A comparison of base running and sliding techniques in collegiate baseball
with implications for sliding into first base

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Abstract

Purpose: The purpose of this study was to compare 4 techniques for arrival at a base after sprinting maximally to reach it: sliding head-first, sliding feet-first, running through the base without slowing, and stopping on the base. A secondary purpose of the study was to determine any advantage there may be to diving into first base to arrive sooner than running through the base.

Methods: Two high-definition video cameras were used to capture 3-dimensional kinematics of sliding techniques of 9 intercollegiate baseball players. Another video camera was used to time runs from first base to second in 4 counterbalanced conditions: running through the base, sliding head-first, sliding feet-first, and running to a stop. Mathematical modeling was used to simulate diving to first base such that the slide would begin when the hand touches the base.

Results: Based upon overall results, the quickest way to the base is by running through it, followed by head-first, feet-first, and running to a stop.

Conclusion: There was a non-significant trend toward an advantage for diving into first base over running through it, but more research is needed, and even if the advantage is real, the risks of executing this technique probably outweigh the miniscule gain.

Keywords: Baseball; Biomechanics; First base; Running; Sliding

1. Introduction

Safe arrival at a base in baseball requires covering the distance between bases in a short time. Often it also requires stopping quickly at the base after running maximally, typically using a head-first (HF) or a feet-first (FF) sliding technique. The HF technique is executed with a diving motion such that the players slide on the front of their trunk and legs, arriving with the hands first at the base (Fig. 1A). The FF technique is executed by sliding on the hip of a leg which is folded underneath the other, extended leg, arriving at the base with 1 foot forward (Fig. 1B).

These techniques allow the base runner to run as fast as possible between bases while maintaining the ability to brake quickly at the base in order to avoid overrunning the base and being tagged out, and have been described in previous studies.1 Though the HF technique potentially provides a larger reach forward at the time of base arrival, previous research has found no time advantage for either sliding technique.2,3

There may also exist a perception among players that the HF technique is faster.2 Given the risks to the upper extremity and the potential exposure to head and neck injury that may be associated with the HF technique,4,5 it is important to know whether any advantages to using it do exist. To better weigh any potential advantages against those risks, more than the comparisons that have been made to the FF sliding technique are needed.

There are 2 other ways to arrive at a base. First, the players may run to a stop on the base, remaining upright on their feet as they brake to stop at the base. Second, a player may run “through” the base, touching it in passing without slowing down. At times, the player may do this without penalty of being put out after running past the base. One example of this is at first base on a force play. This play is essentially a race between the player reaching the base and the ball arriving in the glove of the first baseman to record an out. There may be a perception that diving to first base to beat the throw is somehow advantageous from a

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time perspective because of the diving forward and extending the reach to get to the base, but to date, no peer-reviewed studies have investigated this potential advantage.

The purpose of this study was 2-fold: first, to compare the overall effectiveness of 4 arrival techniques in terms of time and velocity: the HF and FF techniques, running through the base (RT), and running to a stop on the base (RS); and second, to find the advantage, if any, to using the HF technique with its forward reach at first base instead of running through the base in order to arrive sooner.

2. Methods

Nine Division I intercollegiate baseball players (age: 20.9 ± 1.9 years; height: 1.79 ± 0.05 m; weight: 78.4 ± 6.7 kg) volunteered for the study. All subjects were injury-free and medically cleared to play at the time of the study. Procedures for the study were approved by the Indiana University Institutional Review Board, and all participants signed an approved informed consent document.

Data collection took place at team playing facilities, using base paths of dirt. After a warm-up period, each player executed maximum-effort runs from a game-like lead-off position with the right foot at a mark which was 3.96 m (13 feet) ahead of first base and toward second base. This standardized start was based upon typical leading-off technique. In order to limit the effects of fatigue and to reduce exposure to injury, subjects each made only 2 successive runs for each of the RT, HF, FF, and RS techniques in a random, counter-balanced order with 2–3 min of rest between trials. Players were not required to touch the base in the RT trials so that their strides were not altered unnaturally. In all other conditions, base contact was required.

A video camera recording at 60 Hz (Canon ZR90; Canon Inc., Melville, NY, USA) was positioned in foul territory between third base and home plate and recorded the entire run for timing purposes. After a warm-up period, each player executed maximum-effort runs from a game-like lead-off position with the right foot at a mark which was 3.96 m (13 feet) ahead of first base and toward second base. This standardized start was based upon typical leading-off technique. In order to limit the effects of fatigue and to reduce exposure to injury, subjects each made only 2 successive runs for each of the RT, HF, FF, and RS techniques in a random, counter-balanced order with 2–3 min of rest between trials. Players were not required to touch the base in the RT trials so that their strides were not altered unnaturally. In all other conditions, base contact was required.

A video camera recording at 60 Hz (Canon ZR90; Canon Inc., Melville, NY, USA) was positioned in foul territory between third base and home plate and recorded the entire run for timing purposes. In order to obtain 3-dimensional (3D) coordinate data as subjects approached the base, the final 10 m of each run was also recorded with 2 high-definition (HD) (1080i) cameras shooting at 50 Hz (Sony HVR-V1P; Sony Corp., New York, NY, USA). One camera was situated in shallow center field and the other was situated in shallow right field such that the optical axes of the cameras were approximately orthogonal to each other (Fig. 2). Lens zoom was set so that all landmark data were captured in the middle 80% of the field of view, thus avoiding lens distortions.

Previous pilot testing had revealed that highly skilled players tend to execute each sliding technique in a repeatable fashion from trial to trial. Accordingly, a representative trial was selected for analysis. To compare the best possible outcomes for each condition, the fastest trial by time for each player in each condition as determined by the 60 Hz video footage was chosen for analysis, resulting in 4 analyzed trials (1 of each condition) per player. Since only the body center of mass (COM) locations leading to the base were needed for the study, 50 Hz data provided sufficient time resolution.

To synchronize the 2 HD cameras for 3D data, a clock-like device was situated so that its face was visible to each camera. The device had a rapidly spinning “hand” that provided events (the hand passing a mark on the “clock” face) visible to both cameras. The frame numbers of these events were noted for each camera and corresponding frames for the events from each camera were plotted against each other. A line with slope = 1 was fitted through the plotted points by linear regression and frame-to-frame correspondence was calculated for data synchronization between the 2 camera views. A 3D calibration object was positioned in the center of the capture volume and recorded by each camera for use in the direct linear transformation (DLT) algorithm.

The locations of 21 body landmarks (vertex, gonion, suprasternale, right and left shoulders, elbows, wrists, third knuckles, hips, knees, ankles, heels, and toes) were manually digitized in each frame captured by the 2 video cameras for each trial, starting from the time the subject was visible, to 12 frames after base arrival, using SIMI Motion Capture 3D software (SIMI Reality Motion Systems GmbH, Unterschleissheim, Germany).

The digitized coordinate data were used in the DLT algorithm to calculate the 3D coordinates of the 21 body landmarks
for output frames of 0.02 s each. These coordinates were expressed with respect to a global reference frame, \( R_b \). \( R_b \) was a right-handed, orthogonal reference frame which had its origin at the middle of the front edge of second base (Fig. 2), and had axes \( X_b, Y_b, \) and \( Z_b \). \( Y_b \) was horizontal at the ground and was directed from the middle of first base to the middle of second base. \( Z_b \) pointed vertical upward, and \( X_b \) was horizontal at the ground, perpendicular to \( Y_b \) and \( Z_b \), and pointed to the right of the runner.

Quintic spline functions were fitted to the time series coordinates of the landmarks using a smoothing factor that corresponded to a 12 Hz cutoff frequency. These spline functions were used to calculate smoothed time series 3D position, velocity, and acceleration data for the landmarks in each output frame. Then, the body was modeled as a 16-segment system and the locations and velocities of the COM of the segments and the whole body were calculated for each frame.

The start of the run was defined as the instant when the trail foot left the ground. The times for the entire 22.90 m run (\( t_{TOT} \)), the first 12.90 m (\( t_{1290} \)), and the final 10 m (\( t_{10} \)) were measured using video analysis, estimated to the nearest half-frame. It was predicted that the differences between techniques would only affect the last 10 m of the run, and so the times for this portion and the initial 12.90 m portion were separated. First, \( t_{TOT} \) was calculated from the video of the entire run. Then, \( t_{10} \) was calculated as the time from the instant the body COM was 10 m from the base to the instant at which the base was contacted, or when the forward toe crossed the plane of the front of the base in the case of the RT condition if the subject did not touch the base. After \( t_{10} \) was calculated, \( t_{1290} \) was calculated by subtracting \( t_{10} \) from \( t_{TOT} \).

In all trials, the COM was still short of the base at the instant of contact. Because of this, 2 average velocities were computed for the last 10 m: effective velocity (\( v_{EFF} \)) and actual velocity (\( v_{COM} \)). Because the player only needs to contact the base rather than get his COM all the way to it, \( v_{EFF} \) was calculated as though the COM traveled the entire final 10 m:

\[
v_{EFF} = \frac{10 \text{ m}}{t_{10}} \tag{1}
\]

The actual velocity of the COM for the last 10 m, \( v_{COM} \), was calculated using the formula:

\[
v_{COM} = \frac{d_{ADJ}}{t_{10}} \tag{2}
\]

where \( d_{ADJ} \) was the horizontal distance traveled by the COM between the instant when the COM reached a point 10 m from second base and the instant of first contact with the base. The difference between 10 m and \( d_{ADJ} \) was considered to be a reaching “bonus”; \( d_{REACH} \). The difference between \( v_{EFF} \) and \( v_{COM} \) represented a theoretical velocity gain (\( v_{REACH} \)) achieved by touching the base with a point of the body located at a distance \( d_{REACH} \) ahead of the body COM (Fig. 3).

An average velocity of the body COM was calculated for each meter-long interval in the last 10 m prior to the base in each condition, from the interval 10–9 m away from the base to the interval 3–2 m away from the base. This yielded 8 interval velocities for each player in each condition. These velocities allowed for comparison between conditions at defined intervals approaching the base. The intervals were long enough to measure a stable velocity within using the 50 Hz sampling rate, but short enough to reveal the changes that the different techniques caused as subjects approached the base. Times and interval velocities were compared across conditions using 1-way repeated measures ANOVA. Pairwise post hoc \( t \) tests were used to identify specific differences between means, with the critical \( t \) value adjusted using a Bonferroni procedure to prevent type I error \( (\alpha = 0.05) \). All statistical analyses and Bonferroni adjustments were carried out using SPSS software (Version 17.0; SPSS Inc., Chicago, IL).

A mathematical model was used to simulate the condition of executing an HF slide with the slide starting as the hand contacts the base. A modified time for the last 10 m, \( t_{FDOM} \), was determined and then added to \( t_{1290} \) for the HF and RT conditions for a new total time, \( t_{FDTMOD} \), which corresponded to the theoretical time it would take to reach the base if the subject maintained running speed up to the instant when his COM was \( d_{REACH} \) away from the base, which would occur if he began his slide at base arrival.

The time \( t_{FDOM} \) was calculated as the time required to cover the distance \( d_{ADJ} \) between 10 m away from the base and \( d_{REACH} \) away from the base at the velocity measured when the HF slide started. For both HF and FF sliding, the slide was defined as starting when anything other than a foot first touched the ground. The time \( t_{FDOM} \) was compared to \( t_{TOT} \) for the HF and RT conditions using a paired \( t \) test due to its having been mathematically modeled, rather than measured like the variables included in the omnibus ANOVA model \( (\alpha = 0.05) \).

3. Results

All time and velocity data for the base arrival techniques appear in Table 1, with differences between means reported using the Bonferroni-adjusted \( p \) values \( (p_{bon}) \). Observed power and effect size for statistical tests were \((1-\beta) = 0.847 \) and \( \eta^2 = 0.56 \), respectively. No significant time differences were found between any of the conditions in the first 12.90 m of the run. However, \( t_{TOT} \) and \( t_{10} \) for RT were significantly less than for FF and RS \( (p_{bon} = 0.026, 0.001 \) and \( p_{bon} = 0.018, 0.001 \) \). There were no significant differences between RT and HF for \( t_{TOT} \) or \( t_{10} \). The differences between HF and FF for \( t_{TOT} \) and \( t_{10} \) were not significant. RS had a greater \( t_{TOT} \) and \( t_{10} \) \( (p_{bon} < 0.001, 0.001) \) than the next slowest condition (Table 1).

For the final 10 m, RT was faster than FF and RS by \( v_{EFF} \) \( (p_{bon} = 0.012 \) and \( 0.001) \), but there was no difference in \( v_{EFF} \) between RT and HF. The difference between HF and FF for \( v_{EFF} \) was not significant. RS had a smaller \( v_{EFF} \) \( (p_{bon} < 0.001) \) than the next slowest condition.

For actual \( v_{COM} \) over the last 10 m, RT was faster than HF and FF \( (p_{bon} < 0.001, 0.001) \) and RS was slower than HF and FF \( (p_{bon} < 0.001, 0.001) \). There were no significant differences between HF and FF (Table 1).
Fig. 3. Positions of each subject at the instant of base contact, each with the COM marked. The dotted line for each condition indicates the average COM location of all subjects for the condition. avg = average; COM = center of mass; \(d_{REACH}\) = reach bonus; HF = head-first technique; FF = feet-first technique; RS = running to a stop; RT = running through the base; Sub = subject.
The bonus velocity, $v_{\text{REACH}}$, was linked to the reach distance, $d_{\text{REACH}}$. The HF condition produced the largest reach distance and bonus velocity in the samples, followed by FF, RS, and RT, in that order (Table 1). Statistically, the values were larger in HF than in RS and RT ($p_{\text{Bonf}} = 0.030, 0.043$ and $p_{\text{Bonf}} = 0.002, 0.001$), and larger in FF than in RT ($p_{\text{Bonf}} = 0.045, 0.039$). There were no differences between HF and FF for $d_{\text{REACH}}$ or $v_{\text{REACH}}$.

The velocity of the RT condition showed a slightly increasing trend during the last 10 m, while the other 3 conditions showed consistent velocity followed by a marked slowing down in the last 3–7 m (Fig. 4). In the 10th meter prior to the base, the COM velocities of the 4 conditions showed no significant differences. In the 8th or 7th meter prior to the base, there were still no significant differences between RT and HF, between HF and FF, and between FF and RS, but RT was significantly faster than FF and RS, and HF was significantly faster than RS (Fig. 4). In the 5th meter prior to the base, RS became significantly slower than all the other conditions, while the interrelationships between RT, HF, and FF remained the same as before, with RT faster than FF, but no significant differences between RT and HF nor between HF and FF. In the 4th or 3rd meter prior to the base, RT became the fastest condition, RS remained the slowest, and there was still no significant difference between HF and FF. HF and FF showed no significant COM velocity differences in any of the 1 m intervals.

When $t_{\text{TOTMOD}}$, for the simulation of starting an HF slide as the hand contacts the base, was compared to $t_{\text{TOT}}$ for HF and RT conditions as measured, $t_{\text{TOTMOD}}$ for HF was significantly less (3.24 ± 0.09 s) than $t_{\text{TOT}}$ for HF (3.33 ± 0.10 s, $p < 0.001$) but not for RT (3.28 ± 0.09 s), although it did approach significance ($p = 0.07$).

4. Discussion

There were no differences for time between conditions in the first 12.90 m. This indicates that the time differences discovered for the whole run were due to differences in mechanics over the final 10 m approaching the base. These time differences were linked to velocity differences. By separating the times and velocities for each technique into the first sprinting portion of 12.90 m over which all techniques were effectively identical, and the last 10 m over which the differences in technique emerge, the present study adds to previous studies that have compared only the HF and FF techniques. Additionally, by using full-body kinematics in the final 10 m approach to the base, the sources of real or perceived advantages can be further explored.

Like the present study, previous studies found no overall temporal advantage to using the HF technique over the FF technique. However, the present study measured the final reaching distance ahead of the COM at base arrival, and so more can be understood about perceived advantages for the HF technique. The RT condition produced a larger average real $v_{\text{COM}}$ than the HF condition in the last 10 m. However, the larger $d_{\text{REACH}}$ of the HF condition closed some of the velocity gap. Thus, the effective velocity $v_{\text{EFF}}$ was not significantly larger in RT than in HF (although it approached significance, and was in fact detectable by paired $t$ test with $p < 0.01$), and thus $t_{10}$ and $t_{\text{TOT}}$ were not different between RT and HF.

The FF condition had a smaller $v_{\text{COM}}$, smaller $d_{\text{REACH}}$, and smaller $v_{\text{EFF}}$ than the RT condition, but when compared to HF sliding, there were no differences for velocities or times. Relatively, $t_{\text{TOT}}$, arguably the most important of these variables to game play, was not different between HF and FF sliding.

### Table 1

| Condition | $t_{\text{TOT}}$ (s) | $t_{\text{12m}}$ (s) | $t_{10}$ (s) | $v_{\text{EFF}}$ (m/s) | $v_{\text{COM}}$ (m/s) | $v_{\text{REACH}}$ (m/s) | $d_{\text{REACH}}$ (m/s) |
|-----------|----------------------|----------------------|--------------|------------------------|------------------------|------------------------|------------------------|
| RT        | 3.28 ± 0.09          | 2.14 ± 0.05          | 1.13 ± 0.04  | 8.85 ± 0.35            | 8.42 ± 0.16            | 0.44 ± 0.22            | 0.48 ± 0.23            |
| HF        | 3.33 ± 0.10          | 2.14 ± 0.04          | 1.19 ± 0.07  | 8.44 ± 0.49            | 7.63 ± 0.40            | 0.81 ± 0.11            | 0.96 ± 0.09            |
| FF        | 3.40 ± 0.08          | 2.18 ± 0.06          | 1.22 ± 0.07  | 8.20 ± 0.46            | 7.54 ± 0.37            | 0.65 ± 0.12            | 0.79 ± 0.12            |
| RS        | 3.48 ± 0.06          | 2.16 ± 0.05          | 1.32 ± 0.05  | 7.59 ± 0.27            | 7.11 ± 0.23            | 0.49 ± 0.07            | 0.63 ± 0.08            |

Notes: Significant differences are noted by numerical footnotes, and are all at Bonferroni-adjusted $p$ levels. * Different with FF and RS; ** Different with all others; † Faster than all others; ‡ Slower than all others; § Greater than RT; ¶ Greater than RT and RS.

Abbreviations: $d_{\text{REACH}}$ = reach bonus; FF = feet-first technique; HF = head-first technique; RS = running to a stop; RT = running through the base; $t_{\text{10}}$ = time over the last 10 m; $t_{\text{12m}}$ = time over the first 12.90 m; $t_{\text{TOT}}$ = total run time; $v_{\text{COM}}$ = real center of mass velocity; $v_{\text{EFF}}$ = effective velocity; $v_{\text{REACH}}$ = velocity gained by the reach bonus $d_{\text{REACH}}$.
However, $v_{\text{eff}}$ in the FF condition was significantly slower than in the RT condition, whereas in the HF condition it was not.

The RS condition suffered the disadvantage of the smallest $v_{\text{COM}}$ and a small $d_{\text{REACH}}$. This combination produced a slower $v_{\text{eff}}$ for RS than for any other condition, along with the worst $t_{10}$ and $t_{\text{TOT}}$, despite having the same $t_{1290}$ as the other conditions. Therefore, in terms of getting to the base quickest, RS is not desirable, but there are other reasons for its use, as will be discussed further.

Based on having the greatest $v_{\text{COM}}$, RT is likely the fastest way to reach a base for most players, even though its $t_{\text{TOT}}$ only approached being significantly less than for HF in this sample. Though there was no statistical advantage between HF and FF sliding techniques, there was one between RT and FF (but not between RT and HF, due to the HF technique’s reach advantage), and it is probable that HF sliding ranks ahead of FF sliding in terms of reaching the base quickly. Clearly, the RS condition is the slowest way to reach the base.

Though running through the base is fastest as measured, it is not always wise to do so in game play. If the arrival at the base occurs at second or third base, the runner is in jeopardy of being put out after going past, and no longer contacting the base. At first base and at home plate, however, the runner may run past the base without penalty, and so running through is desirable unless there is a need to avoid a tag, which could occur at both home plate and first base.

Using $d_{\text{REACH}}$ and $v_{\text{COM}}$ for the HF and RT techniques, a novel analysis for sliding into first base to beat a throw was made without subjecting players to hazardous sliding conditions. The subjects in the present study executed their HF slides into second base, simulating an attempted stolen base scenario, and not the situation in which a base runner runs a full 90 feet from the batter’s box, which could change their approach speed given more distance to accelerate. However, an effort was made to use the data measured in the study to simulate HF diving into first base for the purposes of comparison to running through first base, since having runners actually execute the maneuver as modeled would be too dangerous.

While running through the base would be an advantage in terms of time when compared to the HF method normally used (starting the slide well in advance of the base and sliding to it), if the player were able to begin his slide at the base (that is, the first sliding contact with the ground occurs as the hand touches the base) there may be a time advantage. Based on the reported results here, more investigation would be needed to demonstrate this conclusively, but there was a trend in the HF diving method’s favor, and it is possible that the player would be able to add slightly more speed before starting this later slide by continuing the sprint beforehand a little while longer. To date, this potential advantage has not been demonstrated using measured data, but has been explored here mathematically based upon novel data collected for the present study.

It is, however, important to note that a quick time to the base is not the only strategic factor in the effectiveness of any of these techniques. For example, though the present study confirms the lack of a time advantage for either HF or FF sliding, it is suggested here that the HF technique ranks slightly ahead of the FF technique. However, using the FF technique allows a player to “pop up” on the base after sliding in. This allows the player to be upright for further game play should there be an errant throw, or some other reason to continue running to the next base. If there will be no play at all on the advancing player, and reaching a subsequent base is unlikely, even the RS condition offers advantages: namely, remaining upright, and avoiding unnecessary exposure to injury.

Finally, when taking all things into consideration about diving into first base to be faster (i.e., not just to avoid a tag), there are some good reasons to run through the base and avoid sliding into first base, even in the unlikely event that diving would be demonstrably faster. In addition to the increased exposure to injury inherent to touching the base as the sliding impact occurs, the technique itself would be very difficult to execute. Even in the cases where the player executed the dive flawlessly, was faster to the base, and was not hurt, he could not immediately advance to second base if the first baseman were to miss the fielder’s throw, as he could in the case where he remains upright, running through the base.

This study used a relatively small number of subjects, which may be perceived as a limitation. There was an implied assumption that players of this skill level execute their slides in a highly repeatable way. Though some limited pilot testing supported this assumption, it is not known how reliable and repeatable the motion is. Because the slides were executed under controlled conditions, without a throw and tag to worry about, the slides were probably as repeatable as they could be for the players. The subjects were all high-level collegiate players and so these results are not generalizable to players of lower skill levels. However, effect sizes were large enough to reveal the investigated differences in the techniques, and the discussion concerning using an HF technique to arrive at first base is probably more applicable to younger players from a safety and skill standpoint. Further, these results are not generalizable to the game of softball, where bases are closer together, there is no lead-off from the base, and the intercollegiate participants are female. Runners were not required to make contact with the base when running through in order to avoid altering their strides. This may present a limitation to the study if there is a significant time penalty for stride alteration, but this is unknown and needs to be investigated in future studies. Finally, though most data were measured for this study, those pertaining to the analysis of diving into first base for a time advantage were mathematically modeled. These modeled data were based on data measured in stopping at second base, rather than attaining first base as a batter-runner, adding another limitation to the study. If there is a real difference between running through first base and sliding head first into it from a time standpoint, future research will need to find ways of measuring it without subjecting players to undue risk of injury.

5. Conclusion

The times and effective velocities in the last 10 m clearly showed that the RT, FF, and RS conditions are ranked in that
order in regard to the time required for reaching the base, while the HF condition is probably intermediate between the RT and FF conditions. However, it is important to keep in mind that minimizing travel time between bases is not the only factor to be considered. Before deciding which technique to use, the player has to take into account the possible need to stop at the base, they need to avoid the baseman’s tag, keeping options open for possible further immediate play, and minimizing the risk of injury. The possibility that diving into first base, rather than running through it, will be faster is remote, and it is probably better to run through the base if no tag is imminent, both for safety and to preserve further running options should the fielder’s throw to first somehow get past the first baseman.

Accordingly, in situations where reaching first base as fast as possible is the objective, coaches should instruct players to remain upright and run through the base when possible, as it is faster and less dangerous than sliding head first into the base. When trying to reach second or third base as fast as possible, players will often need to slide so that their braking begins as late as possible before reaching the bag. In this case, there are no advantages for the HF or FF techniques, and player preference and skill will determine the choice of technique.

Authors’ contributions

TF contributed to conception, data collection, data reduction, software development, statistical analysis, and writing. JD contributed to conception, data collection, data reduction, software development, statistical analysis, and writing. AB contributed to data collection, data reduction, and editing. All authors have read and approved the final version of the manuscript, and agree with the order of the presentation of authors.

Competing interests

None of the authors declare competing financial interests.

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