

Accuracy of a linear power transducer for measuring counter movement jump performance in elite female volleyball players

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Abstract

INTRODUCTION: The countermovement jump (CMJ) has become a common assessment for evaluating force and power output of the lower extremity. The evaluation of these performance characteristics is critical in athletic populations, such as female volleyball players. The purpose of this study was to compare the assessment of vertical jump performance between a linear power transducer (LPT) and a force plate system (FPS). **METHODS:** Sixteen Division I female volleyball players (age = 19.4 ± 1.5 years, height = 176.2 ± 10.6 cm, weight = 71.5 ± 11.1 kg) participated in this study. Each participant performed two CMJ familiarization attempts, followed by three trials that were simultaneously measured with an LPT and an FPS, with 1-minute rest periods between trials. The tether from the LPT raised vertically and attached to a belt that was securely fit around the waist of each participant. Proper technique of the CMJ attempts were verified through observation by two Certified Strength and Conditioning Specialists. The peak height value (cm) from the three trials obtained via FPS (as the criterion) was recorded and analyzed. **RESULTS:** The mean ± SD values for peak jump height was 48.2 ± 4.4 cm for the LPT and 36.2 ± 3.9 cm for the FPS, which was significantly different (p < 0.001). The CMJ value from LPT was significantly correlated (r = 0.89, p < 0.001) to FPS and showed a standard error of estimate (SEE) of ± 1.86 cm. Limits of agreement procedures showed a 95% confidence interval (constant error ± 1.96 SD) of 12.1 ± 4.1 cm. **CONCLUSION:** Compared to the criterion FPS, the LPT provided significantly higher mean values, yet displayed a strong correlation, small SEE value, and tight LOA when used to test CMJ in elite female volleyball players. **PRACTICAL APPLICATIONS:** Practitioners who work with elite female volleyball players should consider the results of the study when testing CMJ with an LPT, as according to the results, it may consistently provide higher CMJ values compared to an FPS. However, due to the relatively small range of individual error, applying a correction factor may reduce the mean error associated with the LPT.

Introduction

- The countermovement jump (CMJ) is a widely accepted and frequently used performance test for assessing lower-body explosive strength and neuromuscular readiness in athletic populations (2,5).
- In sports such as volleyball, where jumping, landing, and rapid force production are central to performance, accurately measuring vertical jump height provides critical insights into training effectiveness and physical readiness (1).
- Traditionally, force plate systems (FPS) have been considered the gold standard for CMJ assessment due to their precision and ability to quantify ground reaction forces (3,4,6).
- However, linear position transducers (LPTs) offer a more accessible and portable alternative that may be attractive to strength and conditioning professionals working in field or team settings (6).
- Before substituting FPS with LPTs in practical applications, it is essential to determine the validity and reliability of LPT-derived measurements.
- The purpose of this study was to evaluate the accuracy of an LPT in measuring CMJ peak height compared to a criterion FPS in elite female collegiate volleyball players.

Methods

- Sixteen Division I female volleyball players (age = 19.4 ± 1.5 years, height = 176.2 ± 10.6 cm, weight = 71.5 ± 11.1 kg) participated in this study.
- Each participant performed two CMJ familiarization attempts, followed by three trials that were simultaneously measured with an LPT (GymAware Power Tool, Kinetic Performance Technologies, Canberra, Australia) and an FPS (ForceDecks, VALD Performance, Queensland, Australia), with 1-minute rest periods between trials.
- The tether from the LPT raised vertically and attached to a belt that was securely fit around the waist of each participant.
- Proper technique of the CMJ attempts were verified through observation by two Certified Strength and Conditioning Specialists.
- The peak height value (cm) from the three trials obtained via FPS (as the criterion) was recorded and analyzed.

Results

Table 1. Agreement statistics comparing CMJ height values (cm) between the FPS and LPT.

	Mean ± SD	p	ES	r	SEE	CE ± 1.96 SD	Upper	Lower
FPS	36.2 ± 3.9							
LPT	48.2 ± 3.8	<0.01	2.9	0.89*	1.86	12.1 ± 4.1	16.1	8.0

FPS = Force plates, LPT = Linear position transducer, cm = centimeters, SD = standard deviation, p = probability, ES = effect size, r = correlation coefficient, SEE = standard error of the estimate, CE = constant error. *Indicates statistical significance for correlation (p < 0.05)

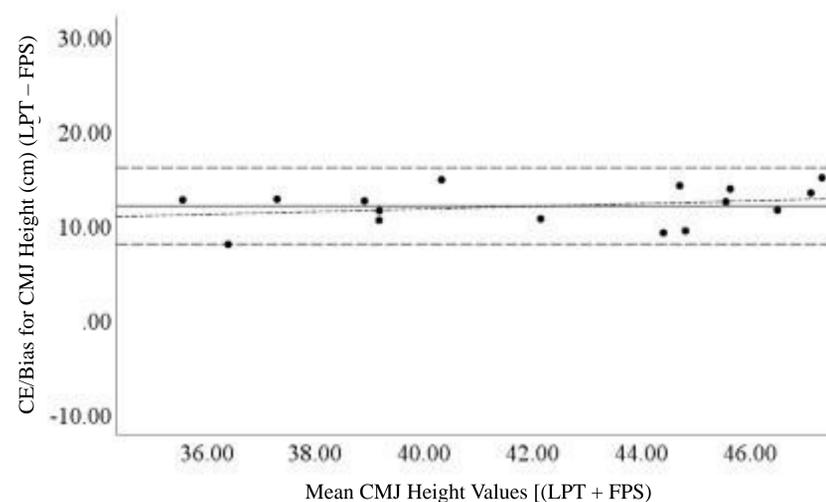


Figure 1. Bland-Altman plots comparing height (cm) and CMJ power (W) measurements by the linear position transducer (LPT) and criterion force plates (FPS). The solid line represents the constant error (CE). The dashed lines represent the upper and lower 95% limits of agreement. The dashed dotted line represents the correlation line between the x- and y-axes, which was non-significant (r = 0.28, p = 0.69).

Conclusions

- The results of this study revealed a significant difference in CMJ peak height values between the LPT and the FPS, with the LPT producing systematically higher values.
- Despite this discrepancy, the LPT demonstrated a very strong correlation with the FPS, along with a relatively small SEE and narrow limits of agreement.
- These findings suggest that although LPTs may overestimate jump height due to the nature of their measurement technique, they still provide consistent and predictable results when compared to the criterion method.
- As such, while the LPT cannot be used interchangeably with FPS values, it may still serve as a valid tool for assessing relative changes in CMJ performance over time, especially when the same device is used consistently in a longitudinal or training-monitoring context.

Practical Applications

- Professionals working with elite female volleyball players may benefit from using an LPT to assess CMJ performance due to its portability, ease of use, and ability to provide real-time feedback.
- However, direct comparisons of LPT-derived jump heights to FPS-based normative data or performance benchmarks should be avoided, unless there is a correction factor applied.

References

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