INTRODUCTION

Successful hitting in baseball and softball is dependent on many factors. Bat quickness (BQ) measured in seconds is defined as the time it takes the bat head to travel from its initial position at the launch phase to the point the bat makes contact with the ball [2]. Bat velocity (BV) is measured in meters/second and is the linear velocity of the bat head at contact with the ball. In baseball, BQ and BV and relationships between them have been previously reported for male athletes at the professional level [1]. However, no such parameters have been investigated or established for female softball players. The purpose of this study was to describe BQ and BV for Division I collegiate softball players in game conditions and investigate the relationships that exist between BQ and BV.

METHODS

Video data were collected for all swings during a 15-game softball tournament in which six NCAA Division I teams played. The Ratings Percentage Index (RPI) for the teams ranged from 1 to 271 for the sample. For every pitch of the tournament, video cameras (JVC GC-PX1, Tokyo, JP) shooting at 300 Hz were used to capture any swing made. One camera was positioned on the first-base side of the field with its optical axis even with and parallel to the front edge of home plate. This camera was used to capture any swings made by right-handed hitters. The other, identical camera was positioned oppositely on the third-base side of the field, also with its optical axis parallel to the front edge of the plate. This second camera was used to capture any swings made by left-handed hitters. Though the cameras captured during all pitches, only data from trials in which a swing was made were kept. This resulted in a total of 1099 swings.

BQ was calculated by video analysis. The number of frames of video from the onset of the swing to contact, or, if the ball was missed, the frame in which the ball reached the same horizontal position as the bat head, were counted. This number of frames was then multiplied by (1/300) s. The onset of the swing was determined to be the frame in which the bat head made its first movement on a continuous trajectory to the contact point.

BV was calculated through digitization. The head of the bat was digitized at contact, or, if there was no contact, in the frame in which the ball had reached the same horizontal position as the bat head. The bat head was also digitized five frames (1/60 s) prior to this instant. A reference distance was calculated between the back corner of home plate and the centroid of the front, inner corners of the batters’ boxes. The distance covered by the bat head in the 1/60 s immediately prior to contact or its equivalent frame was then converted to meters and divided by 1/60 s to yield BV.

Means for BV and BQ were calculated for each player in the tournament. Additionally, correlation between BV and BQ was tested using Pearson’s r.

RESULTS AND DISCUSSION

Mean BQ and BV for individual players were 0.208 (± 0.035) s and 28.71 (± 2.62) m/s respectively, compared to a reported 0.14 - 0.18 s and 29.06 - 35.76 m/s in major-league baseball hitters [1].

Mean BQ and BV for players were inversely correlated (r = -0.40, p < .001), meaning the shortest player swing times were associated with the greatest player bat velocities. When all swings are considered, BQ and BV is still inversely correlated (r = -0.25, p < .001).
Total reaction time given to hitters (the time between the release of the ball from the pitcher’s hand to the instant at which contact needs to be made) is comparable between elite-level baseball and softball hitters. For example, a 95-mph fastball pitched from a 60 ft 6 in distance in baseball has comparable travel time to that of a 66 mph softball pitched from 43 ft in softball. It is therefore reasonable that BQ for the subjects in the present study was not dissimilar to that of elite baseball hitters in previous studies [1]. The differences probably stem from male and female strength differences, and it is unclear precisely how BV was measured in previous studies.

However, the existing differences are probably minimized by differences in equipment. For instance, major-league players must use wood bats, and college baseball players must use heavier bats. Both bats have bigger moments of inertia than those used by softball players.

The relationship between BQ and BV established previously for male professional baseball players indicated that a quicker bat resulted in a smaller velocity. This was thought to be true due to increased time of a swing leading to the greater accumulation of velocity. Thus, previous researchers have made a distinction between a “contact hitter” (a hitter with batting average > .299) and a “power hitter” (batting average < .300 and with 35 or more home runs) and shown that better BQ is associated with the former and better BV with the latter [1]. Superior athletes would then be able to have greater BV while still maintaining a low BQ.

This relationship did not materialize in the present study, either by individual player (see Figure 1), or by swing (see Figure 2). Instead, the greater BV were also associated also with better BQ (less time of swing). This is probably due to a very wide range of player abilities, whereas previous research has been conducted with top-level, more homogenous sample. Additionally, in the present study, the best and worst hitters were probably disproportionately distributed as witnessed by the wide range in team RPI.

It is also probably the case that at the Division I level, most players are capable of executing a quick swing (i.e. - having good BQ). Therefore, meaningful ability differences are probably to be seen in BV. Future studies should address the relationships between these descriptive parameters and outcomes associated with hitting success.

![Figure 1: BQ vs. BV means for every player executing at least one swing in the tournament.](image1)

![Figure 2: BQ vs. BV means for every swing executed during the tournament.](image2)

REFERENCES
