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Development and Test-Retest Reliability Of The 5M Step Test

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ABSTRACT

This study developed a standardized procedure to measure fencing-specific step speed in national fencing players and examined its test-retest reliability across three non-consecutive sessions (Day 1, Day 3, and Day 5). Twenty national players performed three maximal trials per session on Days 1, 3, and 5 from a controlled en-garde starting position following an auditory stimulus; the best trial was recorded each day. Relative reliability was assessed using the intraclass correlation coefficient (ICC), and absolute reliability was observed using the standard error of measurement (SEM). A one-way repeated-measures ANOVA showed no systematic differences across different testing sessions ($F = 0.09$, $p = .91$). The test showed good relative reliability with ICC (3,1) = 0.78 and acceptable reliability with SEM = 59.9 ms, and good consistency with CV = 5.34%. This finding supports the 5m Step Test as a reliable field-based measure for assessing step speed in fencing.

1. Introduction

Among combat sports, fencing is one of the games in which two players engage in a bout on a piste with the same weapon. According to the weapon player's movement, techniques, playing styles, rules, and strategies differ (Haobam & Singh, 2025). However, lunge, stepping, and change of direction

are the most frequently used techniques in fencing (Chtara et al., 2020). Steps in fencing are the main key to combat since players fence in an en-garde position. Stepping is what a player does to initiate an offensive move or defensive move during a bout. An athlete's agility and muscular strength are directly correlated with dynamic movements such as stepping back and forth. Players with different body types and sizes can still execute steps successfully (Turna, 2020).

Although several general speed and agility tests exist, they lack relevance to the sport of fencing. Therefore, a reliable and standardized method for measuring fencing forward step speed is necessary for coaches, players, and researchers.

2. Methods

2.1 Participants

Twenty national fencing players were selected from Khongman Fencing Academy for the study. All the players had participated in the national fencing championship and were free from lower-limb injury at the time of the test.

2.2 Test Standardization equipment and procedure

The 5m step test was standardized as follows:

- Equipment: Piste, stopwatch and whistle
- Standard en-garde position, with the front foot toe aligned to the starting line.
- The tester blew the whistle, and the player performed the forward fencing step in speed until reaching the finish line.
- The timer started after the whistle and stopped when the front foot reached the finish line.
- The score was recorded in real-time as soon as the whistle blew, as the participant performed the forward fencing step from the starting line until the finishing line. The score was generated in milliseconds.
- The procedure was repeated 3 times.
- Out of the three trials, the best was recorded for analysis.
- The same tester, piste, equipment, and approximate time of the day were maintained across all sessions.

2.3 Test-Retest Design

The test was conducted in the evening on three separate days: **Day 1, Day 3, and Day 5**. These intervals were maintained to minimize fatigue while reducing learning adaptation.

2.4 Statistical Analysis

Descriptive statistics, including mean and standard deviation, were calculated for 5m step scores for each testing session. Standard deviation was reported for descriptive purposes only. Test-restest reliability was assessed using the Intraclass Correlation Coefficient. A one-way repeated-measures ANOVA was used to obtain the mean square between subjects (MSR) and mean square error (MSE) required for ICC calculation. Absolute reliability was evaluated using Standard Error of Measurement (SEM), calculated as the square root of the error mean square. Relative reliability was assessed using Coefficient of Variance (CV%), and statistical significance was set at $p<.05$.

3. Results

3.1 Descriptive statistics

Table 1

MEAN AND STANDARD DEVIATION FOR THE 5m STEP TEST ACROSS THE THREE TESTING SESSIONS

Session	Mean (ms)	SD (ms)
Day 1	2411.5	236.1
Day 2	2421.0	257.0
Day 3	2403.5	329.5

Table 1 represents the Mean and Standard Deviation values of step speed across the three testing sessions. The mean and standard deviation across three different days: **Day 1, Day 3, and Day 5** are 2411.5±236.1, 2421.0±257.0 and 2403.5±329.5, respectively.

3.2 Test-Retest reliability

TABLE 2

ONE-WAY REPEATED-MEASURES ANOVA FOR THE 5m STEP TEST

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Rows	3746160	19	197166.3	11.86	1.2E-10	1.867
Columns	3070	2	1535	0.09	0.91	3.245
Error	631530	38	16619.21			
Total	4380760	59				

Table 2 shows the one-way repeated-measures ANOVA for the 5m Step Test. The analysis demonstrated that no significant differences were observed between the testing sessions, as indicated by F (2, 38) = 0.09 and p = 0.91, suggesting the absence of fatigue effects and systematic learning across the three testing sessions.

TABLE 3

TEST-RETEST RELIABILITY STATISTICS OF THE 5m STEP TEST

Measure	Value
ICC (3,1)	0.78
SEM (ms)	59.9
CV (%)	0.78

Note: ICC = Intraclass Correlation Coefficient; SEM = Standard Error of Measurement;

CV = Coefficient of Variation

Table 3 shows that the ICC (3, 1) value was 0.78, suggesting good consistency in the 5m Step Test across the three testing sessions. The SEM was 59.9 ms, indicating a moderate level of measurement error and acceptable precision of the test. The CV (%) was 0.78%, which is below the commonly accepted threshold of 5%, demonstrating high consistency across the testing sessions.

4. Discussion

The purpose of this study was to standardize a 5m Step test and evaluate its test-retest reliability in national fencing players. The results demonstrated good reliability, as per established guidelines. The ICC (3, 1) value was 0.78, suggesting good consistency in the 5m Step Test across the three testing sessions. The SEM was 59.9, indicating a moderate level of measurement error and acceptable precision of the test. The CV (%) was 0.78%, which is below the commonly accepted threshold of 5%, demonstrating high consistency across the testing sessions. Furthermore, there were no significant differences between the testing sessions, as indicated by $F(2, 38) = 0.09$ and $p = 0.91$, suggesting the absence of fatigue effects and systematic learning across the three testing sessions. These findings suggest the practical utility of the test to measure fencing step speed.

5. Conclusion

The standardized 5m Step test showed good reliability, acceptable measurement precision, and no systematic differences across the three different testing sessions. The test is a reliable, field-based assessment tool for coaches and researchers to evaluate forward step speed performance by measuring the 5m Step speed. This standardized test provides a practical and cost-effective assessment tool for monitoring players' performance and scientific research.

6. Recommendations

From the standardization of establishing a reliable 5m Step test, the following recommendations can be drawn:

- It is recommended to use the standardized 5m step test as a reliable monitoring tool to assess the speed performance over time in fencers.
- It is applicable as a reliable monitoring tool to track performance changes over time and assess the effectiveness of speed and agility training interventions.
- Due to its cost-effective and practical nature, the test is applicable across different performance levels, such as elite and grassroots fencing players.
- The test is suitable under field conditions without disrupting normal training sessions.

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