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Laboratory-Grade Accuracy on a Budget: Concurrent Validity of CC Athletics Portable Force Plates for Vertical Jump Analysis

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Abstract

Vertical jump assessments are widely used to evaluate athletic performance. As demand grows for field-ready systems with laboratory-grade accuracy, portable devices like the CC Athletics PlateMate force plates offer affordable and accessible solutions. This study examined the concurrent validity of PlateMate compared to a gold-standard AMTI force plate during squat jump (SJ), countermovement jump (CMJ), and countermovement jump with arm swing (CMJH). Seventeen recreationally active participants performed five trials per jump while force data were recorded simultaneously from both systems. Agreement was evaluated using Bland–Altman plots, RMSE, Pearson's r, ICC, CV%, and SEM. Across conditions, raw force-time signals and most derived metrics showed excellent agreement ($r \geq 0.95$; ICC > 0.93), with RMSE under 50 N and SEM for jump height between 0.2–0.9 cm. PlateMate demonstrated strong feasibility as a practical, low-cost alternative to laboratory force plates for field-based vertical jump testing.

Keywords: *ground reaction force; jump testing; countermovement jump; squat jump; sports performance; jump assessment*

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Introduction

Vertical jump is a well-established method in sports and rehabilitation to evaluate athletic performance (Claudino et al., 2017). However, relying solely on outcome metrics, such as jump height, can overlook important details on how that height is achieved, including force production and movement mechanics (Anicic et al., 2023; Hubley & Wells, 1983). Additionally, force-time analysis can provide valuable insights into lower limb injury mechanisms (Lichtwark et al., 2024), further amplifying the need for comprehensive vertical jump analysis (Mandic et al., 2016). Given this pivotal role that vertical jumps play in assessing athletic capacity, the need for reliable and accurate measurements cannot be overstated (Hori et al., 2009). Studies have demonstrated that even minor measurement variations can affect the reliability of jump metrics. For example, small errors in take-off phase estimation (ex. 3 ms) can lead to inaccuracies in calculated vertical velocity, displacement or jump height, later affecting informed decisions in sport (Hori et al., 2009; McMahon et al., 2018; Kibele, 1998).

Force plates are widely recognized as the "gold standard" for accurate vertical jump measurements (Cormie et al., 2009; Chavda et al., 2017). These plates capture vertical ground re-

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action forces, which reflect an athlete's power output, and can be further analyzed to extract a wide range of variables (Anicic et al., 2023; Hori et al., 2009). However, despite their accuracy, force plates are typically confined to laboratory settings due to their lack of portability and high cost (Aleksic et al., 2024). Portable force plates, like those from VALD (Collings et al., 2024), have demonstrated validity for field settings; however, their high cost, including software subscription, limits their accessibility for many sports practitioners. Alternatively, less sophisticated equipment is often used in field settings, such as contact mats (e.g., the Just Jump mat), Vertec systems (Leard et al., 2007), or smartphone applications like MyJump (Balsalobre-Férnandez et al., 2015). While these tools are more accessible, their utility is limited by the range of metrics they capture often focusing solely on jump height without offering the deeper insights which are available from laboratory equipment (Aleksic et al., 2024).

Advances in technology continue to drive the development of new measurement tools aimed at bridging the gap between laboratory accuracy and field practicality. In this context, the PlateMate (CC Athletics, Odense, Denmark) force plates represent a promising innovation, particularly due to their portability and no subscription costs related to the software. They enable real-time analysis of jump performance, capturing a comprehensive array of over 45 variables. Additionally, users have the option to export raw data, providing flexibility for in-depth analysis and integration with other systems.

The aim of this study was to assess the level of agreement between PlateMate and the established AMTI force plates (AMTI, Watertown, MA, USA) across key variables of squat jump (SJ), countermovement jump (CMJ) and countermovement jump with arm swing (CMJH). This comparison will contribute to validating PlateMate's suitability as a field-ready tool for accurate vertical jump assessments, potentially expanding the options available to sports scientists, coaches, and practitioners in diverse training and competition environments.

Materials and Methods

Experimental Session

The study involved seventeen healthy male (n=12) and female (n=5) participants, categorized as recreational athletes ($\bar{x}$ ± SD: Age = 25.6 ± 4.8 years; Height = 180.2 ± 11 cm; Body Mass = 75.7 ± 14.8 kg). All participants were familiar with the proper SJ, CMJ and CMJH jumping techniques prior to this research and their participation was voluntary. Ethical approval was granted by the University's Institutional Ethical Review Board (#02-848/23-2; 5th May 2023), and written informed consent was obtained from all participants in accordance with the Declaration of Helsinki. The required sample size was computed in G*Power (ver. 3.1.9.7; Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany) and yielded 9 subjects for statistical power (1-β) of 0.8, significance level (α) of 0.05, and correlation of 0.8.

Experimental Protocol

Prior to experiment, participants completed a standardized warm-up protocol which included 3 min of cycling and dynamic stretching, followed by 2–3 familiarization jump trials. After the warm-up, participants were instructed to step onto a calibrated force plate system. The experimental set-up is illustrated in Figure 1. For data synchronization purposes, PlateMate was positioned on top of AMTI force plates, with both systems zeroed prior to use, following the methodology described in Collings et al. (2024). Both systems were simultaneously started via a manual trigger. After stepping on the platforms, the participants were asked to stand still for 2 s, jump as high as possible after the "go" signal, and then remain stationary for another 2 s. Each participant completed a total of 15 jump trials: five SJs, five CMJs and five CMJHs, with a 60 s rest interval between trials and 120 between jump types (Gathercole et al., 2015a). The order of jumps was randomized to avoid bias (Anicic et al., 2023). For all jumps, participants chose their preferred squat depth (Petronijevic et al., 2018).

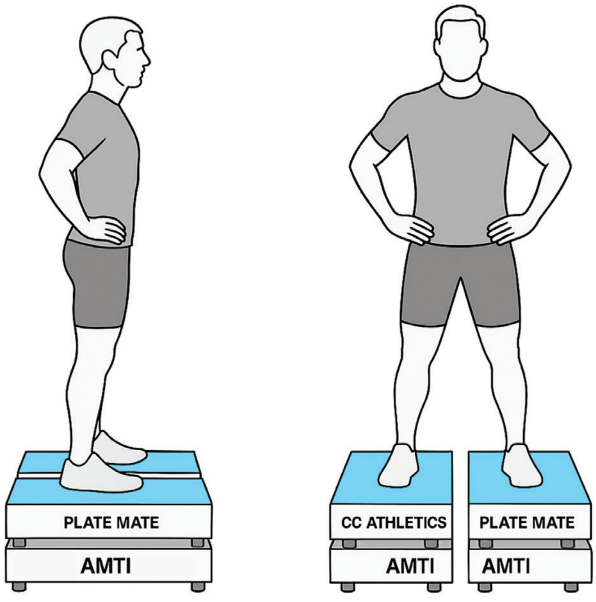

Figure 1. Experimental set-up.

Data Processing

Vertical ground reaction force (vGRF) data was recorded using dual fixed (AMTI BP600400, Watertown, MA, USA) and portable (PlateMate, CC Athletics, Odense, Denmark) three-dimensional force platforms, sampling at 1000Hz and 960Hz, respectively. The vGRF data obtained from both platforms was processed in MATLAB (Statistics Toolbox Release 2025a, The MathWorks, Inc., Natick, MA, USA). Sig-

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nals from both platforms were processed using an identical pipeline with a 2nd-order zero-phase (forward-backward) Butterworth low-pass filter and a cutoff frequency of 50 Hz. The zero-phase implementation eliminated phase distortion at key temporal events such as movement onset and take-off (Winter, 2009). The 50 Hz cutoff was selected following visual inspection of unfiltered and filtered force-time traces for each platform individually, confirming adequate noise attenuation without loss of movement-relevant signal characteristics. Applying a uniform filter across both systems supported methodological comparability between platforms.

Participant's body weight was established during the 2 s motionless period prior to the beginning of each jump. For both the CMJ and CMJH, the onset of the downward movement was marked by a threshold set at five times the standard deviation (SD) of the recorded body weight. When the vGRF dropped below this threshold, it signified the start of the unweighting phase (McMahon et al., 2018). The braking phase was then determined as the interval between the point of minimum vGRF and the return of vGRF to a level that corresponded to the deepest part of the countermovement (i.e., lowest squat position). For all jump conditions, the take-off phase was marked as the point when vGRF exceeded the participant's body weight and continued until it dropped below a threshold of 5*SD of the force recorded during the flight phase, averaged over a 300 ms period. The flight phase was identified as the interval between take-off and landing, during which the vGRF remained near zero. Finally, the landing phase commenced when the vGRF exceeded a 5N threshold value and continued until stabilizing at body weight again.

Variables

The study focused on a refined set of 15 variables for SJ and 24 variables for CMJ and CMJH, selected as the most relevant for vertical jump performance assessment in applied settings (Anicic et al., 2023; Bishop et al., 2022). A relatively broader set was retained because one of the practical strengths of the PlateMate system is its ability to generate and export numerous force-time metrics, allowing coaches and practitioners to look deeper into jump performance. To preserve clarity and readability of the manuscript, only a core subset of key outcome variables is presented in the primary results tables, whereas the descriptive and validity results for the remaining variables are reported in Supplementary Tables S1 and S2. The complete list of analyzed variables is presented in Table 1.

Table 1. Definition of vertical jump variables examined in this study.

Phase	Variable	Description	Unit
Weighing Phase	BW	Body Weight	N
	BM	Body Mass	kg
Unweighting Phase	dt_Fmin	Time from movement onset to the minimum force during the unweighting phase.	s
	dt_UP	Duration of the unweighting phase.	s
	Fmin_UP	Minimum force during the unweighting phase.	N
	Favg_UP	Average force during the unweighting phase.	N
Braking Phase	dt_BP	Duration of the braking phase (time from the end of unweighting to the lowest center of mass position)	s
	hmin_BP	Minimum center of mass displacement during the braking phase.	m
	Fmax_BP	Maximum force recorded during the braking phase.	N
	Favg_BP	Average force during the braking phase.	N
Propulsion (push-off) Phase	dt_PP	Duration of the propulsion phase (time from the lowest center of mass position to push-off).	s
	vto	Velocity at take-off.	$m{\cdot}s^{-1}$
	Fmax_PP	Maximum force during the propulsion phase.	N
	Favg_PP	Average force during the propulsion phase.	N
	J_PP	Impulse (force x time) during the propulsion phase.	N·s
Flight Phase	dt_FP	Duration of the flight phase (time from push-off to landing).	s
	hmax_FP	Maximum height achieved during the flight phase.	m
Landing Phase	F1_LP	First peak vertical ground reaction force during the landing phase (initial impact peak).	N
	F2_LP	Second peak force during landing (eccentric braking).	N
	dt_F1_LP	Duration of the eccentric part of the landing phase.	s
	dt_F2_LP	Duration of the concentric part of the landing phase.	s
Performance Metrics	RSImod	Reactive strength index modified (Jump height / Time to take-off)	m/s
	hmax_vto	Maximum height calculated from take-off velocity method.	m
	hmax_IMP	Maximum height calculated from impulse-momentum method.	m

Note: kg = kilogram; N = Newtons; s = seconds; m = meters; $m{\cdot}s^{-1}$ = meters per second; N·s = Newton-seconds.

Statistical analysis

Descriptive statistics were calculated for all SJ, CMJ and CMJH variables. To evaluate the level of agreement between the two systems (i.e., AMTI and PlateMate), the force-time traces were first compared using Bland–Altman analysis (Bland & Altman, 1986), root mean square error (RMSE) and Pearson's correlation coefficient (r). Correlation thresholds were interpreted based on Hinkle et al. (2003) as follows: r <

0.3 (negligible), r = 0.3–0.5 (low), r = 0.5–0.7 (moderate), r = 0.7–0.9 (high), and r = 0.9–1.0 (very high). The force-time traces were examined separately for each plate (i.e., left and right) and for both plates combined.

Subsequently, consistency of key SJ, CMJ and CMJH variables was compared between the two systems by calculating the intraclass correlation coefficient (ICC 3,1), coefficient of variation (CV%) and standard error of measurement (SEM). Additionally, mean difference (MD) and Pearson's correlation coefficient (r) were computed to further assess the agreement between the systems. Statistical significance was determined a priori at $p < 0.05$. The Bland-Altman analyses, RMSE, and r calculations were conducted using the MATLAB toolbox (Klein, 2023), while all other statistical analyses were performed using the SPSS software (IBM SPSS Version 20.0, Chicago, IL, USA).

Table 2. Descriptive statistics for key SJ, CMJ and CMJH variables obtained from AMTI and PlateMate

		SJ		
		AMTI	PlateMate	AMTI vs PlateMate
Phase	Variable (Unit)	Mean ± SD	Mean ± SD	MD
Weighing Phase	BW (N)	761.00 ± 141.19	760.84 ± 142.55	0.15
	BM (kg)	77.57 ± 14.39	77.56 ± 14.53	0.02
Propulsion Phase	dt_PP (s)	0.35 ± 0.04	0.35 ± 0.04	0.00
	Fmax_PP (N)	1771.90 ± 390.81	1742.17 ± 388.47	29.73
Flight Phase	hmax_FP (m)	0.28 ± 0.06	0.28 ± 0.06	0.00
Performance Metrics	RSImod (m/s)	0.78 ± 0.17	0.65 ± 0.19	0.13
		CMJ		
Weighing Phase	BW (N)	756.44 ± 139.19	747.92 ± 139.12	8.52
	BM (kg)	77.11 ± 14.19	76.24 ± 14.18	0.87
Unweighting Phase	dt_UP (s)	0.32 ± 0.05	0.33 ± 0.05	0.00
Braking Phase	dt_BP (s)	0.17 ± 0.03	0.17 ± 0.03	0.00
	Fmax_BP (N)	1802.70 ± 396.86	1783.49 ± 395.48	19.21
Propulsion Phase	dt_PP (s)	0.28 ± 0.02	0.28 ± 0.02	0.00
	Fmax_PP (N)	1830.21 ± 398.52	1809.39 ± 397.49	20.83
Flight Phase	hmax_FP (m)	0.33 ± 0.07	0.33 ± 0.07	0.00
Performance Metrics	RSImod (m/s)	0.42 ± 0.10	0.41 ± 0.11	0.00
		CMJH		
Weighing Phase	BW (N)	757.42 ± 141.76	749.52 ± 141.26	7.90
	BM (kg)	77.21 ± 14.45	76.40 ± 14.40	0.81
Unweighting Phase	dt_UP (s)	0.34 ± 0.06	0.34 ± 0.06	0.00
Braking Phase	dt_BP (s)	0.18 ± 0.05	0.18 ± 0.05	0.00
	Fmax_BP (N)	1622.29 ± 377.85	1607.70 ± 377.12	14.58
Propulsion Phase	dt_PP (s)	0.29 ± 0.04	0.29 ± 0.04	0.00
	Fmax_PP (N)	1871.32 ± 444.19	1845.14 ± 442.69	26.18
Flight Phase	hmax_FP (m)	0.38 ± 0.08	0.38 ± 0.08	0.00
Performance Metrics	RSImod (m/s)	0.46 ± 0.11	0.46 ± 0.12	0.00

Note: SD- Standard Deviation; MD- Mean Difference.

Table 3. Bland-Altman comparison between AMTI and PlateMate raw force-time signals.

		Bias (min÷max)	LoA lower (min÷max)	LoA upper (min÷max)	RMSE (min÷max)	Pearson's r (95% CI)
BOTH	SJ Force-time (N)	11 (-15 ÷ 58)	-82 (-307 ÷ -3)	105 (22 ÷ 401)	50 (10 ÷ 184)	0.988 (0.980 ÷ 0.996)
	CMJ Force-time (N)	10 (-3 ÷ 25)	-54 (-200 ÷ -4)	73 (17 ÷ 203)	35 (9 ÷ 103)	0.997 (0.995 ÷ 0.999)
	CMJH Force-time (N)	9 (-49 ÷ 25)	-67 (-629 ÷ -7)	85 (5 ÷ 673)	41 (8 ÷ 333)	0.993 (0.988 ÷ 0.998)
LEFT	SJ Force-time (N)	6 (-79 ÷ 95)	-108 (-247 ÷ 5)	121 (-21 ÷ 351)	70 (11 ÷ 161)	0.951 (0.938 ÷ 0.964)
	CMJ Force-time (N)	7 (-70 ÷ 122)	-119 (-306 ÷ -10)	134 (36 ÷ 550)	72 (21 ÷ 250)	0.973 (0.965 ÷ 0.980)
	CMJH Force-time (N)	7 (-107 ÷ 128)	-153 (-421 ÷ -11)	166 (46 ÷ 632)	89 (26 ÷ 287)	0.954 (0.942 ÷ 0.967)
RIGHT	SJ Force-time (N)	22 (-13 ÷ 49)	-37 (-155 ÷ 6)	81 (15 ÷ 199)	39 (8 ÷ 93)	0.987 (0.980 ÷ 0.995)
	CMJ Force-time (N)	18 (-3 ÷ 43)	-28 (-90 ÷ 1)	63 (8 ÷ 159)	31 (5 ÷ 73)	0.996 (0.994 ÷ 0.998)
	CMJH Force-time (N)	16 (-36 ÷ 39)	-34 (-295 ÷ -4)	67 (6 ÷ 349)	33 (4 ÷ 166)	0.992 (0.986 ÷ 0.998)

Note: LoA lower/ upper– Lower/ Upper Limits of Agreement; min- Minimum; max- Maximum; RMSE- Root Mean Square Error; Pearson's r- Pearson's Correlation Coefficient; 95% CI- 95% Confidence Interval.

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Results

Descriptive statistics for the key variables pertaining to SJ, CMJ and CMJH are presented in Table 2. The complete descriptive statistics for all analyzed variables are provided in Supplementary Table S1.

Table 3 and Figure 2 present the comparison between vGRF force-time traces from the AMTI and PlateMate, for each plate separately (i.e., left and right), and for both plates combined.

Validity measures for key variables are summarized in Table 4 for SJ, CMJ and CMJH. The full validity statistics for all analyzed variables are provided in Supplementary Table S2.

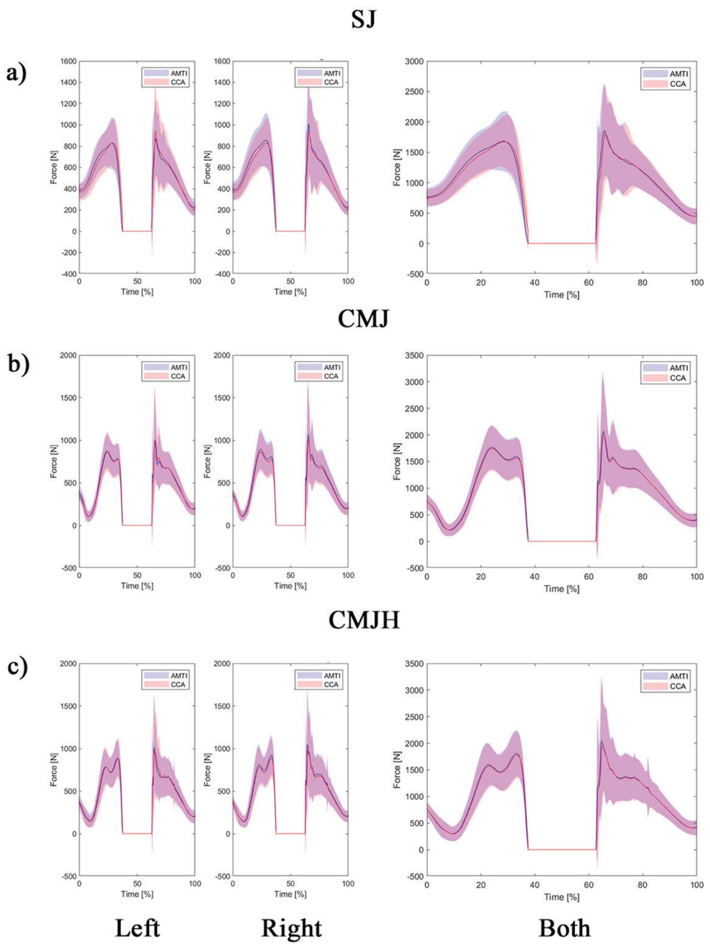

Figure 2. Comparison between AMTI and PlateMate force plate vertical ground reaction force-time traces. Left panel represents the signals for left and right plates individually. Right panel represents the signal for both plates collectively. The solid blue lines represent data from the AMTI system, and the red lines represent data from the PlateMate force plate system. The shaded areas represent variability (95% confidence intervals).

Table 4. Validity statistics for key SJ, CMJ and CMJH variables obtained from AMTI and PlateMate

			SJ		
Phase	Variable (Unit)	ICC (95% CI)	CV%	SEM	r
Weighing Phase	BW (N)	0.998 (0.998 ÷ 0.999)	1.02	7.79	0.997*
	BM (kg)	0.998 (0.998 ÷ 0.999)	1.02	0.80	0.699*
Propulsion Phase	dt_PP (s)	0.996 (0.995 ÷ 0.998)	1.00	0.00	0.993*
	Fmax_PP (N)	0.999 (0.999 ÷ 0.999)	0.46	8.03	0.999*
Flight Phase	hmax_FP (m)	0.999 (0.999 ÷ 0.999)	0.27	0.00	0.999*
Performance Metrics	RSImod (m/s)	0.821 (0.739 ÷ 0.877)	13.80	0.10	0.997*
			CMJ		
Weighing Phase	BW (N)	0.999 (0.999 ÷ 0.999)	0.36	2.74	0.999*
	BM (kg)	0.999 (0.999 ÷ 0.999)	0.36	0.28	0.999*
Unweighting Phase	dt_UP (s)	0.999 (0.998 ÷ 0.999)	0.80	0.00	0.998*
Braking Phase	dt_BP (s)	0.999 (0.999 ÷ 0.999)	0.67	0.00	0.998*
	Fmax_BP (N)	0.999 (0.999 ÷ 0.999)	0.37	6.62	0.999*

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Table 4. Validity statistics for key SJ, CMJ and CMJH variables obtained from AMTI and PlateMate

		CMJ			
Phase	Variable (Unit)	ICC (95% CI)	CV%	SEM	r
Propulsion Phase	dt_PP (s)	0.997 (0.996 ÷ 0.998)	0.60	0.00	0.995*
	Fmax_PP (N)	0.999 (0.999 ÷ 0.999)	0.36	6.62	0.999*
Flight Phase	hmax_FP (m)	0.999 (0.999 ÷ 0.999)	0.68	0.00	0.999*
Performance Metrics	RSImod (m/s)	0.993 (0.989 ÷ 0.995)	3.01	0.01	0.986*
		CMJH			
Weighing Phase	BW (N)	0.999 (0.999 ÷ 0.999)	0.82	6.15	0.998*
	BM (kg)	0.999 (0.999 ÷ 0.999)	0.82	0.63	0.998*
Unweighting Phase	dt_UP (s)	0.996 (0.995 ÷ 0.997)	1.54	0.01	0.993*
Braking Phase	dt_BP (s)	0.999 (0.999 ÷ 0.999)	0.57	0.00	0.999*
	Fmax_BP (N)	0.999 (0.999 ÷ 0.999)	0.56	9.00	0.999*
Propulsion Phase	dt_PP (s)	0.999 (0.999 ÷ 0.999)	0.56	0.00	0.998*
	Fmax_PP (N)	0.999 (0.999 ÷ 0.999)	0.62	11.46	0.999*
Flight Phase	hmax_FP (m)	0.999 (0.999 ÷ 0.999)	0.42	0.00	0.999*
Performance Metrics	RSImod (m/s)	0.988 (0.982 ÷ 0.991)	3.91	0.02	0.976*

Note: ICC- Intraclass Correlation Coefficient; 95% CI- 95% Confidence Interval; CV%- Coefficient of Variation (%); SEM- Standard Error of Measurement; r- Pearson's r; * p<.001.

Discussion

This study set out to validate the feasibility of PlateMate portable force plates compared to a laboratory-grade AMTI system across SJ, CMJ and CMJH. Overall, the results demonstrated an excellent agreement between the systems, both in terms of the raw force-time signal comparisons and the subsequently derived variables. These findings suggest that PlateMate represents a viable, field-ready alternative to traditional laboratory-based force plates. Below, we discuss the findings in detail.

For all the observed variables, the descriptive results produced mean values that fall within expected ranges reported in the literature for similar populations (Claudino et al., 2017; Collings et al., 2024; Ferná Ortega et al., 2022; Mandic et al., 2016), with minimal differences between the systems. For instance, in CMJ, mean jump height was approximately 0.30–0.33 m in both the PlateMate and AMTI. The CMJH condition naturally improved performance (~0.35–0.40 m), reflecting the well-known contribution of arm momentum to jump height gain (Hara et al., 2006). The squat jump, which involves no preparatory countermovement, yielded slightly lower mean heights (~0.25–0.28 m) in both systems.

Other basic outcome measures showed a similar pattern, such as the Fmax which was around 1.5–2.0 times body weight in both systems, a typical value reported for maximal effort jumps in non-elite athletes (Collings et al., 2024; Donahue et al., 2021). These descriptive comparisons indicate that PlateMate not only measures similar magnitudes of performance as the laboratory-grade force plates, but also that the sample's performance was expected for their level.

Validity: raw force-time signal comparisons

Beyond descriptive statistics, the PlateMate demonstrated a near-perfect agreement to the "gold standard" when comparing raw force-time signals across all jump types, both for each plate individually (i.e., left and right) and combined. Specifically, the Bland–Altman analysis yielded trivial systematic bias between the systems across all jump conditions, with the mean difference in the recorded force at any given time point on the order of 9-11 N for the combined signal of both plates, and 6-22 N for individual plates (<2% bias when compared to the typical peak vGRF values). The 95% LoA were also narrow, spanning between -54 and 105 N for all jumps (less than 10% deviation relative to peak vGRF values). When analyzing the plates individually, the limits of agreement were slightly wider (-28 – 166 N), likely due to natural asymmetries in bilateral force production and greater sensitivity to small variations in signal timing or magnitude (Bell et al., 2014; Impellizzeri et al., 2007). Regardless, this level of agreement meets acceptable criteria for variability in biomechanical measurements (Lake et al., 2018) and indicates that PlateMate accurately captures not only the peak force, but the entire profile of the force-time curve. The reported RMSE values further confirm an exceptional accuracy of PlateMate, with average errors < 50 N for combined plates, and < 89 N for individual plates. Moreover, when each force-time record was treated as a series and correlated with its counterpart, correlations were extremely high and consistently exceeded 0.95 for all jump types.

These results confirm that the PlateMate system is feasible for both single-plate and dual-plate applications. Furthermore, it is worth noting that portable force-plates typically do not offer the option to export raw force-time data, which is a distinguished strength of the PlateMate system. The ability to access and export raw data allows for more detailed, customized analysis and facilitates transparency in data handling, enabling researchers and practitioners to independently verify results or apply their own specific analysis methods.

Validity: SJ-derived metrics

Building on these results, 13 out of 15 variables analyzed in SJ demonstrated excellent agreement between the systems (ICC > 0.974, CV% < 10%) and minimal measurement

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errors (e.g., 0.00 - 0.06 m for jump height and 0.00 - 0.05 s for time-derived variables). Correlations were also very high (r > 0.950) for the vast majority of variables, further confirming the strength of agreement between devices. The only exceptions were BM and hmax_vto, which showed moderate correlation (r = 0.699 and 0.585, respectively), though the mean difference between devices was negligible in practical terms (0.02 kg and 0.04 m, respectively). The hmax_vto also exhibited higher variability (CV% = 14.57), which is expected in the SJ condition where take-off velocity is lower than in CMJ. In such cases, even a small absolute difference between devices translates into a proportionally larger percentage error, thereby inflating the CV%. Additionally, any minor residual countermovement at take-off can further influence the velocity calculation and contribute to this variability.

Some exceptions were also observed in the RSImod which demonstrated slightly lower agreement (ICC = 0.821) and greater variability (CV% = 13.80). This, again, likely stems from the nature of the SJ test, where athletes start from a static squat position and initiate the concentric phase directly. Additionally, the SJ typically features shorter propulsion times and lower jump heights due to the absence of stored elastic energy from a countermovement. These factors may amplify the relative impact of small timing inconsistencies or measurement noise, especially when calculating ratios like RSImod, which are sensitive to small absolute changes in both jump height and time to take-off. Moreover, Bishop et al. (2018) and Gathercole et al. (2015b) both emphasized that RSImod is task-dependent and is most valid in movements with a clear eccentric-concentric transition (e.g., CMJ or drop jump) (Bishop et al., 2018; Gathercole et al., 2015b). Consequently, computing RSImod in the context of a squat jump is more prone to variability and less reliable.

Validity: CMJ and CMJH-derived metrics

Out of the 24 variables analyzed for the CMJ task, 22 variables demonstrated a near-perfect agreement (ICC ≥ 0.990), while the rest of the variables still showed an excellent agreement (ICC > 0.973). For the CMJH, 20 variables showed a near-perfect agreement (ICC ≥ 0.991) and 4 demonstrated an excellent agreement (ICC > 0.950).

Furthermore, the coefficients of variation between the systems were generally very low, falling below 5% for robust measures like jump height, peak force, and time-derived metrics, and below 10% for the rest of the variables examined. Such low CV% values suggest that the typical error or noise between the devices was small relative to the mean values. For example, the standard error of measurement (SEM) was as low as 0.00-0.01 m for jump height and 0.00-0.06 s for time-derived variables, which is practically negligible when evaluating athlete performance. It is particularly important to note that the SEM for push-off phase duration was 2 ms (0.002 s), which aligns with recommendations from previous studies who suggest that a deviation of less than 3 ms is critical to avoid inaccuracies in subsequent calculations of vertical velocity, displacement, or jump height (Hori et al., 2009; McMahon et al., 2018; Kibele, 1998).

The only exception was F2_LP where CV% was slightly over the 10% mark. This aligns with findings from Impellizzeri et al. (2007), who noted that eccentric braking measures tend to show higher variability and are more affected by asymmetries and coordination differences (Impellizzeri et al., 2007). Similarly, correlations were very high (r ≥ 0.905) for all variables, indicating very high to near-perfect agreement between PlateMate and the AMTI system.

Study limitations

Overall, this study confirms that PlateMate delivers measurements that are virtually interchangeable with those of a laboratory-grade force plate for vertical jump assessment. From an applied perspective, PlateMate offers measurement accuracy while also providing key advantages in portability and cost-effectiveness. Despite strong validation results, several limitations must be acknowledged. First, the study included a modest sample size (n=17) which consisted solely of recreational athletes. While the statistical power analysis indicated that this number was sufficient for detecting large correlations, a larger sample might have allowed for more nuanced analyses (e.g., subgroup analyses by sex) and further increased the generalizability of findings.

Second, our testing protocol focused on the SJ, CMJ, and CMJH jump variations. The validity of PlateMate for measuring other tasks, or generally for capturing asymmetrical force outputs, remains to be verified. In our setup, participants jumped with both feet on separate force plates, and we analyzed the individual and combined force-time signal outputs. However, we did not explore asymmetries or unilateral metrics. For practitioners interested in using force plates to detect imbalances, further research should confirm that PlateMate can reliably quantify asymmetry to the same degree as laboratory-grade systems.

Finally, this study did not include a formal test-retest reliability analysis of the PlateMate system, as the primary objective was to evaluate its concurrent validity against the AMTI force plate. However, the exceptionally high ICCs and low between-device variability (CV% < 10%) suggest minimal inherent measurement noise. It is therefore reasonable to expect that PlateMate would demonstrate similarly strong reliability across repeated sessions. Nevertheless, future research should directly assess its test-retest reliability to support its use in longitudinal monitoring.

Conclusion

In conclusion, this study provides strong evidence that PlateMate is a viable solution for vertical jump assessment, delivering accuracy that is comparable to laboratory-grade force plates. Specifically, PlateMate demonstrated a near-perfect agreement with the "gold standard" (i.e., AMTI) when comparing both the raw force-time signals, and the subsequently derived variables of SJ, CMJ, and CMJH. These findings are significant for sports and rehabilitation experts as they verify that a portable and cost-effective force plate system can deliver high-quality data without the typical constraints of a laboratory-bound equipment.

Furthermore, the option to export raw force-time signals gives practitioners greater analytical flexibility compared to many subscription-based portable platforms. This makes PlateMate especially valuable for conducting detailed neuromuscular assessments in a wide range of training and rehabilitation environments. By doing so, PlateMate holds great promise for enhancing athlete monitoring, training optimization, and rehabilitation tracking.

Validating PlateMate against an industry benchmark expands the toolkit available for applied sport science, helping bring lab-level measurement quality closer to everyday practice. With its combination of accuracy, portability, and user-friendly access to raw data, PlateMate is poised to make advanced jump monitoring more accessible than ever, thereby contributing to better-informed training decisions and improved athlete development in both sports and rehabilitation settings.

Author Contributions

Conceptualization, D.M.M.; Methodology, D.M.M., J.A., and Z.A.; Formal analysis, J.A., and D.M.M..; Data curation, Z.A., M.S., and D.N.; Writing—original draft preparation, J.A., D.M.M.; Writing—review and editing, J.A., Z.A., M.S., D.N, O.M.K, and D.M.M. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Institutional Review Board of the University of Belgrade, Faculty of Sport and Physical Education—#02-848/23-2 (Approved on: 5 May 2023).

Informed Consent Statement

Written informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The data presented in this study are available on request from the corresponding author.

Conflicts of Interest

The authors declare no conflicts of interest.

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