Energy System Demands of Fastpitch Softball

Salma Mehter
Smith College
1/31/2011
Introduction

A wise person once said, “Practice doesn't make perfect; perfect practice makes perfect”. This is clear when one looks at different sports that exist and the diverse nature in them in terms of demands of different energy systems. There are three specific ways that our bodies convert stored energy into mechanical/kinetic energy: The ATP-PC System, The Lactic Acid System and Aerobic Metabolism. Fastpitch softball is a sport where excessive aerobic training could actually take away from a player’s ability. Therefore, in order to be able to coach softball successfully it is imperative for one to have background knowledge in the physiological profile of human beings as well as the sport specific energy and muscular demands.

The ATP-PC System

The ATP-PC system is the immediate energy system that our body relies on for short-lived, high intense exercises. This system transfers chemical energy into mechanical energy used for running full-speed, by breaking down adenosine triphosphate (ATP). When one mole of ATP breaks down 7.3 kCal is released, which is the energy used for muscle contraction. The reverse of this is simply the synthesis of ATP, called phosphorylation, which happens with the presence of phosphocreatine (PCr). Phosphocreatine exists in the muscles fibers and releases energy as fast as ATP. Thus these two reactions are usually referred to as a single energy system. This system does not involve the use of oxygen, and therefore is anaerobic. A downside of this is that when the system is very fast at maximal activity it is only available for about 8 seconds (Johnson, 2010).
The Lactic Acid System
The Lactic Acid System serves as the system that can supply energy so that phosphorylation continues even after the ATP-PC system is not available. This system involves the anaerobic breakdown of carbohydrates through glycolysis. However, glycolysis results in the production of Lactic Acid which builds up in body tissues, as too much is produced further exercise is discontinued thus this system lasts about 10-90 seconds of maximal high intense activity (Johnson, 2010).

The Aerobic System
The last system, Aerobic Metabolism, is the system in which carbohydrates, fats, and proteins are all broken down. This is the aerobic system which depends on the delivery of oxygen to the cell through the cardio-respiratory system. This system has no fatiguing bi-products such as lactic acid, and because of this it can be used for an infinite amount of time (greater than 90 seconds). However, due to the complex nature of the system it is very slow in comparison to the other two systems (Johnson, 2010).

Discussion
While one can generally say that the ATP-PC systems is in use the first 8 seconds of activity, the Lactic Acid system is used in the next 80 seconds of activity and the Aerobic system is the last system used for the remainder of time, it is important to realize these systems do not turn on and off. At any given moment it is possible that all three systems are in use simultaneously. It is also important to mention that time and intensity are the key predicting variables when determining energy system use. As far as the sport of softball goes, it is important to also take into account the various positions that one can play. For example, an outfielder is much more
likely to be using their aerobic system than a third basemen. Table 1 below shows some estimation of position specifics of the sport.

**Table 1 Estimated Position Specific Energy System Demands for Softball**

<table>
<thead>
<tr>
<th>Softball Position</th>
<th>ATP-PC</th>
<th>Anaerobic Glycolysis</th>
<th>Aerobic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infield Corner(^2)</td>
<td>H</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Middle Infielder(^3)</td>
<td>H</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>Catcher</td>
<td>H</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>Pitcher</td>
<td>H</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>Outfielder(^4)</td>
<td>H</td>
<td>M-H</td>
<td>M</td>
</tr>
<tr>
<td>General Softball</td>
<td>H</td>
<td>M</td>
<td>L</td>
</tr>
</tbody>
</table>

As can be seen, softball is a sport with very high demands on the ATP-PC system, medium demands on the Lactic Acid System, and low demands on the aerobic system. Regardless of one’s position, the sport involves lots of high intense movements that are very short lived, whether it be offensively sprinting the bases or defensively fielding a ball, and for this reason the ATP-PC is a crucial system to have work-out programs for softball players’ focus on. The next system that has mediocre importance with regards to softball is the Lactic Acid system, which is very important for pitchers to develop because they are constantly moving defensively, pitch after pitch at high intensity throughout the game. However, this system has very little importance for the 1st basemen and 3rd basemen. The Aerobic System, while also generally having minimal importance in softball, can really add to the endurance an outfielder has because they are constantly moving, whether it be backing up the infielders or backing up each other. These factors are even more important to consider for softball programs in which double

---

\(^1\) L = Low, M= Medium, H=High  
\(^2\) 1st Basemen, 3rd Basemen  
\(^3\) 2nd Basemen, Shortstop  
\(^4\) Left-Fielder, Center-Fielder, Right-Fielder
headers are common. However, it is also important to keep in minds that excessive aerobic training can decrease muscle mass, power, speed, strength and anaerobic capacity, which are all crucial to the sport of softball (McArdle, Katch, & Katch, 2001).

**Conclusion**

The key to the development of a successful workout program for Fastpitch Softball athletes is prioritizing importance and finding balance. One should train themselves position-specifically with regard to their energy systems. It is generally crucial for softball athletes to develop their anaerobic energy systems while finding a balance developing their aerobic system to increase their endurance. However, for softball excessive aerobic activities can lead to the adverse effects in terms of developing softball skills.
References


