Research Article

Run-A-Three Test Performance Across Playing Positions In Professional Cricketers: A Cross-Sectional Comparative Study

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Abstract

Background: Running between the wickets is a decisive, repeatedly executed physical act in cricket, yet it is habitually regarded as the concern of specialist batters alone. In practice every member of a batting side may be called to the crease, and when early wickets fall middle- and lower-order players typically all-rounders, wicketkeepers and bowlers must run under the same time pressure as recognised batters. Whether cricket-specific running capacity is in fact distributed evenly across playing roles has not been established.

Objectives: To compare Run-a-Three test performance across the four principal playing positions in professional cricketers within each sex; to examine the same comparison after regrouping players by their customary batting-order tier; to quantify the test's test–retest reproducibility; and to derive sex-specific normative reference values.

Methods: One hundred and fifty-five professional cricketers (100 men, 55 women; 26.5 ± 5.3 years) drawn from four playing positions (41 batsmen, 39 bowlers, 32 all-rounders, 43 wicketkeepers) completed a maximal Run-a-Three test as part of a wider field battery. A subsample of 60 athletes repeated the test after 48 hours. Because male and female cricketers differ systematically in absolute physical capacity, every analysis was stratified by sex. Distributions were screened with the Shapiro–Wilk test and variance homogeneity with Levene's test. Positional differences were examined by one-way analysis of variance with Tukey post-hoc comparisons and confirmed by the Kruskal–Wallis test, with eta-squared and epsilon-squared as effect sizes. Reliability was expressed as ICC(2,1), standard error of measurement (SEM), minimal detectable change (MDC95) and coefficient of variation (CV). Analyses were conducted in IBM SPSS Statistics version 23 with significance set at $p < 0.05$.

Results: Run-a-Three time discriminated powerfully between the sexes (men 7.85 ± 0.31 s vs. women 8.58 ± 0.39 s; $t(153) = 12.65$, $p < 0.001$, $d = 2.12$). Within each sex, however, performance did not differ across playing positions: men $F(3,96) = 0.91$, $p = 0.440$, $\eta^2 = 0.028$; women $F(3,51) = 1.47$, $p = 0.233$, $\eta^2 = 0.080$, with all Tukey comparisons non-significant and Kruskal–Wallis confirming both results. Regrouping players into upper-, middle- and lower-order batting tiers produced the same null outcome (men $p = 0.342$; women $p = 0.206$). Reproducibility over 48 hours was good in the pooled subsample (ICC = 0.86, SEM = 0.20 s, MDC95 = 0.56 s, CV = 1.97%) with no systematic session-to-session change ($p = 0.635$), although the within-men estimate was attenuated (ICC = 0.50) by the narrow spread of male times. Within sex, Run-a-Three time was essentially unrelated to sprint, jump, agility, strength and aerobic measures (all $|r| \leq 0.15$), whereas the sex-pooled correlation with the 30-m sprint reached $r = 0.63$ — an artefact of aggregation.

Conclusion: Cricket-specific running-between-the-wickets capacity was uniform across playing positions in professional cricketers of both sexes. Rather than a negative result, this is reassuring evidence that non-specialist batters are not disadvantaged in the running task they may be required to perform when early wickets fall. The Run-a-Three test is reproducible and supplies interpretable sex-specific reference values, and the accompanying MDC95 of approximately 0.5–0.6 s defines the change that must be exceeded before individual improvement can be claimed.

Keywords: cricket; running between the wickets; field testing; playing position; batting order; normative values; reliability; sex differences.

1. Introduction

Cricket is an intermittent sport in which long passages of low-intensity activity are punctuated by brief, near-maximal efforts.1,2 Among those efforts, running between the wickets occupies a peculiar position. It is simultaneously one of the most frequently repeated maximal actions in a batting innings and one of the least systematically assessed. Every run scored by placement rather than by boundary is purchased through an accelerated sprint over roughly the pitch length, executed with a bat in hand, often with a turn, and frequently under acute time pressure against a fielder's throw. Time-motion work has repeatedly shown that the running burden of batting escalates in the shorter formats, and that a substantial share of a batter's total high-intensity distance is accrued in precisely this manner.3,4

The physical texture of the task is distinctive. Unlike a straight-line sprint test, running between the wickets combines acceleration from a stationary or near-stationary start, deceleration into a turn, a change of direction executed while grounding the bat, and re-acceleration in the opposite direction; repeated for the second and third run.5 Houghton demonstrated that the turning technique adopted materially alters completion time, indicating that the task carries a skill component in addition to its physical demand.5 It follows that a test constructed around three consecutive pitch-length runs measures something that neither an unresisted sprint nor a conventional change-of-direction course fully captures.

Because the action is so plainly a batting action, it has customarily been treated as the province of specialist batters. This framing sits uncomfortably with the realities of match play. A cricket team fields eleven players, of whom every one may be required to bat. When early wickets fall a commonplace occurrence across all three formats; middle-order and lower-order players are brought to the crease sooner, for longer and often at a stage of the innings when the scoring rate must be forced. In the customary structure of a professional side, those middle- and lower-order roles are occupied not by recognised batters but by all-rounders, wicketkeepers and bowlers. A bowler batting at number nine in the final overs of a limited-overs innings is asked to convert ones into twos with the same urgency as an opener; the fielding side does not moderate its throwing because of the batter's nominal specialism.

Whether this expectation is matched by physical capacity is an open question. Two opposing predictions are plausible. On one view, specialist batters who accumulate far more running-between-the-wickets exposure in training and match play should be quicker at the task through sheer practice and specificity. On the alternative view, running between the wickets draws on general acceleration and change-of-direction qualities that are broadly developed in all professional cricketers by contemporary strength-and-conditioning practice, in which case no positional advantage would be expected.6,7 The distinction matters practically: if lower-order players are demonstrably slower, that constitutes a targeted conditioning gap and an argument for role-specific running preparation; if they are not, coaches may reasonably direct limited preparation time elsewhere.

The available literature does not resolve this. Cricket profiling studies have compared positions extensively on sprint speed, jump performance, aerobic capacity and anthropometry, generally reporting that fast bowlers carry the heaviest match running load while positional differences in laboratory and field fitness tests are modest or absent.3,8,9,10 Very few, however, have used a cricket-specific running task as the outcome, and the authors are aware of no study that has compared a standardised three-run test across playing positions in a professional cohort of both sexes. The women's game compounds the omission: despite rapid professionalisation, applied physical data for female cricketers remain sparse, and where they exist, they rarely permit within-sex positional comparison.11,12

A further methodological consideration governs any such comparison. Male and female athletes differ systematically in absolute speed and power, typically by margins far exceeding any positional contrast.13 Analyses that pool the sexes therefore risk producing associations and group differences that encode sex rather than the variable of interest a form of aggregation artefact well described in the measurement literature.14 Sex-stratified analysis is consequently not a refinement in this context but a prerequisite.

Accordingly, the present study had four aims: (i) to compare Run-a-Three test performance across the four principal playing positions within each sex; (ii) to repeat that comparison after regrouping athletes according to the batting-order tier they customarily occupy, thereby testing the practical question directly; (iii) to establish the test–retest reproducibility of the Run-a-Three test and the smallest change that can be regarded as real; and (iv) to derive sex-specific normative reference values against which an individual cricketer's time may be interpreted. It was hypothesised that positional differences would be small, and that the test would demonstrate acceptable reproducibility.

2. Materials and Methods

2.1 Study design

This was a cross-sectional comparative study with an embedded test–retest reliability component. The investigation formed a supporting study within a doctoral programme concerned with the development of a comprehensive fitness profiling tool for professional cricketers, and drew on the same participant cohort and testing session as that programme. Reporting follows accepted recommendations for observational studies and for studies of measurement properties.15,16

2.2 Ethical approval

Ethical approval was granted by the Institutional Ethics Committee of SPB Physiotherapy College, Surat, Gujarat, India (approval number: EC/SPB/111) and the parent study was prospectively registered with the Clinical Trials Registry – India (CTRI/2025/04/086056). The study was conducted in accordance with the Declaration of Helsinki.17 All participants received a written participant information sheet and provided written informed consent prior to enrolment. Participation was voluntary and withdrawal was permitted at any point without consequence. Data were anonymised at the point of entry and stored on password-protected media with access restricted to the investigators.

2.3 Participants

One hundred and fifty-five professional cricketers (100 men, 55 women) were recruited by purposive sampling from cricket academies, district and state squads, and affiliated clubs in Gujarat, India. Eligibility required current professional or semiprofessional competitive participation, age of eighteen years or above, a minimum of one year of competitive cricket, and freedom from injury at the time of testing. Athletes were excluded if they presented with an acute musculoskeletal injury, or with any neurological, cardiovascular or systemic condition liable to affect maximal physical performance, or if they were unwilling to provide consent. All eligible athletes approached agreed to participate and completed the test; there were no missing data for the primary outcome.

Participants were classified by their principal playing position as batsman (n = 41), bowler (n = 39), all-rounder (n = 32) or wicketkeeper (n = 43), on the basis of the role recorded in squad documentation and confirmed by the athlete at enrolment. For a secondary analysis, these positions were additionally mapped onto the batting-order tier customarily occupied within the participating squads: batsmen were classified as upper order (openers and top order), all-rounders and wicketkeepers as middle order, and bowlers as lower order. This mapping reflected the recorded batting practice of the participating squads and is stated explicitly because it is a proxy, not a scorecard-derived batting position.

2.4 Sample size

The available cohort of 155 athletes was used in full for the positional comparison. For a four-group one-way analysis of variance at $\alpha = 0.05$ with 80% power, a sample of 100 men affords detection of a medium effect (Cohen's $f \approx 0.32$); the smaller female sample (n = 55) affords detection only of a large effect ($f \approx 0.44$). The study is therefore adequately powered to exclude a large positional difference in both sexes but not to exclude a small one, and this constraint is carried explicitly into the interpretation of the null findings. For the reliability component, a subsample of 60 athletes (30 men, 30 women) exceeds commonly cited minimums for stable estimation of an intraclass correlation coefficient in the good range.18,19

2.5 The Run-a-Three test

The Run-a-Three test replicates the act of running three runs between the wickets. Two creases were marked 17.68 m apart, corresponding to the distance between the popping creases of a full-length cricket pitch. From a stationary start behind the first crease, and carrying a standard cricket bat, the athlete sprinted to the opposite crease, grounded the bat behind the line, turned, sprinted back, grounded the bat, turned again and sprinted through the finishing crease — a total of three completed runs. Turns were executed in the athlete's habitual manner; no turning technique was prescribed, since technique forms part of the skill the test is intended to capture.5 A trial was discarded and repeated if the bat was not grounded behind a crease.

Timing commenced on the athlete's first movement and ceased as the torso crossed the final crease line. All timing was performed by a single experienced investigator using a calibrated handheld stopwatch with 0.01 s resolution. A standardised demonstration and one submaximal familiarisation run preceded maximal trials. Two maximal trials were completed, separated by at least three minutes of passive recovery, and the faster time was retained for analysis.

2.6 Testing procedures and standardisation

Testing was conducted on a level, dry grass outfield during the competitive preparation period, at a comparable time of day, with participants wearing their habitual training footwear. Athletes were instructed to avoid strenuous exercise in the 24 hours preceding testing. Each session opened with a standardised warm-up comprising five minutes of light jogging, lower-limb dynamic mobility drills and three progressive sprint efforts at approximately 60%, 80% and 95% of perceived maximum, followed by three minutes of passive rest. The Run-a-Three test was administered within a wider profiling battery in a fixed sequence designed to minimise fatigue carry-over, with maximal speed and agility items preceding the aerobic assessment and following the skill and strength items. A single investigator supervised all testing to standardise instruction, encouragement and timing.

Participants in the reliability subsample repeated the test 48 hours later under matched conditions like same surface, same time of day, same warm-up, same equipment and same investigator. The 48-hour interval was chosen to permit recovery while precluding genuine change in fitness, so that between-session variation may reasonably be attributed to measurement error.

2.7 Statistical analysis

All analyses were performed in IBM SPSS Statistics version 23 (IBM Corp., Armonk, NY, USA), with statistical significance set at $p < 0.05$ (two-tailed). Continuous variables are reported as mean ± standard deviation with 95% confidence intervals, and medians with interquartile ranges where distributions departed from normality.

Because male and female cricketers differ systematically in the qualities under examination, every inferential analysis was stratified by sex; sex-pooled statistics are presented at one point only, as a deliberate methodological illustration, and are not interpreted substantively.13,14 Distributional normality was assessed within each sex and within each sex-by-position cell using the Shapiro–Wilk test, supported by skewness, kurtosis, histograms and normal Q–Q plots. Homogeneity of variance across positional groups was examined with Levene's test based on the median.

The between-sex comparison used an independent-samples t-test with Cohen's d as the effect size, confirmed by the Mann–Whitney U test. The primary analysis — comparison of Run-a-Three time across the four playing positions — used one-way analysis of variance within each sex, with Tukey's honestly significant difference procedure for pairwise comparisons and eta-squared (η^2) and omega-squared (ω^2) as effect-size indices. Because one sex-by-position cell departed from normality, the Kruskal–Wallis H test with epsilon-squared (ε^2) was computed in parallel as a distribution-free confirmation of every omnibus result. Effect sizes were interpreted as small ($\eta^2 \approx 0.01$), medium ($\eta^2 \approx 0.06$) and large ($\eta^2 \approx 0.14$).20 A two-way analysis of variance with sex and position as fixed factors was additionally fitted as a sensitivity analysis to test for a sex-by-position interaction. Between-position differences in age, stature, body mass and body mass index were examined to confirm that positional groups were comparable on characteristics that might otherwise confound the running comparison.

The secondary analysis repeated the omnibus comparison after collapsing playing positions into three batting-order tiers, again within sex, with independent-samples t-tests and Cohen's d for the three pairwise contrasts.

Test–retest reliability was quantified using the intraclass correlation coefficient ICC(2,1) — a two-way random-effects model for absolute agreement, single measures — with 95% confidence intervals, interpreted as poor (< 0.50), moderate (0.50–0.75), good (0.75–0.90) and excellent (> 0.90).18 Absolute reliability was expressed as the standard error of measurement ($SEM = SD \times \sqrt{(1 - ICC)}$), the minimal detectable change at the 95% level ($MDC95 = SEM \times 1.96 \times \sqrt{2}$) and the within-subject coefficient of variation.19,21 Systematic change between sessions was tested with a paired-samples t-test and Cohen's dz, and visualised by Bland–Altman analysis reporting mean bias and 95% limits of agreement.22

To characterise what the test measures, Pearson correlations were computed within sex between Run-a-Three time and the other field measures in the battery (unresisted and parachute-resisted 30-m sprint, M-Agility, vertical jump, standing long jump, leg-press one-repetition maximum, Yo-Yo intermittent recovery distance, estimated VO_2max, body-fat percentage and body mass index), with Fisher z-transformed 95% confidence intervals. The corresponding sex-pooled coefficients were computed for two variables solely to demonstrate the magnitude of the aggregation artefact. Sex-specific normative percentiles (5th, 10th, 25th, 50th, 75th, 90th, 95th) were derived for the full cohort.

3. Results

3.1 Participant characteristics

All 155 recruited cricketers completed the Run-a-Three test, with no missing data and no adverse events. Descriptive characteristics by sex are presented in Table 1. Men were taller and heavier and carried a lower relative body-fat percentage than women, while age was comparable between the sexes. Within each sex, the four positional groups did not differ significantly in age, stature, body mass or body mass index (all $p \geq 0.196$ in men and $p \geq 0.525$ in women), indicating that the positional groups were demographically and anthropometrically comparable and that any difference in running performance could not readily be ascribed to these characteristics.

Table 1. Participant characteristics by sex (mean ± SD).

Variable	Men (n = 100)	Women (n = 55)	All (n = 155)	p
Age (years)	26.6 ± 5.2	26.3 ± 5.5	26.5 ± 5.3	0.733
Height (cm)	174.7 ± 6.5	162.7 ± 4.9	170.4 ± 8.3	< 0.001
Body mass (kg)	76.2 ± 7.1	61.2 ± 7.2	70.9 ± 10.1	< 0.001
BMI ($kg \cdot m^{-2}$)	25.1 ± 3.2	23.2 ± 3.0	24.4 ± 3.3	< 0.001
Body fat (%)	12.6 ± 2.9	19.4 ± 3.4	15.0 ± 4.5	< 0.001
Run-a-Three (s)	7.85 ± 0.31	8.58 ± 0.39	8.11 ± 0.49	< 0.001
Run-a-Three range (s)	7.04 – 8.50	7.66 – 9.50	7.04 – 9.50	–

BMI, body mass index. p-values from independent-samples t-tests with Mann–Whitney U confirmation.

Positional group sizes were: men — batsmen 23, all-rounders 22, wicketkeepers 29, bowlers 26; women — batsmen 18, all-rounders 10, wicketkeepers 14, bowlers 13.

3.2 Distributional screening

Run-a-Three times were normally distributed within each sex when considered as a whole (men: W = 0.981, p = 0.152; women: W = 0.990, p = 0.912), with skewness and kurtosis values within ±1. At the level of individual sex-by-position cells, seven of the eight groups were consistent with normality; the male batsman group departed from it (W = 0.873, p = 0.007), reflecting a mild negative skew (Table 2). Levene's test indicated homogeneous variances across positional groups in both sexes (men W = 0.234, p = 0.872; women W = 0.317, p = 0.813). Parametric analysis of variance was therefore applied as the primary procedure, with the Kruskal–Wallis test reported alongside it as a distribution-free confirmation in view of the single non-normal cell.

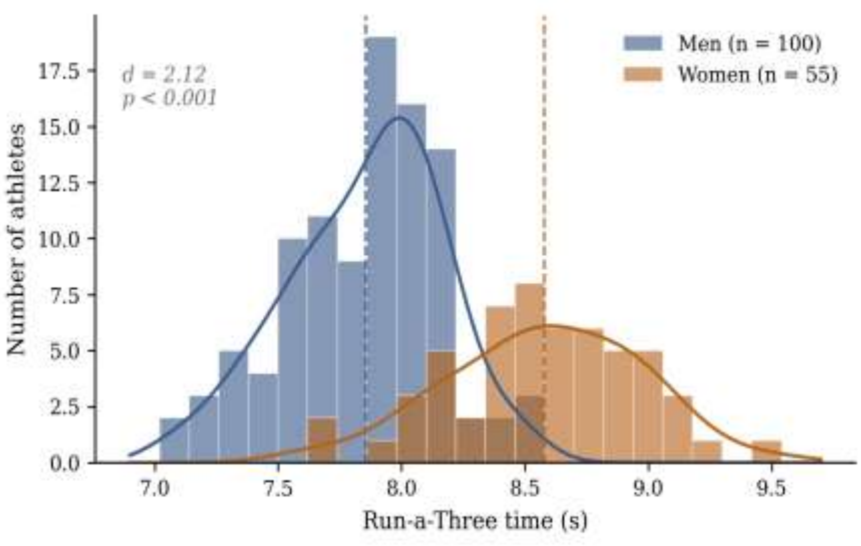
Table 2. Shapiro–Wilk normality screening of Run-a-Three time by sex and playing position.

Group	n	W	p	Distribution
Men – overall	100	0.981	0.152	Normal
Men – batsman	23	0.873	0.007	Non-normal
Men – all-rounder	22	0.984	0.966	Normal
Men – wicketkeeper	29	0.941	0.104	Normal
Men – bowler	26	0.983	0.929	Normal
Women – overall	55	0.990	0.912	Normal
Women – batsman	18	0.954	0.485	Normal
Women – all-rounder	10	0.969	0.886	Normal
Women – wicketkeeper	14	0.971	0.886	Normal
Women – bowler	13	0.903	0.149	Normal

3.3 Sex differences in Run-a-Three performance

Male cricketers completed the three runs substantially faster than female cricketers (7.85 ± 0.31 s vs. 8.58 ± 0.39 s), a difference of 0.72 s. The contrast was highly significant and of very large magnitude ($t(153) = 12.65$, $p < 0.001$, Cohen's $d = 2.12$), and was confirmed non-parametrically (Mann–Whitney $U = 405$, $p < 0.001$; Figure 1). This difference — more than seven times the largest positional contrast observed within either sex — establishes the necessity of sex-stratified analysis and of sex-specific reference values.

Figure 1. Distribution of Run-a-Three times by sex (n = 155). Histograms are overlaid with kernel density estimates; dashed vertical lines mark group means. The near-separation of the two distributions (Cohen's d = 2.12) demonstrates why sex-stratified analysis and sex-specific reference values are required.



3.4 Primary analysis: Run-a-Three performance across playing positions

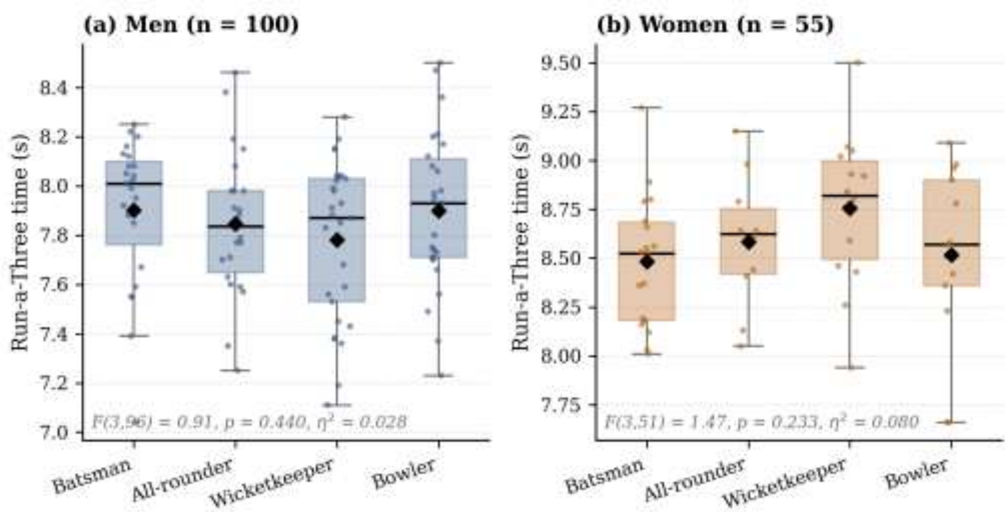
Within each sex, Run-a-Three performance did not differ significantly across the four playing positions (Table 3). Among men the four positional means spanned only 0.12 s, from 7.78 s in wicketkeepers to 7.90 s in batsmen, and the omnibus test was clearly non-significant ($F(3,96) = 0.91$, $p = 0.440$, $\eta^2 = 0.028$, $\omega^2 = -0.003$). Among women the means spanned 0.27 s, from 8.48 s in batsmen to 8.76 s in wicketkeepers, and the omnibus test was likewise non-significant ($F(3,51) = 1.47$, $p = 0.233$, $\eta^2 = 0.080$, $\omega^2 = 0.025$). Kruskal–Wallis tests confirmed both results (men $H(3) = 2.98$, $p = 0.394$; women $H(3) = 4.73$, $p = 0.193$). The near-complete overlap of positional distributions in both sexes is evident in Figure 2.

Table 3. Run-a-Three time by playing position within each sex.

Sex / Position	n	Mean ± SD (s)	95% CI	Median (IQR)
Men – batsman	23	7.90 ± 0.30	7.77 – 8.03	8.01 (7.76–8.10)
Men – all-rounder	22	7.85 ± 0.30	7.71 – 7.98	7.84 (7.65–7.98)
Men – wicketkeeper	29	7.78 ± 0.32	7.66 – 7.90	7.87 (7.53–8.03)
Men – bowler	26	7.90 ± 0.32	7.77 – 8.03	7.93 (7.71–8.11)
Men – omnibus	100	$F(3,96) = 0.91$	$p = 0.440$	$\eta^2 = 0.028$
Women – batsman	18	8.48 ± 0.34	8.31 – 8.65	8.53 (8.18–8.68)
Women – all-rounder	10	8.58 ± 0.35	8.34 – 8.83	8.63 (8.42–8.75)
Women – wicketkeeper	14	8.76 ± 0.39	8.53 – 8.98	8.82 (8.49–9.00)
Women – bowler	13	8.52 ± 0.46	8.24 – 8.79	8.57 (8.36–8.90)
Women – omnibus	55	$F(3,51) = 1.47$	$p = 0.233$	$\eta^2 = 0.080$

CI, confidence interval; IQR, interquartile range. Omnibus rows report one-way ANOVA. Kruskal–Wallis confirmation: men $H(3) = 2.98$, $p = 0.394$; women $H(3) = 4.73$, $p = 0.193$.

Figure 2. Run-a-Three time by playing position within each sex. Boxes show median and interquartile range, whiskers the 1.5 × IQR range, individual athletes are overlaid as points, and black diamonds mark group means. Distributions overlap almost completely across positions in both sexes.



Pairwise Tukey comparisons were non-significant for every positional contrast in both sexes (Table 4). The largest single contrast in men was between batsmen and wicketkeepers (mean difference 0.12 s, $p = 0.505$) and in women between batsmen and wicketkeepers (mean difference 0.27 s, $p = 0.206$). In no case did the 95% confidence interval for a pairwise difference exclude zero.

Table 4. Tukey post-hoc pairwise comparisons of Run-a-Three time by playing position.

Sex	Comparison	Mean difference (s)	95% CI	p (adjusted)
Men	Batsman vs all-rounder	0.06	−0.19 to 0.30	0.933
Men	Batsman vs wicketkeeper	0.12	−0.11 to 0.35	0.505
Men	Batsman vs bowler	0.00	−0.23 to 0.24	1.000

Sex	Comparison	Mean difference (s)	95% CI	p (adjusted)
Men	All-rounder vs wicketkeeper	0.07	−0.16 to 0.30	0.877
Men	All-rounder vs bowler	0.05	−0.18 to 0.29	0.936
Men	Wicketkeeper vs bowler	0.12	−0.10 to 0.34	0.494
Women	Batsman vs all-rounder	0.10	−0.30 to 0.51	0.908
Women	Batsman vs wicketkeeper	0.27	−0.09 to 0.64	0.206
Women	Batsman vs bowler	0.03	−0.34 to 0.41	0.995
Women	All-rounder vs wicketkeeper	0.17	−0.25 to 0.59	0.708
Women	All-rounder vs bowler	0.07	−0.36 to 0.50	0.974
Women	Wicketkeeper vs bowler	0.24	−0.15 to 0.63	0.379

Mean differences shown as absolute values. No comparison reached statistical significance.

The two-way analysis of variance corroborated this pattern. The main effect of sex was very large ($F(1,147) = 161.16$, $p < 0.001$), the main effect of position was negligible ($F(3,147) = 0.05$, $p = 0.986$), and the sex-by-position interaction approached but did not attain significance ($F(3,147) = 2.62$, $p = 0.053$). The marginal interaction reflects the divergent, and individually non-significant, positional orderings in the two sexes: male wicketkeepers were nominally the fastest of their sex whereas female wicketkeepers were nominally the slowest. Given that neither within-sex omnibus test was significant, this interaction is regarded as a hypothesis for future examination rather than a finding.

3.5 Secondary analysis: batting-order tiers

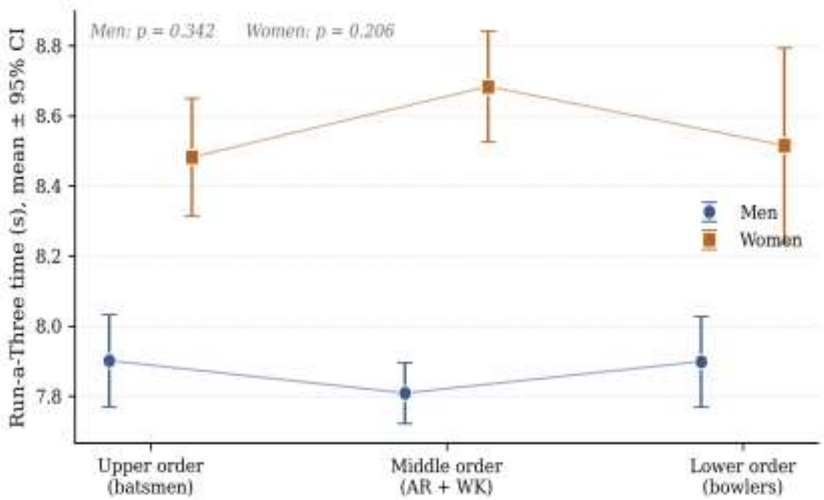
Regrouping athletes by the batting-order tier they customarily occupy produced the same conclusion (Table 5, Figure 3). Among men, upper-, middle- and lower-order players recorded means of 7.90, 7.81 and 7.90 s respectively ($F(2,97) = 1.09$, $p = 0.342$, $\eta^2 = 0.022$; Kruskal–Wallis $H = 2.81$, $p = 0.245$). Among women the corresponding means were 8.48, 8.68 and 8.52 s ($F(2,52) = 1.63$, $p = 0.206$, $\eta^2 = 0.059$; $H = 3.58$, $p = 0.167$). Of the six pairwise contrasts across both sexes, the largest was between female upper- and middle-order players (mean difference 0.20 s, $d = 0.56$, $p = 0.080$), which did not reach significance. Critically, the contrast of direct practical interest — upper order versus lower order, that is, recognised batters versus bowlers — was the smallest observed in men (0.00 s, $d = 0.01$, $p = 0.978$) and among the smallest in women (0.03 s, $d = 0.08$, $p = 0.818$).

Table 5. Run-a-Three time by batting-order tier within each sex.

Sex	Batting-order tier	n	Mean ± SD (s)	95% CI	Omnibus
Men	Upper (batsmen)	23	7.90 ± 0.30	7.77 – 8.03	$F(2,97) = 1.09$
Men	Middle (AR + WK)	51	7.81 ± 0.31	7.72 – 7.90	$p = 0.342$
Men	Lower (bowlers)	26	7.90 ± 0.32	7.77 – 8.03	$\eta^2 = 0.022$
Women	Upper (batsmen)	18	8.48 ± 0.34	8.31 – 8.65	$F(2,52) = 1.63$
Women	Middle (AR + WK)	24	8.68 ± 0.38	8.53 – 8.84	$p = 0.206$
Women	Lower (bowlers)	13	8.52 ± 0.46	8.24 – 8.79	$\eta^2 = 0.059$

AR, all-rounder; WK, wicketkeeper. Kruskal–Wallis confirmation: men $H(2) = 2.81$, $p = 0.245$; women $H(2) = 3.58$, $p = 0.167$.

Figure 3. Run-a-Three time by batting-order tier within each sex (mean ± 95% confidence interval). Overlapping intervals across all three tiers in both sexes indicate that recognised batters, middle-order players and lower-order players did not differ in running-between-the-wickets capacity.



3.6 Test–retest reliability

Reliability indices for the 60-athlete subsample are presented in Table 6 and illustrated in Figure 4. In the subsample as a whole, relative reliability was good (ICC(2,1) = 0.859, 95% CI 0.77–0.91) and absolute reliability was strong, with an SEM of 0.20 s, a coefficient of variation of 1.97% and a minimal detectable change of 0.56 s. No systematic difference emerged between sessions (mean bias +0.018 s; paired t = 0.48, p = 0.635; dz = 0.06), and between-session differences were normally distributed (W = 0.976, p = 0.271), indicating that the single familiarisation run was sufficient to eliminate a learning effect.

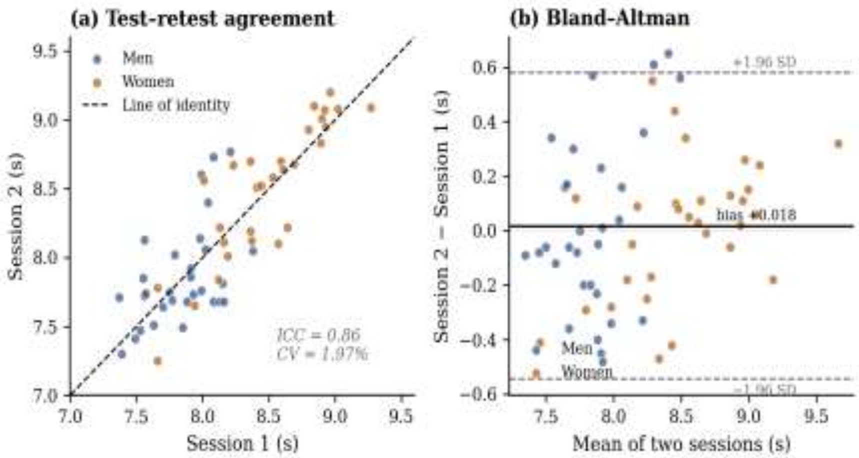
Examined within sex, the estimates diverged. In women, relative reliability was good (ICC = 0.875, 95% CI 0.75–0.94) with an SEM of 0.17 s and MDC95 of 0.48 s. In men, the point estimate fell to the boundary of the moderate band (ICC = 0.499, 95% CI 0.17–0.73) despite an equivalent indeed marginally superior coefficient of variation of 2.28% and an SEM of 0.23 s. This dissociation is the expected consequence of range restriction: male session-one times had a standard deviation of only 0.26 s against 0.44 s in women, and because the ICC is a ratio of between-athlete variance to total variance, a homogeneous group mathematically suppresses the coefficient even when trial-to-trial error is small.19,21 The absolute indices, which are unaffected by the spread of the sample, therefore provide the more faithful description of the instrument's precision in men.

Table 6. Test–retest reliability of the Run-a-Three test (48-hour interval).

Index	Men (n = 30)	Women (n = 30)	All (n = 60)
Session 1 (s)	7.85 ± 0.26	8.52 ± 0.44	8.18 ± 0.50
Session 2 (s)	7.87 ± 0.37	8.54 ± 0.55	8.20 ± 0.57
ICC(2,1) [95% CI]	0.499 [0.17–0.73]	0.875 [0.75–0.94]	0.859 [0.77–0.91]
SEM (s)	0.225	0.174	0.201
MDC95 (s)	0.622	0.482	0.556
CV (%)	2.28	1.67	1.97
Mean bias (s)	+0.021	+0.014	+0.018
95% LoA (s)	−0.61 to +0.65	−0.48 to +0.51	−0.54 to +0.58
Paired t / p	0.36 / 0.724	0.31 / 0.757	0.48 / 0.635
Cohen's dz	0.07	0.06	0.06

ICC, intraclass correlation coefficient; SEM, standard error of measurement; MDC95, minimal detectable change at the 95% level; CV, coefficient of variation; LoA, limits of agreement. Positive bias denotes a marginally slower time at re-test.

Figure 4. Test–retest reproducibility of the Run-a-Three test (n = 60, 48-hour interval). (a) Session 2 plotted against Session 1 with the line of identity; points cluster tightly about the line. (b) Bland–Altman plot showing mean bias and 95% limits of agreement; the bias of +0.018 s is negligible and no proportional trend is evident across the performance range.



3.7 Relationship with other fitness measures

Within each sex, Run-a-Three time was essentially unrelated to every other measure in the battery (Table 7). All coefficients fell within $|r| \leq 0.15$ and none approached significance, including those with the measures theoretically closest to the task — the unresisted 30-m sprint (men r = 0.09; women r = 0.14) and the M-Agility test (men r = −0.08; women r = 0.02).

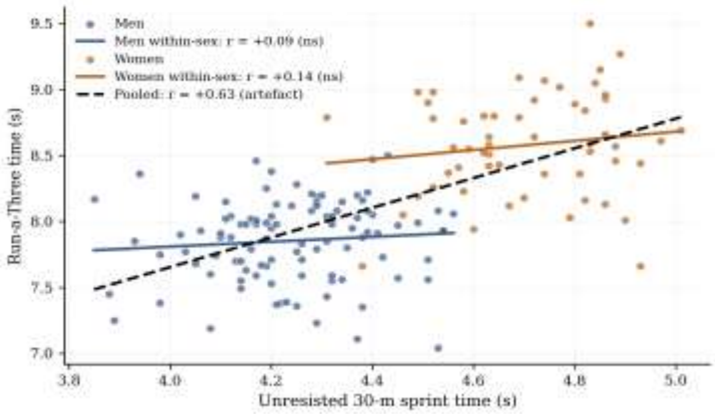
The sex-pooled coefficients told a very different and wholly misleading story. Pooled across both sexes, Run-a-Three time correlated strongly with the unresisted 30-m sprint (r = 0.63, $p < 0.001$), with vertical jump (r = −0.63, $p < 0.001$) and with body-fat percentage (r = 0.55, $p < 0.001$). These apparently substantial associations arise entirely from the separation of male and female clusters — men being simultaneously faster over three runs, faster over 30 m, more powerful and leaner than women — and vanish within sex. This dissociation is displayed in Figure 5. They are reported here purely to document the magnitude of the aggregation artefact and are not interpreted as evidence of any relationship.14

Table 7. Within-sex correlations between Run-a-Three time and other field-fitness measures, with pooled coefficients shown for contrast.

Measure	Men r [95% CI]	p	Women r [95% CI]	p
Unresisted 30-m sprint	+0.09 [−0.11, +0.28]	0.361	+0.14 [−0.13, +0.39]	0.302
Resisted 30-m sprint	+0.06 [−0.14, +0.26]	0.536	+0.13 [−0.15, +0.38]	0.363
M-Agility	−0.08 [−0.27, +0.12]	0.425	+0.02 [−0.25, +0.28]	0.909
Vertical jump	−0.04 [−0.24, +0.16]	0.670	−0.14 [−0.39, +0.14]	0.325
Standing long jump	−0.03 [−0.22, +0.17]	0.778	+0.06 [−0.21, +0.32]	0.687
Leg-press 1-RM	−0.05 [−0.25, +0.15]	0.598	+0.05 [−0.22, +0.31]	0.702
Yo-Yo IR1 distance	−0.04 [−0.23, +0.16]	0.719	−0.12 [−0.37, +0.15]	0.397
Estimated VO2max	−0.04 [−0.23, +0.16]	0.732	−0.12 [−0.37, +0.15]	0.389
Body fat (%)	+0.09 [−0.11, +0.28]	0.393	+0.02 [−0.25, +0.28]	0.912
Body mass index	+0.04 [−0.16, +0.23]	0.708	−0.02 [−0.28, +0.25]	0.906
Pooled: 30-m sprint	+0.63 (n = 155)	< 0.001	artefact of sex pooling	–
Pooled: vertical jump	−0.63 (n = 155)	< 0.001	artefact of sex pooling	–

1-RM, one-repetition maximum; IR1, intermittent recovery test level 1. Pooled coefficients are presented solely to illustrate aggregation bias and are not interpreted.

Figure 5. Run-a-Three time plotted against unresisted 30-m sprint time, illustrating aggregation bias. Within each sex the association is absent (solid regression lines), yet the pooled regression (dashed) yields r = 0.63. The pooled coefficient describes the separation between the male and female clusters, not any within-athlete correspondence between the two tests.



3.8 Sex-specific normative reference values

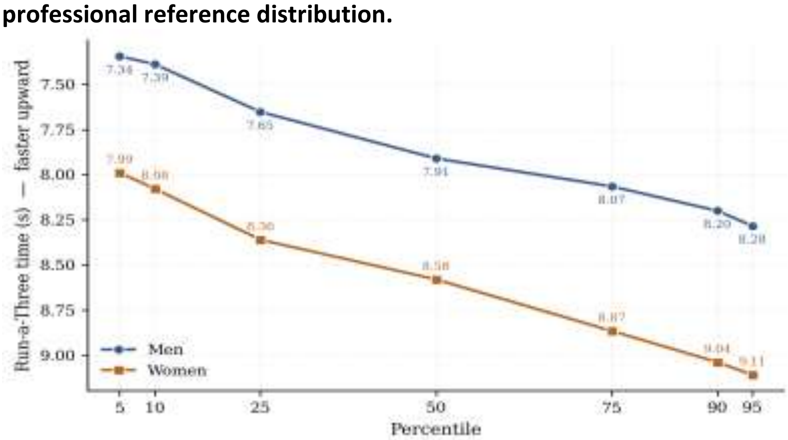
Normative percentiles are presented in Table 8 and plotted in Figure 6. Because a shorter time denotes better performance, lower percentile values correspond to superior running capacity. These reference values permit an individual cricketer's time to be located within the appropriate same-sex professional distribution. In view of the null positional findings, values are presented by sex only; position-specific norms are neither statistically supported nor practically warranted.

Table 8. Sex-specific normative percentile reference values for Run-a-Three time (n = 155).

Percentile	Men (s)	Women (s)	Suggested classification
5th	7.34	7.99	Excellent
10th	7.39	8.08	Very good
25th	7.65	8.36	Good
50th (median)	7.91	8.58	Average
75th	8.07	8.87	Below average
90th	8.20	9.04	Poor
95th	8.28	9.11	Very poor

Lower times denote better performance; the fastest athletes therefore occupy the lower percentiles.

Figure 6. Sex-specific normative percentile curves for Run-a-Three time. The y-axis is inverted so that better (faster) performance appears higher. The curves permit an individual cricketer's time to be located within the appropriate same-sex professional reference distribution.



4. Discussion

This study examined whether cricket-specific running-between-the-wickets capacity differs across playing positions in professional cricketers. It did not. Within each sex, Run-a-Three performance was statistically indistinguishable across batsmen, bowlers, all-rounders and wicketkeepers, and the same conclusion held when players were regrouped into the batting-order tiers they customarily occupy. Against this uniformity, the sex difference was very large. The test proved reproducible over a 48-hour interval, and sex-specific reference values are now available for its interpretation. Four aspects of these findings warrant discussion.

4.1 Positional uniformity and its practical meaning

The central result is best read not as an absence of findings but as a substantive answer to a practical question. The concern that motivated this analysis is a familiar one in cricket: when early wickets fall, players who are not recognised batters — all-rounders, wicketkeepers and, eventually, bowlers — are required to bat, and to run between the wickets under precisely the same time pressure as specialists. If those players were physically slower at the task, the batting side would carry a systematic disadvantage at exactly the moment it can least afford one, and a specific conditioning target would be identified.

The present data do not support that concern. In men, the difference between recognised batters and bowlers was 0.00 s (d = 0.01); in women it was 0.03 s (d = 0.08). Even the largest positional contrast anywhere in the dataset 0.27 s between female batsmen and female wicketkeepers was less than half of the minimal detectable change established for the test in that sex (0.48 s), and therefore lies within the band of measurement error rather than constituting a difference an assessor could confidently detect in an individual. The practical implication is reassuring: at professional standard, a lower-order batter is not a slower runner between the wickets, and coaching effort is better directed at the tactical and technical aspects of running — calling, backing up, turning technique, judgement of the single than at remedying a physical deficit that these data do not show to exist.

This interpretation is consistent with the broader cricket profiling literature, in which positional differences in field fitness tests are characteristically modest or absent even where match running loads differ markedly by position.3,8,9 The reconciliation is straightforward: match load reflects the tactical requirements of a role, whereas a maximal field test reflects underlying capacity. Fast bowlers cover more high-speed distance in a match than wicketkeepers because their role demands it, not because they possess a correspondingly greater maximal capability. Contemporary strength-and-conditioning practice in professional cricket applies broadly similar speed, power and change-of-direction preparation to the whole squad,6,7 and the present result suggest that this generalist preparation is sufficient to equalise capacity in the running task even where match exposure to it differs.

4.2 Heterogeneity within the bowler group

One qualification deserves particular emphasis. The bowler category — which in this cohort maps onto the lower-order batting tier was treated as a single group, but it is not physically homogeneous. It comprises both pace bowlers and spin bowlers, whose physical profiles are known to diverge. Fast bowlers are typically taller, heavier and more powerful, and their bowling action itself constitutes a repeated maximal acceleration and deceleration task that develops precisely the qualities the Run-a-Three test measures; the fast-bowling run-up and delivery stride impose horizontal force demands closely analogous to those of running between the wickets.2,9,23 Spin bowlers, by contrast, operate from a short approach and derive their effectiveness from control, revolutions and flight rather than from pace or explosive lower-limb output, and are correspondingly less exposed to that training stimulus.

Combining these two subtypes within a single lower-order category may therefore have concealed a genuine effect. Fast bowlers, potentially quicker than average, and spin bowlers, potentially slower, could offset one another and produce a group mean indistinguishable from that of specialist batters - a within-group heterogeneity that would attenuate any true batting-order difference toward the null. The present dataset did not record bowling subtype and the possibility cannot be tested here. It represents the single most valuable refinement for subsequent work: subclassifying bowlers as pace or spin would permit a four-tier comparison (upper order, middle order, pace bowlers, spin bowlers) and would establish whether the apparent uniformity reported here is genuine or an artefact of aggregation within the bowler group. Should spin bowlers prove slower, they would constitute a small, clearly identified population for whom targeted running preparation is warranted.

4.3 Reproducibility and the interpretation of individual change

The Run-a-Three test proved reproducible. In the pooled reliability subsample the ICC of 0.86 falls in the good band, the coefficient of variation of 1.97% is low for a hand-timed field measure, and the absence of any systematic session-to-session change (bias +0.018 s, p = 0.635) indicates that a single familiarisation run removed the learning effect that has been documented for other novel sprint tests in this cohort. For practitioners, the operative figure is the minimal detectable change of approximately 0.5–0.6 s: only a change exceeding that magnitude in an individual athlete should be interpreted as real improvement or decline rather than measurement noise.

The divergence between the male and female ICCs merits comment, because it would otherwise invite misreading. The male estimate of 0.499 sits at the poor–moderate boundary, yet the male coefficient of variation (2.28%) and SEM (0.23 s) are close to the female values. The explanation is range restriction rather than instrument failure. Male times in the reliability subsample spanned a standard deviation of just 0.26 s against 0.44 s in women; since the intraclass correlation coefficient expresses between-athlete variance as a proportion of total variance, an unusually homogeneous group depresses it arithmetically even when trial-to-trial error is small.19,21 This is a recognised behaviour of the ICC in elite samples and has been observed for other tests in this population. The practical consequence is that relative reliability indices should not be used to rank the quality of a test across samples of differing homogeneity, and that absolute indices SEM, CV and MDC carry the more useful information for monitoring individual athletes.

4.4 What the test measures, and a methodological caution

Within sex, Run-a-Three time was unrelated to every other measure in the battery, including linear sprint speed and change-of-direction ability. Two explanations are complementary. First, the task is genuinely composite: it fuses acceleration, deceleration, two turns executed while grounding a bat, and re-acceleration, and its total duration of roughly eight seconds places it at a different point on the metabolic and mechanical continuum from a 4-second 30-m sprint. There is no strong a priori reason to expect a short linear sprint to predict it closely. Second, and probably dominant here, the cohort was extremely homogeneous — a professional sample with a coefficient of variation around 2% — and such range restriction attenuates correlations toward zero irrespective of any true underlying association.24 The weak within-sex coefficients should therefore be read as uninformative about the test's construct rather than as evidence of independence, and a heterogeneous sample spanning club to international standard would be required to characterise the relationship properly.

The contrast between the within-sex and pooled coefficients constitutes a methodological caution of wider relevance. Pooled across sexes, Run-a-Three time appeared strongly related to sprint speed ($r = 0.63$), jump height ($r = -0.63$) and body-fat percentage ($r = 0.55$). Every one of these associations collapsed to near zero within sex. The pooled coefficients describe the gap between men and women, not any correspondence between qualities within an individual athlete — a textbook instance of aggregation bias.14 Because mixed-sex professional cohorts are increasingly the norm in cricket research, and because pooled coefficients of this magnitude are superficially publishable, the observation bears repeating: correlations and group comparisons in mixed-sex athletic samples must be computed within sex, or the resulting coefficients will encode sex rather than the construct of interest.

4.5 Sex differences and the case for sex-specific norms

Male cricketers were 0.72 s faster over three runs than female cricketers, an effect of very large magnitude ($d = 2.12$) and consistent with established sex differences in sprint and change-of-direction performance attributable to differences in muscle mass, fibre-type distribution and force-producing capacity.13 The magnitude of this contrast — more than seven times the largest positional difference observed — makes the practical point directly. A single pooled reference standard would classify the substantial majority of female professionals as under-performing despite their competing at professional level. The sex-specific percentiles presented here avoid that misclassification and align this test with the conventional treatment of normative data in mixed-sex populations.

4.6 Strengths

The study has several strengths. The cohort was of reasonable size for cricket research and, unusually, included 55 female professionals, permitting genuine within-sex analysis in a population for which applied physical data remain scarce.11,12 All four principal playing positions were represented in both sexes. The outcome was a cricket-specific task rather than a generic sprint or agility test, increasing ecological relevance. Analysis was stratified by sex throughout, with parametric and non-parametric procedures reported in parallel and effect sizes given alongside p-values, so that the null findings can be evaluated on their magnitude rather than on significance alone. Reliability was established in the same cohort, allowing the observed group differences to be judged against the test's own measurement error — a comparison that is rarely possible and that proved decisive in interpreting the largest positional contrast.

4.7 Limitations

Several limitations qualify these findings. First, and most importantly, the study is powered to exclude a large positional effect but not a small one; with 55 female participants distributed across four positions, subgroups of ten to eighteen athletes afford limited precision, and the female omnibus effect size ($\eta^2 = 0.080$) was of medium magnitude despite non-significance. A larger female sample might resolve a real but modest positional difference, and the present null result in women should be regarded as provisional.

Second, batting-order tier was derived from playing position rather than from scorecard batting records. Although the mapping reflected the recorded batting practice of the participating squads, individual athletes will occasionally have batted outside their

customary tier, and the secondary analysis should be read as an approximation of the batting-order question rather than a direct test of it.
Third, as discussed above, bowlers were not subclassified by type, and the resulting within-group heterogeneity may have masked a true effect.
Fourth, timing was performed with a handheld stopwatch. Although a single experienced investigator timed every trial to maximise consistency, hand timing introduces operator error, and the absolute reliability indices reported here should be regarded as best-case values pending confirmation with electronic timing gates.
Fifth, the cohort was recruited from a single Indian state by purposive sampling, which constrains generalisability; the normative values should be treated as provisional until replicated in other cricketing populations. Sixth, the design was cross-sectional and cannot establish the test's sensitivity to training-induced change, the property most relevant to longitudinal monitoring. Finally, no measure of on-field running performance — completed twos and threes, run-out involvement, running-derived strike rate — was available, so the relationship between Run-a-Three time and actual match running effectiveness remains unexamined.

4.8 Future directions

Four priorities follow. The most immediate is subclassification of bowlers into pace and spin subtypes, which would test the principal alternative explanation for the present null result. Second, replication with electronic timing and in a sample spanning a wider range of playing standard would both sharpen the reliability estimates and permit proper characterisation of the test's construct, unencumbered by range restriction. Third, prospective validation against match-derived running outcomes would establish whether Run-a-Three time predicts on-field running effectiveness, which is the criterion that ultimately matters. Fourth, tracking the test across a competitive season would determine its responsiveness to training and its utility for monitoring — and, given the MDC established here, would indicate whether typical seasonal change in this quality is even large enough to be detected.

5. Conclusion

In professional cricketers of both sexes, Run-a-Three test performance did not differ across the four principal playing positions, nor across the batting-order tiers those positions customarily occupy. The largest positional contrast observed fell within the test's own measurement error. Recognised batters, all-rounders, wicketkeepers and bowlers therefore appear equally equipped for the running-between-the-wickets task, which addresses directly the practical concern that lower-order players may be disadvantaged when early wickets bring them to the crease sooner than anticipated. Against this positional uniformity, the sex difference was very large, confirming that sex-specific rather than pooled reference standards are required. The Run-a-Three test demonstrated good reproducibility over 48 hours with a minimal detectable change of approximately 0.5–0.6 s, and the sex-specific normative percentiles reported here provide an immediate interpretive framework for practitioners. Subclassification of bowlers by type, and prospective validation against match running outcomes, are the necessary next steps.

Declarations

Ethics approval and consent to participate. This study forms a supporting investigation within a doctoral thesis programme. Approval was granted by the Institutional Ethics Committee of SPB Physiotherapy College, Surat (approval number: EC/SPB/111), and the parent study was prospectively registered with the Clinical Trials Registry – India (CTRI/2025/04/086056). All participants provided written informed consent. The study conformed to the Declaration of Helsinki.

Consent for publication: Not applicable.

Availability of data and materials: The datasets analysed during the current study are available from the corresponding author on reasonable request.

Competing interests: The Run-a-Three test forms part of a fitness profiling battery developed by the corresponding author. The authors declare no other competing interests.

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Authors' contributions: MM conceived and designed the study, collected and analysed the data, and drafted the manuscript. SP supervised the project, contributed to the design and interpretation, and critically revised the manuscript. Both authors read and approved the final version.

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