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THE M - AGILITY TEST: TEST-RETEST RELIABILITY AND SEX-SPECIFIC NORMATIVE REFERENCE VALUES IN PROFESSIONAL CRICKETERS: A CROSS-SECTIONAL MEASUREMENT STUDY

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ABSTRACT

Background. Change-of-direction (COD) ability is integral to cricket, yet most agility tests applied to cricketers were devised for other sports and may not reflect the short, multi-directional efforts characteristic of the game. The M-Agility (Mirani Agility) test is a novel, equipment-light COD test whose measurement properties have not previously been reported.

Objectives. To establish the test–retest reliability of the M-Agility test in professional cricketers, to generate sex-specific normative reference values, and to examine, transparently, its relationship with the established Illinois Agility Test and other field-fitness measures.

Methods. One hundred fifty-five professional cricketers (100 men, 55 women) completed the M-Agility test. A subsample of 60 athletes (30 men, 30 women) repeated the test after 5–7 days for reliability and additionally performed the Illinois Agility Test. Analyses were conducted in IBM SPSS Statistics v23 and stratified by sex throughout. Relative reliability was quantified with the intraclass correlation coefficient [ICC(3,1)]; absolute reliability with the standard error of measurement (SEM), minimal detectable change (MDC_{95}), coefficient of variation (CV) and Bland–Altman limits of agreement. Normative percentiles were derived for each sex.

Results. M-Agility times were normally distributed within each sex (Shapiro–Wilk $p > 0.05$). Test–retest reliability was moderate in relative terms but strong in absolute terms: ICC(3,1) 0.66 (95% CI 0.40–0.82) in men and 0.69 (0.44–0.84) in women, with CV ≈ 2.1–2.5%, SEM 0.25–0.28 s and MDC_{95} 0.70–0.79 s; no systematic change between sessions was observed ($p \geq 0.07$). Within sex, M-Agility times were not associated with Illinois times (men $r = 0.10$; women $r = 0.06$; both $p > 0.6$); the apparently strong pooled correlation ($r = 0.66$) was shown to be an artifact of sex aggregation. Men were faster than women (9.18 ± 0.34 s vs 10.13 ± 0.42 s). Sex-specific normative percentiles are presented, and acceptability among athletes was high (mean 4.65/5).

Conclusion. The M-Agility test demonstrates acceptable test–retest reproducibility and provides usable sex-specific normative standards for professional cricketers. Within this homogeneous elite sample it behaved as a measure distinct from the longer, weaving Illinois test; criterion validation against a construct-matched COD test in a more heterogeneous sample is recommended before the test is used for selection decisions.

KEYWORDS: agility; change of direction; cricket; reliability; normative values; field testing; athletic performance.

1. INTRODUCTION

Cricket places diverse physical demands on its players, combining repeated short sprints, rapid braking and turning while running between the wickets, explosive fielding actions and sustained intermittent activity across formats. [5] [9] Among these qualities, the ability to accelerate, decelerate and change direction quickly is repeatedly identified as a determinant of effective running between wickets, ground fielding and pursuit of the ball. [6] [7] [8] As the professional game has become faster and more physically contested, the assessment of such qualities has moved from a peripheral concern to a core component of athlete profiling and talent identification. [9] [10]

Agility has been defined as a rapid whole-body movement involving a change of velocity or direction in response to a stimulus. [1] In practice, field testing usually isolates the physical, pre-planned component of this construct; change-of-direction (COD) speed, because it can be measured reproducibly without the perceptual-cognitive demands of reactive agility. [1] [3] Importantly, COD speed, linear sprinting and reactive agility are only modestly inter-related and are increasingly regarded as separable qualities; a fast straight-line sprinter is not necessarily an effective mover when direction changes are introduced. [2] [4] This relative independence has a direct methodological consequence: a COD test should not be assumed to be interchangeable with either a sprint test or a different COD test built around a dissimilar movement pattern.

A range of COD tests is available, of which the Illinois Agility Test is among the most widely used and has demonstrated good reliability and criterion-related validity in male team-sport athletes. [11] However, the Illinois course is comparatively long (a total running distance of roughly 60 m) and dominated by tight slalom weaving and repeated 180° turns, a profile that maps imperfectly onto the brief, shallow-angle cuts that typify many cricket actions. [11] [12] Several authors have cautioned that COD tests differing in distance, number of turns and turn angle tax partly different capacities, and that test selection should therefore be guided by the movement demands of the target sport rather than by convenience. [3] [13] Despite the growing literature on cricket fitness, there remains a shortage of concise, cricket-oriented COD tests with documented measurement properties and population-specific reference data. [8] [9]

The M-Agility (Mirani Agility) test was developed to address this gap. It is a short, equipment-light course - two 5 m straight segments linked by two 3.5 m diagonal segments arranged in an "M/W" configuration - that emphasises acceleration and shallow-angle direction change over a brief total distance, a pattern intended to resemble the running actions encountered in cricket. Before any new test can be recommended for monitoring or selection, its reproducibility must be established and reference values made available; reporting these properties transparently, including absolute measurement error, is a prerequisite for sound interpretation of change in an individual athlete. [13] [14] [15]

Accordingly, the present study had three aims: (i) to determine the test–retest reliability of the M-Agility test in professional cricketers, reported in both relative and absolute terms; (ii) to derive sex-specific normative reference values; and (iii) to examine the test's relationship with the Illinois Agility Test and with other field-fitness measures, in order to characterise, rather than to assume, what the M-Agility test measures. In keeping with established methodological practice and with the wider programme of work from which these data are drawn, all analyses were stratified by sex.

2. MATERIALS AND METHODS

2.1 Study design

This was a cross-sectional measurement study with an embedded test–retest reliability component. Reporting follows accepted recommendations for studies of measurement properties. The study formed a supporting investigation within a doctoral programme on fitness profiling of professional cricketers.

2.2 Ethics

This study is the part of the doctoral thesis study as supportive study. The study was approved by the Institutional Ethics Committee of SPB Physiotherapy College, Surat [approval number: EC/SPB/111], and conducted in accordance with the Declaration of Helsinki. All participants provided written informed consent before testing. Trial registration noted in Clinical Trials Registry - India: [CTRI/2025/04/086056].

2.3 Participants

One hundred fifty-five professional cricketers (100 men, 55 women) were recruited by purposive sampling from academies, district, state and national-level squads. Inclusion criteria were: aged ≥ 18 years; a minimum of one year of competitive cricket participation; and freedom from injury at the time of testing. Players with an acute musculoskeletal injury, or any neurological, cardiovascular or systemic condition likely to affect performance, were excluded. For the reliability and Illinois-comparison component, a subsample of 60 athletes (30 men, 30 women) was assessed on a second occasion.

2.4 Sample size

For the normative component, the full available cohort of 155 athletes was used. For test-retest reliability, a subsample of 60 (30 per sex) exceeds commonly cited minimums for stable estimation of an ICC at an expected value in the moderate-to-good range, providing reasonable precision around the point estimate within each sex. [14] [16]

2.5 The M-Agility test

The course comprised five cones. From a standing start at the start line, the athlete sprinted 5 m forward to the first cone, cut diagonally 3.5 m to a central cone, cut diagonally 3.5 m to a second outer cone, and finally sprinted 5 m to the finishing line (an "M/W"-shaped path; total path length ≈ 17 m). Participants were instructed to complete the course as quickly as possible, turning at each cone. Time was recorded from start to finish. A standardised demonstration and two submaximal familiarisation runs preceded maximal trials.

2.6 Comparator measures

The Illinois Agility Test was administered to the 60-athlete subsample using the standard 10 m × 5 m layout with four central cones, following established procedures. [11] Additional field-fitness measures collected on the full cohort, and used to characterise the construct assessed by the M-Agility test, included a 30 m sprint, standing long jump, vertical jump, the Yo-Yo Intermittent Recovery distance, handgrip dynamometry and body-fat percentage; these were obtained as part of the broader profiling battery using standardised procedures.

2.7 Testing procedures and standardisation

Testing was conducted on a consistent non-slip surface, with participants in their own athletic footwear, at a comparable time of day. Each session began with a standardised warm-up (light jogging followed by dynamic mobility drills). Three maximal trials of each test were performed with 2–3 min of recovery between trials, and the fastest time was retained for analysis. Test order was counterbalanced across participants to limit order effects. Retesting was performed 5–7 days after the initial session under matched conditions.

2.8 Statistical analysis

All analyses were performed in IBM SPSS Statistics version 23 (IBM Corp., Armonk, NY, USA) and were stratified by sex; the conventional significance threshold was $p < 0.05$. Distributional normality was examined with the Shapiro–Wilk test and inspection of histograms and Q–Q plots. Descriptive data are reported as mean ± standard deviation (SD). Relative test–retest reliability was quantified using a two-way mixed-effects, single-measures, absolute-agreement/consistency intraclass correlation coefficient, ICC(3,1), with 95% confidence intervals; values were interpreted as poor (< 0.50), moderate (0.50–0.75), good (0.75–0.90) or excellent (> 0.90). [14] Absolute reliability was expressed as the SEM ($SD \times \sqrt{(1 - ICC)}$), the minimal detectable change at the 95% level ($MDC_{95} = 1.96 \times \sqrt{2} \times SEM$), and the within-subject coefficient of variation; systematic change between sessions was assessed with a paired-samples t-test and Bland–Altman analysis (mean bias and 95% limits of agreement). [15] [17] [18] The relationship between the M-Agility and Illinois tests, and between the M-Agility test and the other fitness measures, was examined with Pearson correlation coefficients computed within sex; a pooled (sex-aggregated) coefficient was also calculated to illustrate the influence of aggregation. Between-position differences were tested with one-way ANOVA. Normative reference values were derived as sex-specific percentiles (5th, 10th, 25th, 50th, 75th, 90th and 95th).

3. RESULTS

3.1 Participant characteristics:

Descriptive characteristics of the cohort are presented in Table 1. As expected, men were taller and heavier than women. M-Agility times were normally distributed within each sex (men: Shapiro–Wilk $W = 0.985$, $p = 0.335$; women: $W = 0.983$, $p = 0.603$), and the distribution of times is shown in Figure 1.

Variable	Men (n = 100)	Women (n = 55)
Age (years)	26.6 ± 5.2	26.3 ± 5.5
Height (cm)	174.7 ± 6.5	162.7 ± 4.9
Body mass (kg)	76.2 ± 7.1	61.2 ± 7.2
BMI ($kg \cdot m^{-2}$)	25.1 ± 3.2	23.2 ± 3.0
M-Agility time (s)	9.18 ± 0.34	10.13 ± 0.42
M-Agility range (s)	8.27 – 10.11	9.25 – 11.01

Table 1. Participant characteristics (mean ± SD).

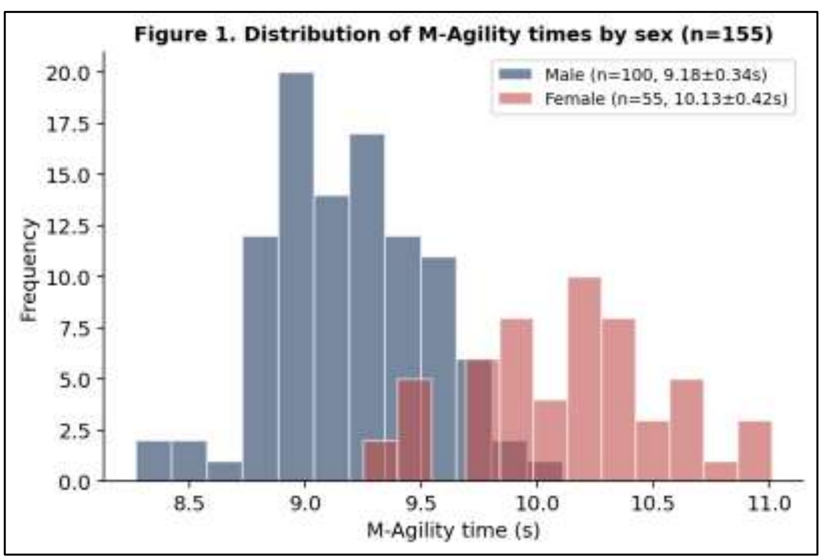

Figure 1. Distribution of M-Agility times by sex (n = 155).

3.2 Test–retest reliability

Reliability indices for the 60-athlete subsample are summarised in Table 2. Relative reliability was moderate in both sexes, with ICC(3,1) of 0.66 (95% CI 0.40–0.82) in men and 0.69 (0.44–0.84) in women. Absolute reliability was, by contrast, strong: the within-subject coefficient of variation was approximately 2.1% in men and 2.5% in women, with an SEM of 0.25 s and 0.28 s respectively. The minimal detectable change (MDC_{95}) was 0.70 s in men and 0.79 s in women, indicating the magnitude a true individual change must exceed to be distinguished from measurement noise. No systematic difference between sessions was detected in either sex (men: mean change +0.07 s, $p = 0.285$; women: −0.14 s, $p = 0.073$), and Bland–Altman analysis (Figure 2) showed bias close to zero with limits of agreement consistent with the calculated MDC. Between-session differences were normally distributed (Shapiro–Wilk $p \geq 0.25$).

Index	Men (n = 30)	Women (n = 30)
Session 1 (s)	9.24 ± 0.37	10.05 ± 0.43
Session 2 (s)	9.31 ± 0.49	9.91 ± 0.58
ICC(3,1) [95% CI]	0.66 [0.40–0.82]	0.69 [0.44–0.84]
Mean change (s)	+0.07	−0.14
Paired t-test (p)	0.285	0.073
CV (%)	2.06	2.52
SEM (s)	0.25	0.28
MDC_{95} (s)	0.70	0.79
Bland–Altman LoA (s)	−0.63 to +0.77	−0.92 to +0.65

Table 2. Test–retest reliability of the M-Agility test (5–7 day interval). ICC, intraclass correlation coefficient; CV, coefficient of variation; SEM, standard error of measurement; MDC, minimal detectable change; LoA, limits of agreement.

3.3 Relationship with the Illinois Agility Test

Within sex, M-Agility times showed no meaningful association with Illinois times (men: $r = 0.10$, 95% CI −0.27 to 0.44, $p = 0.616$; women: $r = 0.06$, 95% CI −0.31 to 0.41, $p = 0.751$). When the sexes were pooled, the correlation rose markedly to $r = 0.66$ ($p < 0.001$); however, as Figure 3 shows, this reflects the separation of the male and female clusters — men being faster on both tests and women slower on both — rather than any within-individual correspondence between the two tests. The pooled coefficient is therefore a statistical artifact of aggregation and is not interpretable as evidence of agreement. [18] Notably, in this subsample the Illinois test was likewise unrelated to the other speed and power measures (all $|r| < 0.31$, $p > 0.10$), consistent with substantial range restriction in a homogeneous elite group (see Discussion).

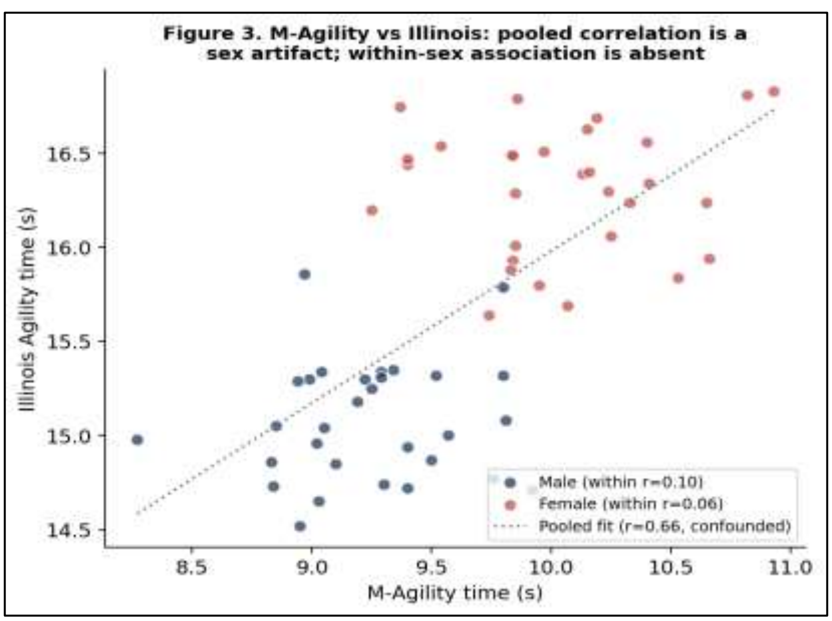

Figure 3. M-Agility versus Illinois times. The pooled regression (dotted) reflects between-sex separation; within-sex associations are absent.

3.4 Relationship with other fitness measures

Correlations between M-Agility time and the other field-fitness measures were generally weak within sex (Table 3). The only statistically significant association was with 30 m sprint time in women ($r = -0.28$, $p = 0.041$), in the expected direction (faster sprinters tended to record faster, i.e. lower, M-Agility times); the corresponding relationship in men was negligible. Associations with theoretically unrelated measures (handgrip strength, body-fat percentage, BMI) were uniformly small and non-significant, consistent with discriminant separation, although the predominantly weak convergent correlations are most plausibly attributable to the limited spread of ability in this elite cohort. [19]

Measure (within sex)	Men r (p)	Women r (p)	Expected relation
30 m sprint time	+0.09 (.380)	−0.28 (.041)*	Convergent
Standing long jump	+0.07 (.507)	+0.21 (.121)	Convergent
Vertical jump	−0.10 (.334)	+0.08 (.548)	Convergent
Yo-Yo IR distance	−0.18 (.068)	+0.01 (.943)	Convergent
Handgrip (right)	+0.11 (.274)	+0.11 (.438)	Discriminant
Body-fat %	+0.03 (.775)	+0.23 (.099)	Discriminant
BMI	−0.13 (.202)	−0.02 (.905)	Discriminant

Table 3. Within-sex Pearson correlations between M-Agility time and other fitness measures ($n = 155$). *$p < 0.05$.

3.5 Differences by playing position

Among women, M-Agility times differed across playing positions (one-way ANOVA, $F = 3.06$, $p = 0.036$): all-rounders (9.89 ± 0.48 s) and batters (10.02 ± 0.40 s) were faster than wicketkeepers (10.27 ± 0.35 s) and bowlers (10.30 ± 0.38 s). Among men, positional differences were not statistically significant ($F = 1.45$, $p = 0.233$), with means clustered between 9.11 s and 9.29 s.

3.6 Normative reference values

Sex-specific normative percentiles are presented in Table 4 and Figure 4, together with a suggested qualitative classification. Because shorter times indicate better performance, lower percentile values correspond to superior performance. These standards allow an individual cricketer's M-Agility time to be located within an appropriate sex-specific reference distribution.

Percentile	Men (s)	Women (s)	Classification
5th	8.73	9.40	Excellent
10th	8.83	9.52	Very good
25th	8.96	9.84	Good
50th (median)	9.16	10.15	Average
75th	9.41	10.41	Below average
90th	9.55	10.65	Poor
95th	9.76	10.85	Very poor

Table 4. Sex-specific normative percentiles for M-Agility time ($n = 155$). Lower times denote better performance.

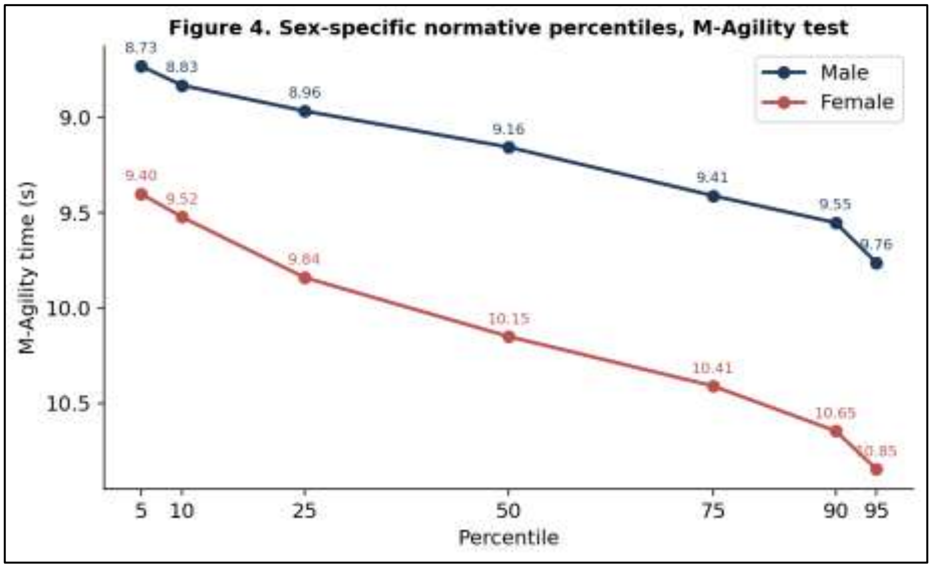

Figure 4. Sex-specific normative percentile curves for the M-Agility test (y-axis inverted so that better performance is higher).

3.7 Athlete-reported feasibility and acceptability

Among the 60 athletes who provided structured feedback, ratings of the M-Agility test were high across all four domains assessed on a 5-point scale: usefulness 4.64, feasibility 4.59, practicality 4.61 and acceptability 4.73, for an overall mean of 4.65/5 (92.9%). These data indicate that the test was well received and considered straightforward to administer in an applied cricket setting.

4. DISCUSSION

This study provides the first measurement-property evidence for the M-Agility test in professional cricketers. Three findings stand out: the test is reproducible, with strong absolute consistency and moderate relative reliability; it yields workable sex-specific normative standards; and, within this elite sample, it behaves as a measure distinct from the longer, weaving Illinois test. Each warrants comment.

4.1 Reliability

The combination of a moderate ICC with a low coefficient of variation (≈ 2%) and small SEM is initially counter-intuitive but well understood. The ICC is a ratio of between-athlete variance to total variance; when a sample is highly homogeneous; as elite cricketers are on a brief COD task - the between-athlete variance is small, which mathematically suppresses the ICC even when trial-to-trial measurement error is low. [15] [17]

The low CV and small SEM therefore give a truer picture of the instrument's precision than the ICC alone, and indicate that a single M-Agility trial can be reproduced closely on a separate day.

The absence of any systematic between-session change further suggests that, with the familiarisation used here, learning effects were negligible. For practitioners, the most actionable figure is the MDC_{95} of roughly 0.7–0.8 s: only changes exceeding this should be interpreted as real improvement or decline in an individual athlete.

These values sit within the range of measurement error reported for other COD tests, although the relative reliability is lower than the excellent ICCs reported for the Illinois test in more heterogeneous samples. [11] [12]

4.2 What the M-Agility test measures

The near-zero within-sex correlation with the Illinois test is the study's most important interpretive finding, and it should not be read as a failure of either test. Two complementary explanations apply. First, the two courses are constructed differently: the M-Agility test is short (≈ 17 m) with shallow-angle cuts and is dominated by acceleration, whereas the Illinois test is long (≈ 60 m) with tight slalom weaving and repeated 180° turns. Tests differing this much in distance and turn demand are known to tax partly different capacities, so a strong correlation would not necessarily be expected even in a varied population. [2] [3] [13] Second, and decisively for the present data, the elite cohort was extremely homogeneous (CV ≈ 2%), and this range restriction attenuates correlations towards zero — a point underscored by the observation that the Illinois test itself correlated with nothing else in the subsample, including sprint and jump performance. [19] The marked inflation of the coefficient on sex aggregation (r = 0.66) is a textbook illustration of why measurement relationships in mixed-sex samples must be examined within sex; the pooled value describes the gap between men and women, not the correspondence between two tests within an individual. [18]

Taken together, these results characterise the M-Agility test as a short, acceleration-biased COD measure rather than a substitute for the Illinois test. They do not, however, establish criterion validity, and we are explicit that the present design cannot do so: a homogeneous elite sample provides too little spread for any criterion relationship to emerge, and the Illinois test is in any case a sub-optimal construct match for a short course of this kind. [3] [13] Establishing criterion validity will require a purpose-built study using a construct-matched COD test (for example, the 505 test or a modified agility T-test) in a sample spanning a wider range of ability. [12] [13]

4.3 Normative values and positional differences

The sex-specific reference values address a practical shortfall: until now there have been no published M-Agility standards against which a cricketer's score could be interpreted. The clear sex difference (men ≈ 0.95 s faster) is consistent with established differences in sprint and COD performance and reinforces the need for sex-specific norms rather than pooled standards. [6] The positional difference observed among women with all-rounders and batters faster than wicketkeepers and bowlers; aligns with the greater premium placed on quick running and turning in those roles, though the modest subgroup sizes warrant caution and the effect was not replicated in men. [5] [6]

4.4 Feasibility

High athlete-reported usefulness, feasibility, practicality and acceptability, together with minimal equipment requirements and a short administration time, support the M-Agility test as a field-friendly option for routine monitoring, provided its results are interpreted in light of the measurement error reported here.

4.5 Limitations

Several limitations should be acknowledged. First, the sample, although adequate in size, was homogeneous in ability, which both suppressed the ICC and attenuated correlations; the reliability estimates may therefore be conservative and the convergent correlations under-estimated. [19] Second, criterion validity was not established, and the Illinois test proved an imperfect comparator. Third, timing was performed by stopwatch; electronic timing gates would reduce measurement error and are recommended for future work. Fourth, reactive (stimulus-driven) agility was not assessed, so the findings pertain to pre-planned COD speed only. [1] Finally, the feasibility data were collected on the subsample and reflect athlete perception rather than a formal implementation audit.

4.6 Future directions

Priorities for subsequent work are: a criterion-validity study against a construct-matched COD test in a heterogeneous sample; confirmation of reliability using electronic timing; and examination of the test's sensitivity to training-induced change over a season. Establishing these properties would clarify whether the M-Agility test can support selection and return-to-play decisions, beyond the monitoring role its present reliability already justifies.

5. CONCLUSION

The M-Agility test is a short, practical, cricket-oriented change-of-direction test with strong absolute reproducibility (CV ≈ 2%; MDC_{95} ≈ 0.7–0.8 s) and moderate relative reliability that reflects the homogeneity of an elite cohort. It provides usable sex-specific normative standards and is well accepted by athletes. Within this sample it measured a quality distinct from the longer, weaving Illinois test; accordingly, it is recommended at present for within-athlete monitoring and population profiling, with criterion validation against a construct-matched test in a more varied sample identified as the necessary next step before the test is used for selection.

Declarations

Ethics approval and consent: Approved by SPB Physiotherapy College, Surat [approval number: EC/SPB/111]; all participants gave written informed consent.

Funding: None.

Conflicts of interest: The authors declare no conflict of interest.

Data availability: The datasets analysed during the current study are available from the corresponding author on reasonable request.

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