Baseball-Specific Conditioning

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Baseball demands speed, power, and quickness. To perform at a high level, and avoid injuries that are common among baseball players, an evaluation of current trends in strength and conditioning practices is helpful. Based on the demands of the sport and the injury risks, qualified strength and conditioning professionals can develop effective baseball-specific conditioning programs. This commentary briefly covers historical aspects of baseball conditioning, recent injury trends, current practices among elite baseball professionals, and provides suggestions for future improvements in training.

Over the past 100 or more years, the equipment, strategies, and approach to the game of baseball have changed quite dramatically. Physical conditioning among baseball players has also evolved greatly during the same time. Through history, some baseball players have paid little attention to their physical preparation other than practicing the techniques of various baseball tasks such as fielding, throwing, and hitting. In fact, Babe Ruth, the champion player in the United States in the 1920s and 30s was well known for his unhealthy eating habits and lack of an exercise or training routine. The success of many baseball players who are visibly and apparently unfit perhaps contributed to the lack of emphasis of advanced conditioning among baseball players for decades. However, over the past 30 years, baseball players and sports conditioning professionals have altered the physical conditioning practices in baseball quite dramatically. This commentary describes the specific physical demands of baseball, discusses injury trends and prevention strategies, and details a sport-specific approach to conditioning baseball players for healthy and successful competitive performance.

A Competition Model of Baseball

As with any sport, a detailed understanding of the demands of baseball is needed to develop a sport-specific, advanced training program. Baseball is comprised principally of running, throwing, and hitting. Running tasks can be broken into linear and curvilinear sprinting while running bases or pursuing a ball in the field, quick lateral movements to field a ball, and occasionally short bouts of backpedaling. Throwing and hitting involve a coordinated sequence of lower body, core, and upper-body muscular activity to create a substantial amount of force in very short time. Each of the specified tasks relies on power, or rate of force devel-
opment, to reach high levels of performance.\textsuperscript{2} Even though repeated sprints, throws, and swings may occur during competition, there is generally enough rest between each task to provide adequate recovery.

Pitchers, who may throw sequences of 15 to 30 pitches at a time, are perhaps the sole position players who need well developed power endurance. Their goal is to maintain pitch velocity throughout an inning (sequence of 15 to 30 pitches) and throughout their outing, which may range from 1 to 9 innings (15–100 pitches). During an inning, a pitcher generally has about 20 s before another pitch is thrown. Recovery time between innings may range from 5 to 15 min.

In addition to the reliance on power, baseball performance is also highly dependent on high levels of agility while attempting to field the baseball. Fielders must react to various situations during the game such as fielding balls hit at or toward them. At times, they must perform highly coordinated skills under pressure or stress. The ability to react to numerous cues and coordinate neuromuscular actions in such an environment is the most challenging aspect of this sport.\textsuperscript{3–5}

**Baseball Injury Trends**

Analyzing injury trends among professional baseball players can identify insights on the effectiveness of strength and conditioning techniques being used, and highlight the less effective ones that need to be changed. Uncovering these trends will allow strength and conditioning professionals to train athletes, whether professionals or amateurs, to fulfill a career with the desired success and longevity.

Data\textsuperscript{6} from Major League Baseball in the United States from 1999 to 2004 were gathered, sorted, and analyzed to assess injury trends (Figure 1). During that time, a total of 3,210 injuries were reported. The five most common baseball injury locations were in the shoulders \((n = 727)\), the elbows \((n = 497)\), the hamstrings \((n = 409)\), the back \((n = 366)\), and the knees \((n = 337)\). During the span of data collection, a 91\% increase was noted among these five injuries. Shoulder and elbow injuries are especially debilitating for baseball players given the effect that such injuries have on their ability to throw the baseball. Over 61\% of the total injuries that were reported in this span of 6 y occurred before the midpoint of the 162 games played in a regular baseball season.

The large number of injuries to specific joints and muscles provides strength and conditioning professionals with targets for conditioning to prevent these injuries from occurring. A detailed review of the literature regarding specific exercises to prevent these injuries is beyond the scope of this paper; however, strength and conditioning professionals should examine strategies for preventing shoulder, elbow, hamstring, back, and knee injuries using the most effective modalities available. Timing of injury trends also suggest that there may be a greater need for effective off-season and preseason training programs. It is not uncommon for baseball players to begin preparing for the baseball season only 4 to 6 wk before competition. These players then attempt to rapidly increase fitness and preparedness. This approach may not be as effective, as demonstrated by the early-season injury rates, for increased performance and decreased injury prevention as compared with a year-round, periodized training program designed to develop and maintain optimal levels of physical preparedness.
A survey of strength and conditioning professionals in Major League Baseball published in 2005 identified trends in the use of different conditioning practices at the professional level. All coaches employed flexibility exercises and some form of speed development programming. The majority of coaches employed proprioceptive neuromuscular facilitation (PNF) stretching with a small percentage utilizing ballistic stretches. Plyometric exercises were prescribed by 17/21 respondents for the lower body and 14/21 for upper body. Ninety-two percent of coaches employed plyometrics, whereas only 24% used Olympic-style lifts. The squat and lunge were the most frequently prescribed exercise. Multiset, periodized resistance training routines were most often prescribed.

These data, although limited to a small number of exercise professionals at the elite playing level, provide some idea of the methods for baseball-specific training employed. It should be noted that these practices may not be appropriate for baseball players at younger levels and further information is needed to identify training practices among professionals working with young athletes. Simply prescribing the modes of training identified in the cited survey study to all baseball populations may not be safe and effective.
Baseball Conditioning

Baseball-Specific Training Components

Injury Prevention. Given the propensity for injury in high-level baseball players, the primary goal of a baseball-specific training program is to decrease the overall risk of injury. To accomplish this, appropriate exercise selection and progression is key. This preventive strategy is quite important during the developing years. Conventional shoulder exercises such as shoulder internal/external rotation are, and have been, used with the aim of reducing shoulder injuries among pitchers for many years. However, it appears that shoulder injuries are not declining at the highest level of play. More research is greatly needed to evaluate effective exercises to prevent baseball injuries. To make matters worse, some exercises may place the musculoskeletal system under stresses that increase the risk of baseball injuries. Such exercises should be avoided to prevent added strain on joints that experience tremendous stress during baseball. The lack of evidence of correct exercises to prescribe lead to professionals simply relying on their professional experience and opinions/philosophies in their exercise selection. It becomes the role of exercise scientists to develop and disseminate effective prevention strategies and the responsibility of the strength and conditioning professional to implement such methods.

Flexibility and Functional Movement. The ability to move the body through a full and safe range of motion is vital to avoiding injuries and fostering optimal performance. Stretching, primarily dynamic flexibility exercise, can serve to enhance a player’s flexibility and should be incorporated into a baseball training routine. However, stretching alone may not solve functional movement impairments. Evaluating functional movement and creating a training intervention to resolve existing impairments is a process requiring specialized expertise in therapists, trainers, or strength and conditioning coaches. Once impairments have been identified, targeted interventions should be implemented to ensure that problems are addressed and overcome effectively.

Speed Power. Various methods for increasing running speed have been developed and studied in many different sports. Resisted sprint training is one method and typically involves the athlete sprinting with an added load using a weighted sled, a weighted vest, a speed parachute, performing uphill or sand dune training, or other variations. Another method for increasing running speed is the use of ballistic resistance training. This form of training may include squat jumps, drop jumps, rebound jumps, or others. Resisted sprinting has been studied for training in the sport of rugby and has been found to be more effective than normal rugby training in producing start and acceleration capabilities, but not for improving maximum speed. The results of this study suggest that it may be beneficial to employ a resisted sprint training intervention with the aim of increasing initial acceleration from a static start for sprinting. For all baseball positions and for base runners, this type of training would be beneficial for their individual game and for their teams. Improved sprinting would allow the fielders to get to the ball quicker to make the necessary plays, and increase the chances that a base runner can steal the next base.

Improving hitting power is another goal of baseball conditioning. Bat velocity, which is an important factor in generating hitting power, can be increased by
implementing a full-body resistance training program in high school and novice players. Advanced players should include general resistance training, rotational plyometric drills, and the use of overweight and underweight bats during training. The development of throwing velocity is most likely achieved through a generalized resistance training program with the incorporation of upper-body plyometric drills; however, caution is warranted to avoid placing excessive strain on rotator cuff musculature. Although there is a lack of evidence to suggest that such exercises are dangerous, and given the fact that baseball competition involves very aggressive actions when throwing, a cautious approach is certainly warranted.

Metabolic Preparation. Baseball players are known for performing long–slow cardiovascular endurance training. However, as has been described above, baseball is principally a sport of speed and power. Any metabolic demands of this sport are, in fact, anaerobic in nature. A distinction should be made between aerobic endurance and speed endurance or power endurance. In a recent study, lengthy cardiovascular exercise sessions among collegiate baseball players diminished power output. In contrast, a repeated-sprints training program increased power throughout the season. This training methodology, with the intended result of maximizing the physiological demands of baseball players for competition, should result in changes in metabolic conditioning. The development of speed endurance or power endurance requires a greater focus on repeated bouts of maximal or near-maximal activities such as high-speed running, jumps, medicine ball throws, or agility drills.

Future Directions

As the game of baseball and the preparation of its players continue to evolve, continued focus on developing optimal conditioning practices is certainly needed. Particular focus should be given to the prevention of shoulder and elbow injuries because they represent the most frequent injuries in the sport, and result in the largest impact on performance and career longevity. In-depth analyses of the injury prevention effectiveness of different exercises and programs are required. These analyses should be used to develop appropriate guidelines based on the developmental stage of players as they progress from junior to senior levels of baseball. Further examination of in-season training strategies are required, given the extended duration of the season and the daily and weekly demands of training and competition.

References