

Accuracy of a smartphone application for measuring counter movement jump performance in elite female volleyball players



Shawn Flack¹, Will Wright^{1,2}, Elroy J Aguiar¹, Michael V Fedewa¹, Lee J Winchester¹, Michael R. Esco¹

¹The University of Alabama, Department of Kinesiology

²Jacksonville State University, Department of Athletics

Abstract

INTRODUCTION: The countermovement jump (CMJ) has become a common assessment for evaluating force and power output of the lower extremities. The evaluation of these performance characteristics is critical in athletic populations, such as volleyball players. The purpose of this study was to determine the accuracy of a smartphone application (APP) for assessing vertical jump performance in elite female volleyball athletes. **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. Following a dynamic warm-up protocol, each participant performed two CMJ familiarization attempts, followed by three recorded attempts that were simultaneously measured by an APP and a force plate system (FPS), with 1-minute rest periods between trials. A smartphone fixed to a tripod approximately 1.0 m in front of the participant was used to record the CMJ using the APP. Two Certified Strength and Conditioning Specialists observed each CMJ performance to verify proper technique. 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 35.3 ± 3.8 cm for the APP and 36.2 ± 3.9 cm for the FPS, which was significantly different (p < 0.001). The CMJ values from the two devices showed a significant correlation (r = 0.99, p < 0.001). Additionally, the APP had a standard error of estimate (SEE) of ±0.27 cm, while limits of agreement (LOA) analysis showed a 95% confidence interval (constant error ± 1.96 SD) of -0.84 ± 0.57 cm. **CONCLUSION:** The APP and FPS provided slightly different mean CMJ values. However, when compared to the criterion FPS, the APP displayed a strong correlation, and small SEE and LOA values. Therefore, it appears that the APP provides a valid assessment of CMJ in elite female volleyball players. **PRACTICAL APPLICATIONS:** Practitioners who work with elite female volleyball players should consider using a CMJ testing APP when an FPS is unavailable.

Introduction

- The countermovement jump (CMJ) is a widely used measure for assessing lower-body power and neuromuscular performance in athletic populations.
- This test is particularly relevant in sports like volleyball, where explosive jumping ability is critical for performance in blocking, spiking, and quick directional changes.
- Traditionally, force plate systems (FPS) have been considered the gold standard for CMJ measurement due to their high precision and reliability.
- However, FPS units are costly and typically confined to laboratory or high-performance training environments, limiting their accessibility for many coaches and practitioners.
- Recently, smartphone applications (APPs) using high-speed video analysis have emerged as a more accessible and affordable alternative.
- These tools offer potential for field-based testing, but their accuracy must be validated against established laboratory equipment to ensure confident use in elite athletic settings.
- The purpose of this study was to evaluate the accuracy of a smartphone APP for measuring vertical jump height compared to a criterion FPS in elite Division I female volleyball players.
- By examining the correlation, agreement, and error margins between devices, we aimed to determine whether this APP could serve as a practical substitute for FPS when evaluating CMJ performance in high-level athletes.

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.
- Following a dynamic warm-up protocol, each participant performed two CMJ familiarization attempts, followed by three recorded attempts that were simultaneously measured by an APP (My Jump 2, Version 1.0.9, Carlos Balsalobre-Fernández, App Store) and an FPS (ForceDecks, VALD Performance, Queensland, Australia), with 1-minute rest periods between trials.
- A smartphone fixed to a tripod approximately 1.0 m in front of the participant was used to record the CMJ using the APP.
- Two Certified Strength and Conditioning Specialists observed each CMJ performance to verify proper technique. 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 APP.

	Mean ± SD	p	ES	r	SEE	CE ± 1.96 SD	Upper	Lower
FPS	36.2 ± 3.9							
APP	35.3 ± 3.8	<0.01	-0.22	0.99*	0.27	-0.84 ± 0.57	-0.27	-1.41

FP = Force plates, APP = the smartphone applications, cm = centimeters, SD = standard deviation, p = probability, r = correlation coefficient, SEE = standard error of the estimate, CE = constant error. *Indicates statistical significance for correlation (p < 0.05)

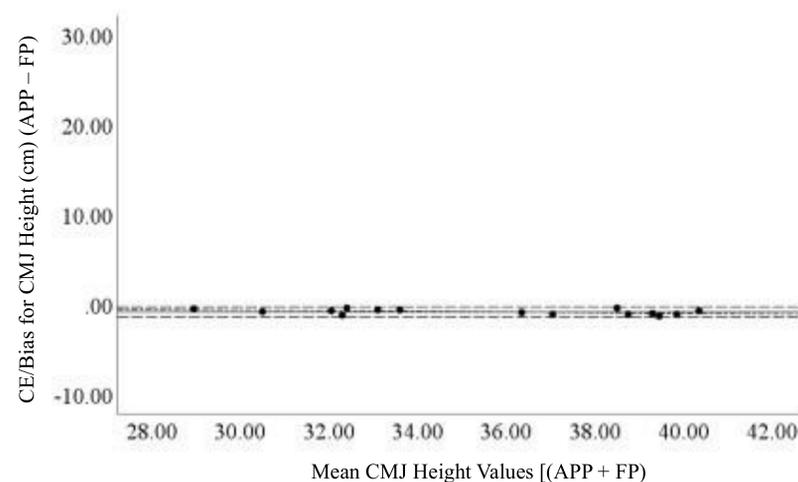


Figure 1. Bland-Altman plots comparing height (cm) and CMJ power (W) measurements by the smartphone application (APP) and criterion force plates (FP). The solid line represents the constant error (CE). The dashed lines represent the upper and lower 95% limits of agreement.

Conclusions

- This study demonstrated that while the APP produced slightly lower average CMJ height values than the FPS, the measurements were highly correlated and showed minimal error.
- Additionally, there was a strong correlation coefficient, small SEE, and narrow limits of agreement when the APP was compared to the FPS.
- These findings suggest that the APP provides a valid method for assessing CMJ performance in elite female volleyball athletes.
- The APP may be used in place of an FPS for measuring CMJ height, particularly for practical purposes.

Practical Applications

- Sport practitioners and researchers working with elite volleyball athletes often require frequent monitoring of neuromuscular performance, including vertical jump height, to guide training and recovery strategies.
- When force plate systems are unavailable due to financial or logistical constraints, validated smartphone applications provide a practical alternative.
- Based on this study, the APP can serve as a valid tool for assessing CMJ height in field settings.
- Although minor differences in absolute values existed between the APP and FPS, the strong correlation and low error margins suggest that the APP can still be used to monitor changes over time and compare performance within athletes or teams.
- Practitioners should remain consistent with the same measurement tool to ensure valid comparisons across testing sessions.
- Furthermore, ensuring proper technique and using consistent smartphone placement, such as positioning it approximately 1 meter in front of the athlete, will help maintain data quality.
- Overall, the APP enables a more accessible performance tracking method, particularly for programs with limited resources.