin to specialize and move to the elite track. In this scenario, athletes in the Develop, Apply, Excel and Inspire stages can begin to shift to more deliberate practice and competition time versus deliberate play. Specifically, the Excel and Inspire stages will depend on the level of competition the athlete is involved in, such as collegiate baseball in Division I, II, III, or junior college, or professional baseball.

While schedules are often set for baseball by leagues and organizations and not by the coach and athlete, making optimal training based on periodization difficult, it is important to remember that the level and length of the competitive season should be aligned with the changing needs of the developing athlete progressing through the LTAD.

## Summary

USA Baseball's Long-Term Athlete Development Plan is a vehicle for change in the way baseball is designed and delivered. It is athlete-centered from the moment a child is first introduced to the sport and includes the development of that child through adulthood. While no two athletes are exactly alike, this LTAD provides a pathway and general guidelines for optimal performance based on the various stages within an athlete's development.

## References

- (1) Ginsburg, R. D., Danforth, N., Ceranoglu, T. A., Durant, S. A., Robin, L., Smith, S. R., and ... Masek, B. (2014). Patterns of Specialization in Professional Baseball Players, *Journal of Clinical Sport Psychology*, 8(3), 261-275.
- (2) Berry, J., Abernethy, B., and Cote, J. (2008). The Contribution of Structured Activity and Deliberate Play to the Development of Expert Perceptual and Decision-Making Skill, *Journal of Sport and Exercise Psychology*, 30, 685-708.
- (3) Physical Activity Guidelines for Americans. (n.d.). Retrieved from <http://health.gov/paguidelines/>
- (4) Malina RM. Early sport specialization: roots, effectiveness, risks. *Curr Sports Med Rep*. 2010;9(6):364-71. doi: 10.1249/JSR.0b013e3181fe3166. PubMed PMID: 21068571.
- (5) Mostafavifar AM, Best TM, Myer GD. Early sport specialisation, does it lead to long-term problems? *Br J Sports Med*. 2013;47(17):1060-1. doi: 10.1136/bjsports-2012-092005. PubMed PMID: 23258850.
- (6) Myer GD, Jayanthi N, DiFiori J, Faigenbaum AD, Keifer AW, Logerstedt D, Micheli L. Sport specialization: Part 1: Does early sports specialization increase negative outcomes and reduce opportunity for success in young athletes? *Sports Health*. 2015;(in press). doi: 10.1177/1941738115598747.
- (7) Smucny M, Parikh SN, Pandya NK. Consequences of single sport specialization in the pediatric and adolescent athlete. *Orthop Clin North Am*. 2015;46(2):249-58. doi: 10.1016/j.ocl.2014.11.004. PubMed PMID: 25771319.
- (8) Gallahue DL, Ozmun JC. *Understanding Motor Development: Infants, Children, Adolescents, Adults*. 6th ed. New York, NY: McGraw-Hill; 2006.
- (9) Lai SK, Costigan SA, Morgan PJ, Lubans DR, Stodden DF, Salmon J, Barnett LM. Do school-based interventions focusing on physical activity, fitness, or fundamental movement skill competency produce a sustained impact in these outcomes in children and adolescents? A systematic review of follow-up studies. *Sports Med*. 2014;44(1):67-79. doi: 10.1007/s40279-013-0099-9. PubMed PMID: 24122775.
- (10) Lubans DR, Morgan PJ, Cliff DP, Barnett LM, Okely AD. Fundamental movement skills in children and adolescents: review of associated health benefits. *Sports Med*. 2010;40(12):1019-35. doi: 10.2165/11536850-000000000-00000. PubMed PMID: 21058749.
- (11) Jurimae T, Jurimae J. *Growth, Physical Activity, and Motor Development in Prepubertal Children*. Boca Raton, FL: CRC Press LLC; 2000.
- (12) Gabbard CP. *Lifelong Motor Development*. 5th ed. San Francisco, CA: Pearson Benjamin Cummings; 2008.
- (13) Fitts PM, Posner MI. *Human Performance*. Belmont: Brooks/Cole; 1967.
- (14) Feijen L, Hodges NJ, Beek PJ. Acquiring a novel coordination skill without practicing the correct motor commands. *J Mot Behav*. 2010;42:295-306.
- (15) Wulf G. Attentional focus and motor learning: a review of 15 years. *Int Rev Sport Exerc Psychol*. 2013;6:77-104.
- (16) Wulf G, Shea C, Lewthwaite R. Motor skill learning and performance: a review of influential factors. *Med Educ*. 2010;44:75-84.
- (17) Bergeron M, Mountjoy M, Armstrong N, Chia M, Côté J, Emery C, Faigenbaum A, Hall G, Kriemler S, Léglise M, Malina R, Pensgaard A, Sanchez A, Soligard T, Sundgot-Borgen J, van Mechelen W, Weissensteiner J, Engebretsen L. International Olympic Committee consensus statement on youth athletic development. *British Journal of Sports Medicine*. 2015;49(13):843-51.
- (18) Lloyd R, Oliver J, Faigenbaum A, Howard R, De Ste Croix M, Williams C, Best T, Alvar B, Micheli L, Thomas D, Hatfield D, Cronin J, Myer G. Long-term athletic development-Part 1: A pathway for all youth. *Journal of Strength and Conditioning Research*. 2015;29(5):1439-50.
- (19) Faigenbaum A, Lloyd R, MacDonald J, Myer G. Citius, Altius, Fortius: Beneficial effects of resistance training for young athletes *British Journal of Sports Medicine*. 2015; epub before print.

- (20) Lloyd R, Faigenbaum A, Stone M, Oliver J, Jeffreys I, Moody J, Brewer C, Pierce K, McCambridge T, Howard R, Herrington L, Hainline B, Micheli L, Jaques R, Kraemer W, McBride M, Best T, Chu D, Alvar B, Myer G. Position statement on youth resistance training: the 2014 International Consensus. *British Journal of Sports Medicine*. 2014;48(7):498-505.
- (21) Cohen D, Voss C, Taylor M, Delextrat A, Ogunleye A, Sandercock G. Ten-year secular changes in muscular fitness in English children. *Acta Paediatrica*. 2011;100(10):e175-e7.
- (22) Hardy L, Barnett L, Espinel P, Okely A. Thirteen-year trends in child and adolescent fundamental movement skills: 1997-2010. *Medicine and Science in Sports and Exercise*. 2013;45(10):1965-70.
- (23) Runhaar J, Collard DC, Singh A, Kemper HC, van Mechelen W, Chinapaw M. Motor fitness in Dutch youth: Differences over a 26-year period (1980-2006). *Journal of Science and Medicine in Sport*. 2010;13:323-8.
- (24) American Academy of Pediatrics. Baseball and softball. *Pediatrics*. 2012;129(4):e842-56.
- (25) Leek D, Carlson J, Cain K, Henrichon S, Rosenberg D, Patrick K, Sallis JF. Physical activity during youth sports practices. *Archives of Pediatric and Adolescent Medicine*. 2010;165(4):294-9.
- (26) Guagliano J, Rosenkranz R, Kolt G. Girls' physical activity levels during organized sports in Australia. *Medicine and Science in Sports and Exercise*. 2013;45(1):116-22.
- (27) Lauersen J, Bertelsen D, Andersen L. The effectiveness of exercise interventions to prevent sports injuries: a systematic review and meta-analysis of randomised controlled trials. *British Journal of Sports Medicine*. 2014;48(11):871-7.
- (28) Faigenbaum A, Lloyd R, Myer G. Youth resistance training: Past practices, new perspectives and future directions. *Pediatric Exercise Science*. 2013;25:591-604.
- (29) Oliver J, Lloyd J, Meyers R. Training elite child athletes: promoting welfare and wellbeing. *Strength and Conditioning*. 2011;33(4):73-9.
- (30) Difiori J, Benjamin H, Brenner J, Gregory A, Jayanthi N, Landry G, Luke A. Overuse injuries and burnout in youth sports: a position statement from the American Medical Society for Sports Medicine. *Clinical Journal of Sports Medicine*. 2014;24(1):3-20.
- (31) Lloyd R, Oliver J, Faigenbaum A, Howard R, De Ste Croix M, Williams C, Best T, Alvar B, Micheli L, Thomas D, Hatfield D, Cronin J, Myer G. Long-term physical development: Barriers to success and potential solutions-Part 2. *Journal of Strength and Conditioning Research*. 2015;29(5):1451-64.
- (32) Behringer M, Vom Heede A, Matthews M, Mester J. Effects of strength training on motor performance skills in children and adolescents: a meta-analysis. *Pediatric Exercise Science*. 2011;23(2):186-206.
- (33) Myer G, Faigenbaum A, Edwards E, Clark J., Best T, Sallis R. 60 minutes of what? A developing brain perspective for activation children. *British Journal of Sports Medicine*. 2015; epub before print.
- (34) Behringer M, vom Heede A, Yue Z, Mester J. Effects of resistance training in children and adolescents: A meta-analysis. *Pediatrics*. 2010;126(5):e1199-e210.
- (35) Faigenbaum A, Myer G. Resistance training among young athletes: Safety, efficacy and injury prevention effects. *British Journal of Sports Medicine*. 2010;44:56-63.
- (36) Myer G, Faigenbaum A, Chu D, Falkel J, Ford K, Best T, Hewett T. Integrative training for children and adolescents: techniques and practices for reducing sports-related injuries and enhancing athletic performance. *Physician and Sports Medicine*. 2011;39(1):74-84.
- (37) Krajnik S, Fogarty KJ, Yard EE, Comstock RD. Shoulder injuries in US high school baseball and softball athletes, 2005-2008. *Pediatrics*. 2010;125(3):497-501. doi: 10.1542/peds.2009-0961. PubMed PMID: 20142288.
- (38) Fleisig GS, Andrews JR, Cutter GR, Weber A, Loftice J, McMichael C, Hassell N, Lyman S. Risk of serious injury for young baseball pitchers: A 10-year prospective study. *Am J Sport Med*. 2011;39(2):253-7. doi: 10.1177/0363546510384224.



- (39) Lyman S, Fleisig GS, Andrews JR, Osinski ED. Effect of pitch type, pitch count, and pitching mechanics on risk of elbow and shoulder pain in youth baseball pitchers. *Am J Sports Med.* 2002;30(4):463-8. PubMed PMID: 12130397.
- (40) Lyman S, Fleisig GS, Waterbor JW, Funkhouser EM, Pulley L, Andrews JR, Osinski ED, Roseman JM. Longitudinal study of elbow and shoulder pain in youth baseball pitchers. *Med Sci Sports Exerc.* 2001;33(11):1803-10. PubMed PMID: 11689728.
- (41) Chambless KM, Knudtson J, Eck JC, Covington LA. Rate of injury in minor league baseball by level of play. *American journal of orthopedics.* 2000;29(11):869-72. Epub 2000/11/18. PubMed PMID: 11079105.
- (42) Conte S, Requa RK, Garrick JG. Disability days in major league baseball. *Am J Sports Med.* 2001;29(4):431-6. PubMed PMID: 11476381.
- (43) McFarland EG, Wasik M. Epidemiology of collegiate baseball injuries. *Clin J Sport Med.* 1998;8(1):10-3. PubMed PMID: 9448950.
- (44) Posner M, Cameron KL, Wolf JM, Belmont PJ, Jr., Owens BD. Epidemiology of Major League Baseball injuries. *Am J Sports Med.* 2011;39(8):1676-80. doi: 10.1177/0363546511411700. PubMed PMID: 21709023.
- (45) Oberlander MA, Chisar MA, Campbell B. Epidemiology of shoulder injuries in throwing and overhead athletes. *Sports Med Arthrosc.* 2000;8(2):115-23. doi: Doi 10.1097/00132585-200008020-00001. PubMed PMID: WOS:000165896400001.
- (46) Fleisig GS, Andrews JR, Dillman CJ, Escamilla RF. Kinetics of baseball pitching with implications about injury mechanisms. *Am J Sports Med.* 1995;23(2):233-9. PubMed PMID: 7778711.
- (47) Oyama S, Yu B, Blackburn JT, Padua DA, Li L, Myers JB. Effect of excessive contralateral trunk tilt on pitching biomechanics and performance in high school baseball pitchers. *Am J Sports Med.* 2013;41(10):2430-8. doi: 10.1177/0363546513496547. PubMed PMID: 23884305.
- (48) Davis JT, Limpisvasti O, Fluhme D, Mohr KJ, Yocum LA, Elattrache NS, Jobe FW. The effect of pitching biomechanics on the upper extremity in youth and adolescent baseball pitchers. *Am J Sports Med.* 2009;37(8):1484-91. doi: 10.1177/0363546509340226. PubMed PMID: 19633301.
- (49) Petty DH, Andrews JR, Fleisig GS, Cain EL. Ulnar collateral ligament reconstruction in high school baseball players: clinical results and injury risk factors. *Am J Sports Med.* 2004;32(5):1158-64. doi: 10.1177/0363546503262166. PubMed PMID: 15262637.
- (50) Fleisig GS, Andrews JR, Cutter GR, Weber A, Loftice J, McMichael C, Hassell N, Lyman S. Risk of serious injury for young baseball pitchers: a 10-year prospective study. *Am J Sports Med.* 2011;39(2):253-7. doi: 10.1177/0363546510384224. PubMed PMID: 21098816.
- (51) Olsen SJ, 2nd, Fleisig GS, Dun S, Loftice J, Andrews JR. Risk factors for shoulder and elbow injuries in adolescent baseball pitchers. *Am J Sports Med.* 2006;34(6):905-12. doi: 10.1177/0363546505284188. PubMed PMID: 16452269.
- (52) Guidelines for Youth and Adolescent Pitchers. Pitch Smart; USA Baseball, 2014.
- (53) Major League Baseball and USA Baseball: Pitch Smart 2014 [updated 2014]. Available from: <http://m.mlb.com/pitchsmart/>.
- (54) Little League Online 2011. Available from: <http://www.littleleague.org/about/aroundtheworld.asp>.
- (55) Ebbeck V, Weiss MR. Determinants of children's self-esteem: An examination of perceived competence and affect in sport. *Pediatric Exercise Science.* 1998;10:285-98.
- (56) Schmidt GW, Stein GL. Sport commitment: A model integrating enjoyment, dropout, and burnout. *Journal of Sport and Exercise Psychology.* 1991;13:254-65.
- (57) Raedeke TD. Is athlete burnout more than just stress? A sport commitment perspective. *Journal of Sport and Exercise Psychology.* 1997;19:396-417.
- (58) DeFreese JD, Smith AL, Raedeke TD. Individual and Organizational Solutions to Athlete Burnout. In: Williams JM, Krane V, editors. *Applied Sport Psychology.* 7 ed. New York: McGraw-Hill; 2015.

- (59) Gustafsson H, Kenttä G, Hassmén P. Athlete burnout: an integrated model and future research directions. *International Review of Sport and Exercise Psychology*. 2011;4(1):3-24. doi: 10.1080/1750984x.2010.541927.
- (60) Raedeke TD, Smith AL. Coping resources and athlete burnout: An examination of stress mediated and moderation hypotheses. *Journal of Sport and Exercise Psychology*. 2004;26:525-41.
- (61) DeFreese JD, Smith AL. Teammate social support, burnout, and self-determined motivation in collegiate athletes. *Psychology of Sport and Exercise*. 2013;14(2):258-65. doi: 10.1016/j.psychsport.2012.10.009.
- (62) Amorose AJ, Anderson-Butcher D. Autonomy-supportive coaching and self-determined motivation in high school and college athletes: A test of self-determination theory. *Psychology of Sport and Exercise*. 2007;8(5):654-70. doi: 10.1016/j.psychsport.2006.11.003.
- (63) Hollembeak J, Amorose AJ. Perceived Coaching Behaviors and College Athletes' Intrinsic Motivation: A Test of Self-Determination Theory. *Journal of Applied Sport Psychology*. 2005;17(1):20-36. doi: 10.1080/10413200590907540.
- (64) Mageau GA, Vallerand RJ. The coach-athlete relationship: A motivational model. *Journal of Sports Sciences*. 2003;21:883-904.
- (65) Visek AJ, Harris B, Blom LC. Mental Training with Youth Sport Teams: Developmental Considerations and Best Practice Recommendations. *J Sport Psychol Action*. 2013;4(1). Epub 2013/11/26. doi: 10.1080/21520704.2012.733910. PubMed PMID: 24273682; PMCID: 3834981.
- (66) Myer GD, Jayanthi N, Difiori JP, Faigenbaum AD, Kiefer AW, Logerstedt D, Micheli LJ. Sport Specialization, Part I: Does Early Sports Specialization Increase Negative Outcomes and Reduce the Opportunity for Success in Young Athletes? *Sports health*. 2015;7(5):437-42. Epub 2015/10/27. doi: 10.1177/1941738115598747. PubMed PMID: 26502420; PMCID: 4547120.
- (67) Jayanthi N, Pinkham C, Durazo R, Dugas L, Luke A. The risks of sports specialization and rapid growth in young athletes. *Clin J Sports Med*. 2011;21(2):157.
- (68) Jayanthi NA, LaBella CR, Fischer D, Pasulka J, Dugas LR. Sports-specialized intensive training and the risk of injury in young athletes: a clinical case-control study. *Am J Sports Med*. 2015;43(4):794-801. doi: 10.1177/0363546514567298. PubMed PMID: 25646361.
- (69) Côté J, Fraser-Thomas J. Youth involvement in sport. In: Crocker P, editor. *Sport psychology: A Canadian perspective*. Toronto: Pearson; 2007. p. 270-98.
- (70) Côté J, Baker J, Abernethy B. Practice and play in the development of sport expertise. In: Tenebaum G, Ecklund RC, editors. *Handbook of sport psychology*. 3rd ed. Hoboken: Wiley; 2007. p. 184-202.
- (71) Brenner JS, American Academy of Pediatrics Council on Sports M, Fitness. Overuse injuries, overtraining, and burnout in child and adolescent athletes. *Pediatrics*. 2007;119(6):1242-5. doi: 10.1542/peds.2007-0887. PubMed PMID: 17545398.
- (72) DiFiori JP, Benjamin HJ, Brenner JS, Gregory A, Jayanthi N, Landry GL, Luke A. Overuse injuries and burnout in youth sports: a position statement from the American Medical Society for Sports Medicine. *Br J Sports Med*. 2014;48(4):287-8. doi: 10.1136/bjsports-2013-093299. PubMed PMID: 24463910.
- (73) Gould D, Udry E, Tuffey S, Loehr J. Burnout in competitive junior tennis players: pt 1 - A quantitative psychological assessment. *Sport Psychol*. 1996;10:322-40.
- (74) Jayanthi N, Pinkham C, Dugas L, Patrick B, Labella C. Sports specialization in young athletes: evidence-based recommendations. *Sports Health*. 2013;5(3):251-7. doi: 10.1177/1941738112464626. PubMed PMID: 24427397; PMCID: 3658407.
- (75) Nyland J. Coming to terms with early sports specialization and athletic injuries. *J Orthop Sports Phys Ther*. 2014;44(6):389-90. doi: 10.2519/jospt.2014.0109. PubMed PMID: 24881902.
- (76) Valovich McLeod TC, Decoster LC, Loud KJ, Micheli LJ, Parker JT, Sandrey MA, White C. National Athletic Trainers' Association position statement: prevention of pediatric overuse injuries. *J Athl Train*. 2011;46(2):206-20. doi: 10.4085/1062-6050-46.2.206. PubMed PMID: 21391806; PMCID: PMC3070508.

- (77) DiFiori JP. Evaluation of overuse injuries in children and adolescents. *Curr Sports Med Rep*. 2010;9(6):372-8. doi: 10.1249/JSR.0b013e3181fdb58. PubMed PMID: 21068572.
- (78) Launay F. Sports-related overuse injuries in children. *Orthop Traumatol Surg Res*. 2015;101(1 Suppl):S139-47. doi: 10.1016/j.otsr.2014.06.030. PubMed PMID: 25555804.
- (79) Paterno MV, Taylor-Haas JA, Myer GD, Hewett TE. Prevention of overuse sports injuries in the young athlete. *Orthop Clin North Am*. 2013;44(4):553-64. doi: 10.1016/j.ocl.2013.06.009. PubMed PMID: 24095071; PMCID: PMC3796354.
- (80) Barynina I, Vaitsekhovskii S. The aftermath of early sports specialization for highly qualified swimmers. *Fitness Sports Rev Int*. 1992;27:132-3.
- (81) Capranica L, Millard-Stafford ML. Youth sport specialization: how to manage competition and training? *International journal of sports physiology and performance*. 2011;6(4):572-9. PubMed PMID: 22174125.
- (82) Feeley BT, Agel J, LaPrade RF. When Is It Too Early for Single Sport Specialization? *Am J Sports Med*. 2015. doi: 10.1177/0363546515576899. PubMed PMID: 25825379.
- (83) Wiersma L. Risks and benefits of youth sport specialization: perspectives and recommendations. *Pediatric Exerc Sci*. 2000;12:13-22.
- (84) Wojtys EM. Sports Specialization vs Diversification. *Sports Health*. 2013;5(3):212-3. doi: 10.1177/1941738113484130. PubMed PMID: 23734282; PMCID: PMC3658411.
- (85) Wall M, Côté J. Developmental activities that lead to dropout and investment in sport. *Phys Educ Sport Pedagogy*. 2007;12:77-87.
- (86) Baker J, Côté J, Abernethy B. Learning from the experts: practice activities of expert decision makers in sport. *Res Q Exerc Sport*. 2003;74(3):342-7. doi: 10.1080/02701367.2003.10609101. PubMed PMID: 14510301.
- (87) Moesch K, Elbe AM, Hauge ML, Wikman JM. Late specialization: the key to success in centimeters, grams, or seconds (cgs) sports. *Scand J Med Sci Sports*. 2011;21(6):e282-90. doi: 10.1111/j.1600-0838.2010.01280.x. PubMed PMID: 21401722.
- (88) Robertson-Wilson J, Baker J, Derbinshyer E, Côté J. Childhood sport involvement in active and inactive adult females. *AVANTE*. 2003;9:1-8.
- (89) Côté J, Lidor R, Hackfort D. ISSP position stand: To sample or to specialize? Seven postulates about youth sport activities that lead to continued participation and elite performance. *USEP*. 2009;9:7-17.
- (90) Sports and Fitness Industry Association (2020). *Sports, Fitness, and Leisure Activities Topline Participation Report*. Retrieved from <https://www.sfia.org/>
- (91) Common Baseball Injuries. (n.d.) Retrieved from <http://web.usabaseball.com/arc/health-and-safety/general-health/common-baseball-injuries/>