

Kinematic determinants of power hitting performance: a technique comparison of male and female cricketers

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Background: Recent research has investigated the relationships between technique and bat speed during a cricket range hitting task in 20 male batsmen ranging from club to international standard¹. The separation between the pelvis and thorax segments in the transverse plane at the commencement of the downswing, and both lead elbow extension and wrist uncocking during the downswing explained 78% of the observed variation in maximum bat speed. However, no research to date has compared such kinematic parameters between male and female batters during power hitting.

Aims: To compare power hitting kinematics between experienced male and female batters.

Methods: Fifteen male and fifteen female batters, ranging from MCCU to international standard, each performed a series of 20 shots against a bowling machine, aiming to hit the ball for maximum carry distance back over the bowling machine in a match-representative manner. An 18 camera Vicon Motion Analysis System operating at 400 Hz was used to collect three-dimensional kinematic data. Fifty-one 14 mm retro-reflective markers were attached to each participant plus bat, with an additional five 15 x 15 mm patches of 3M Scotch-Lite reflective tape placed on the ball. The logarithmic curve fitting methodology of Peplow et al.² was used to calculate instantaneous post-impact ball speed and carry distance for each trial. For each participant's best trial (furthest carry distance), the 28 kinematic parameters previously measured in male batsmen¹ were calculated in Visual 3D software. Bayesian t-tests with non-informative priors compared each kinematic parameter between male and female groups. Evidence for the alternative hypothesis was set as Bayes factor (BF_{10}) > 3.

Results: *Extreme* differences between groups (males > females) were reported for maximum bat speed, ball launch speed, and carry distance. Of the technique parameters, males displayed greater separation between the pelvis and thorax segments in the frontal plane at the commencement of the downswing (*moderate*), lead elbow extension during the downswing (*extreme*), rear elbow extension during the downswing (*very strong*), and rear elbow angle at impact (*strong*) than females. Females had longer downswing durations (*strong*). No other differences were reported. On average, females flexed their lead elbow during the downswing ($-3 \pm 24^\circ$) whilst males extended theirs ($30 \pm 12^\circ$). Seven females (range: -9 to -34°), but no males, flexed their lead elbow during the downswing.

Discussion and Conclusions:

Experienced male and female batters differ in a number of kinematic parameters during power hitting performance. Males displayed greater lead and rear elbow extension during the downswing and greater separation between the pelvis and thorax segments in the frontal plane at the commencement of the downswing compared to females. These differences are highlighted by a tendency for some females to flex the lead elbow, perhaps demonstrating more of a traditional checked drive than a specific power hitting technique similar to that seen in sports such as golf. It is not clear whether the female participants could be coached to extend the lead elbow during the downswing, or whether their use of such a technique may be limited by strength characteristics.

References:

1. Peplow, C., McErlain-Naylor, S. A., Harland, A. R., & King, M. A. (2019). Relationships between technique and bat speed, post-impact ball speed, and carry distance during a range hitting task in cricket. *Human movement science*, 63, 34-44.
2. Peplow, C., McErlain-Naylor, S. A., Harland, A. R., Yeadon, M. R., & King, M. A. (2018). A curve fitting methodology to determine impact location, timing, and instantaneous post-impact ball velocity in cricket batting. *Proceedings of the Institution of Mechanical Engineers, Part P: Journal of Sports Engineering and Technology*, 232(3), 185-196.