THE ACUTE EFFECTS OF HEAVY-BALL BOWLING ON FAST BOWLING PERFORMANCE IN CRICKET

Simon A. Feros, Warren B. Young, Brendan J. O’Brien
University of Ballarat, Victoria, Australia

INTRODUCTION

Cricket fast bowling is an explosive intermittent type activity involving the entire body. Previous research has found that faster ball release speeds are related to faster angular velocities of the bowling arm humerus (1). This may indicate that bowlers with greater power and rate of force development might be able to rotate their bowling arm faster and generate faster ball release speeds. A warm-up may be designed to exploit the postactivation potentiation phenomenon, whereby power output and rate of force development are enhanced (5). Postactivation potentiation is the acute enhancement of muscular performance characteristics following a conditioning activity (6). The mechanisms of postactivation potentiation include the phosphorylation of myosin regulatory light chains (5), the increased recruitment of higher order motor units (2), and the change of muscle pennation angle (3). Previous research has found baseball pitching velocity to be acutely enhanced and accuracy to be acutely diminished following heavy-ball pitching in the warm-up (8). The postactivation potentiation phenomenon may therefore exist after heavy-ball bowling in the warm-up, possibly enhancing bowling speed but possibly at the cost of bowling accuracy. Therefore, the purpose of this study is to examine the acute effects of heavy-ball bowling on fast bowling performance (speed & accuracy).

METHODS

Experimental approach to the problem

The study was a randomised, within-subject design, where participants were assessed on two testing sessions: (a) regular-ball bowling warm-up followed by a four-over fast bowling test, and (b) heavy-ball bowling warm-up (potentiation) followed by a four-over fast bowling test. Participants reported to the laboratory on 6 separate occasions. On the first four occasions, they were familiarised with the heavy-ball bowling and fast bowling test. On the fifth and sixth session, participants performed the two testing conditions. The testing sessions were separated by at least 3-7 days to allow for appropriate recovery.

Subjects

Seventeen male community-level pace bowlers (age: 22.4 ± 6.1 years, weight: 79.6 ± 13.8kg) volunteered to participate in this study. At the time of testing, the majority of participants had at least five years bowling experience, and no resistance training experience. Participants were required to be free of any injury for at least six months prior to the commencement of the study. Informed signed consent was obtained from each participant prior to testing to comply with the committee of ethics requirements of the University of Ballarat.

Experimental protocol

Participants were measured for body weight and their “coping score” prior to both conditions. The coping score is a visual and subjective scale designed to assess general physical and mental fatigue from a score of 0-10. A score of 10 represents feeling as fresh as possible, whereas a score of 0 represents feeling exhausted.

Both conditions performed the same general warm-up routine. This included the following, performed over a 20m distance:

- Jog: 5 x 50% effort
- Side to side shuffle: 2 x 50% effort facing one direction
- Grapevine: 2 x 50% effort, facing one direction
- Backward jog: 2 x 50% effort
- 4 Walking lunges (2 each leg) then run forwards: 1 x 50% effort
- Skipping: 2 x 75% effort
- Sprints: 1 x 50, 60, 70, 80, and 90% effort
- Leg swing throughs (front to back and side to side): 5 x each leg
- Walk + hip circles (in to out): 5 x each leg
- Calf pushes in push-up position: 5 x each foot
- Arm circles: 5 x forwards and backwards
- Lower back rolls and side rolls: 5 x forwards and backwards and to each side
- Windmills: 10 x each side
Both conditions performed a general bowling warm-up afterwards that consisted of the following:

- 3 balls at 60% effort, 5 or 7 step run-up, slower delivery aimed at the top of middle stump
- 3 balls at 70% effort, 5 or 7 step run-up, delivery aimed at outside off-stump on right hand side
- 3 balls at 80% effort, 5 or 7 step run-up, delivery aimed at outside off-stump on left hand side
- 3 balls at 90% effort, full run-up, delivery aimed at yorker target (full pitched delivery)
- 3 balls at 95% effort, full run-up, delivery aimed at bouncer target (short pitched delivery)
- One delivery was bowled every 30s

A three minute passive recovery was provided before the commencement of the conditioning activity. Both conditions consisted of 18 deliveries in the conditioning activity (one delivery bowled every 30s). The participants were allowed to choose a five or seven step approach run, but were required to use it consistently in both conditions. The first nine deliveries were directed outside off-stump on the right hand side, and the last nine deliveries were aimed outside off-stump on the left hand side. Both conditions were instructed to bowl at “match pace, accuracy, and consistency”. The difference between the two conditions was in the mass of the ball used in the conditioning activity. The regular-ball bowling condition (RB) utilised a regular weight cricket ball (156g). The heavy-ball bowling condition (HB) bowled the first nine deliveries with a 300g cricket ball, and the final nine deliveries with a 250g cricket ball. The heavy balls were made by drilling a hole in a standard cricket ball, and infusing it with lead, and sealed off with silicone. The balls were weighed to exactly 300g or 250g through use of digital scales accurate to one decimal place. A three minute passive recovery followed the conditioning activity.

The fast bowling test commenced after the recovery period. Participants were instructed to bowl at “match pace, accuracy, and consistency, and to not modify technique and run-up speed throughout the test”. Both conditions performed the same fast bowling test with a regular weight cricket ball (156g). Each over (6 deliveries) consisted of different targets for bowlers to aim at (Table 1), with one delivery bowled every 30s. The bowler did not bowl to a batsman; this allowed for the measurement of bowling accuracy in the fast bowling test. A three minute passive recovery was provided between each over to allow for adequate recovery.

**Table 1 - Targets aimed at for each delivery and over in the fast bowling test.**

<table>
<thead>
<tr>
<th>Delivery #</th>
<th>Over 1</th>
<th>Over 2</th>
<th>Over 3</th>
<th>Over 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Off stump - RH - N</td>
<td>Off stump - LH - N</td>
<td>Off stump - LH - N</td>
<td>Off stump - RH - N</td>
</tr>
<tr>
<td>5</td>
<td>Off stump - RH - M</td>
<td>Bouncer - N</td>
<td>Off stump - LH - M</td>
<td>Bouncer - N</td>
</tr>
<tr>
<td>6</td>
<td>Middle stump - S</td>
<td>Yorker - N</td>
<td>Middle stump - S</td>
<td>Yorker - N</td>
</tr>
</tbody>
</table>

RH: right hand side, LH: left hand side, N: match speed, M: maximal speed, S: slower ball

Bowling speed for each delivery was measured by a radar gun (Stalker Pro, Applied Concepts, Texas, USA) mounted on a tripod positioned approximately 1.5m behind the front crease, at a height of 180cm, and at an inward angle of 25°, to detect ball speed at release. Bowling accuracy was assessed by use of a vertical target sheet in line with the stumps at the batsman’s end of the pitch (Figure 1). Accuracy was recorded by a digital high-definition video camera (Sony HXR-MC50P, Sony Corporation, Tokyo, Japan) operating at 50 frames per second, and shutter speed of 0.004ms, mounted on a tripod approximately 60cm from the front crease, with a slight inward angle of 10° to capture the entire target sheet. The video footage was analysed through Dartfish Connect (Dartfish, Australia, Version 6.0), by calculating the distance between ball strike and the cross-hair of the intended target. Both the radar gun and high speed camera were positioned to the right hand side of the participant, and approximately 30cm laterally from the middle stump, to ensure the bowler did not contact the equipment in the run-up. Approach speed for each delivery was measured by a dual beam electronic timing system (Swift Performance Equipment, Lismore, Australia) with a timing resolution of 0.01s, and gates positioned 2.5m and 5m behind the front crease. Perceived effort was recorded immediately after each delivery by asking the bowler “how much effort out of 100% was that delivery?”
The only significant difference between both conditions was in mean bowling accuracy, where the HB resulted in 10.9% worse accuracy compared to the RB ($p = 0.049$, Table 2).

### Table 2 - Comparison of RB and HB on fast bowling performance measures in the fast bowling test.

<table>
<thead>
<tr>
<th>Measure</th>
<th>$n$</th>
<th>RB Mean ± SD</th>
<th>HB Mean ± SD</th>
<th>% Difference from RB</th>
<th>Effect size (Cohen’s $d$)</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight (kg)</td>
<td>17</td>
<td>80.97 ± 14.39</td>
<td>80.89 ± 14.17</td>
<td>-0.1</td>
<td>0.007</td>
<td>0.700</td>
</tr>
<tr>
<td>Coping score (0-10)</td>
<td>17</td>
<td>7.32 ± 1.29</td>
<td>7.35 ± 1.37</td>
<td>0.4</td>
<td>0.074</td>
<td>0.896</td>
</tr>
<tr>
<td>Peak bowling speed (kph)</td>
<td>17</td>
<td>105.76 ± 7.84</td>
<td>105.29 ± 7.98</td>
<td>-0.4</td>
<td>0.059</td>
<td>0.445</td>
</tr>
<tr>
<td>Mean bowling speed (kph)</td>
<td>17</td>
<td>101.23 ± 8.14</td>
<td>101.74 ± 7.58</td>
<td>0.5</td>
<td>0.065</td>
<td>0.388</td>
</tr>
<tr>
<td>Mean bowling accuracy (mm)</td>
<td>17</td>
<td>451.60 ± 92.71</td>
<td>500.90 ± 76.15</td>
<td>10.9</td>
<td>0.581</td>
<td>0.049</td>
</tr>
<tr>
<td>Mean approach speed (kph)</td>
<td>17</td>
<td>20.10 ± 2.13</td>
<td>19.67 ± 1.76</td>
<td>-2.1</td>
<td>0.205</td>
<td>0.128</td>
</tr>
<tr>
<td>Mean perceived effort (% of 100)</td>
<td>17</td>
<td>90.51 ± 4.55</td>
<td>90.32 ± 4.45</td>
<td>-0.2</td>
<td>0.042</td>
<td>0.824</td>
</tr>
</tbody>
</table>

RB: regular-ball bowling condition, HB: heavy-ball bowling condition

### DISCUSSION

The primary aim of this investigation was to explore the acute effects of heavy-ball bowling on bowling speed and accuracy. The results indicate that the only significant difference observed between conditions was in mean bowling accuracy, where the HB was 10.9% worse than the RB. This is an interesting finding, and can be supported by feedback from participants in the study. The majority of participants felt they released the heavier ball earlier in their bowling action, and was also harder to control. Some participants mentioned that their technique was more difficult to coordinate with the 300g ball as opposed to the 250g ball. When participants performed regular-ball bowling after heavy-ball bowling, they reported releasing the ball later in their bowling action. This is supported by the observed shorter pitch bowling within the first few deliveries with the regular ball. This indicates a possible negative transfer between heavy and regular ball bowling. Although the movement pattern is similar between the different weighted balls, the force requirements are probably different. The intermuscular coordination may have therefore been negatively affected after bowling with the heavier cricket balls. The accuracy findings from this study are similar to those of Van Huss et al. (8), who found baseball pitching accuracy to be diminished for the first seven balls following an acute bout of heavy-ball pitching. However, accuracy gradually improved in the final three throws, suggesting a possible learning effect (or recovery) has taken place and the participant readjusted to the regular weight baseball.
This investigation did not find any differences in peak or mean bowling speed between both bowling conditions. This finding opposes that of Van Huss et al. (8), who found baseball pitching velocity to be acutely enhanced following a bout of heavy ball pitching. A potential reason for such a difference between studies could be the percentage difference of load between heavy and regular ball weights. Van Huss et al. (8) used a mass that was 120% heavier than the regular baseball, whereas this investigation only increased the mass by 92.3% and 60.3% for the 300g and 250g ball respectively. Another potential difference between studies is the movement patterns; it’s possible that the inclusion of the elbow joint allows more power to be produced in throwing, and this cannot be achieved in fast bowling as the elbow must be extended through the entire bowling arm circumduction.

PRACTICAL APPLICATIONS

The inclusion of heavy-ball bowling into the fast bowling warm-up may impair bowling accuracy, and the weights prescribed in this investigation do not appear to acutely enhance bowling speed. Training with a heavy cricket ball may still have its place for force and power production for the upper body, and may be more applicable to fast bowlers with greater resistance training experience than those used in the current investigation. A heavier cricket ball (e.g., 400 or 350g) may be more effective in acutely enhancing bowling speed. To counteract the impaired bowling accuracy witnessed in this study, a gradual decrease in ball mass in the conditioning activity may allow bowling technique to readjust in time for regular-ball bowling. The recovery periods may need to be longer to allow fatigue to subside and potentiation to be dominant. The postactivation potentiation response appears to be affected by intensity, recovery periods, relative strength, and fast-twitch fibre development. Fast bowlers should trial a different range of weights and protocols to see what works best for them.

REFERENCES


