Jump and Change of Direction Speed Asymmetry using Smartphone Apps: Between-session Consistency and Associations with Physical Performance

Abstract

The aims of the present study were to: 1) quantify the magnitude and direction of asymmetry from jump and change of direction speed (CODS) tests and, 2) determine the relationship between these asymmetries and jump and CODS performance, in a test-retest design. Thirty Spanish national level youth basketball athletes performed single leg countermovement jumps (SLCMJ), single leg drop jumps (SLDJ), and 505 CODS tests, all assessed using the My Jump 2™ and CODTimer™ smartphone applications. All tests showed good to excellent reliability, with no significant differences identified between test sessions in jump, CODS, or asymmetry data. The direction of asymmetry showed *substantial* levels of agreement between test sessions for jump height during the SLDJ (Kappa = 0.72), but only *fair* levels of agreement for reactive strength during the SLDJ (Kappa = 0.25), *fair* levels of agreement for jump height during the SLCMJ (Kappa = 0.29), and *slight* levels of agreement for total time during the 505 test (Kappa = 0.18). Jump height asymmetry from the SLDJ was significantly associated with reduced jump height (ρ = -0.44), reactive strength (ρ = -0.46) and 505 times (ρ = 0.45-0.48) in test session 1, and reactive strength (ρ = -0.42) and 505 time (ρ = 0.40) in test session 2. These data show that jump height asymmetry from the SLDJ was associated with reduced jump and CODS performance in youth basketball athletes during repeated test sessions. In addition, the same asymmetry metric was the only one to show substantial levels of agreement between test sessions. Owing to the consistency of these data, SLDJ height asymmetry may be a useful metric to measure when monitoring inter-limb asymmetries.

Key Words: Basketball; between-limb differences; change of direction speed; jumping.

Introduction

Inter-limb asymmetry can be defined as the difference in performance or function of one limb relative to the other (23) and has been a popular topic of investigation in recent years. For example, the prevalence of asymmetry has been reported in numerous sports such as soccer (5,10), rugby (30), cricket (7), swimming (15) and tennis (26). Furthermore, multiple testing modalities have been used to identify the prevalence of asymmetry. Force asymmetries have been shown during the back squat (33) and isometric squat and mid-thigh pull tasks (8,19). Jump tests are the most common method of detecting inter-limb differences as well with the single leg countermovement jump (SLCMJ), single leg drop jump (SLDJ) and various hop tests often used (8,12,27,28). More recently, literature has also reported side-to-side asymmetries during change of direction speed (CODS) tasks (17,18,26). Although some level of asymmetry appears almost certain regardless of the selected task, the prevalence alone does little to aid our understanding of its importance to athletic performance.

Recent research has investigated the association between jump asymmetry and measures of athletic performance. For example, Lockie et al. (25) reported inter-limb asymmetry values of 10.4% for jump height (SLCMJ), 5.1% for distance (lateral hop) and 3.3% for distance (single leg broad jump) in collegiate athletes. However, associative analysis showed no significant correlations with speed or CODS tasks. Similarly, Dos'Santos et al. (17) reported jump distance asymmetries of between 5-6% for the single and triple hop tests in male collegiate athletes, with no significant relationships evident with two CODS tasks. In contrast, Bishop et al. (10) reported significant correlations between SLCMJ height asymmetry and 5-m (r = 0.49), 10-m (r = 0.52) and 20-m (r = 0.59) sprint times in youth female soccer players. In a separate study, Bishop et al. (5) reported stronger associations between SLCMJ height asymmetry and 5-m (r = 0.60-0.86), 10-m (r = 0.54-0.87), 20-m (r = 0.56-0.79) linear sprint times, 505 on the left leg (r = 0.61-0.63) and 505 on the right leg (r = 0.71-0.85) CODS times in under-16, under-18, and under-23 elite academy soccer players. Thus, given the conflicting evidence in the literature to date, further research is warranted to fully elucidate the importance of asymmetry on athletic performance. In addition, one critical issue is that the aforementioned studies only provide data for a single test session. Previous literature has acknowledged a distinct lack of repeated monitoring for asymmetry (11,29); thus, it does pose the question as to whether any significant relationships would be repeatable.

Another emerging area in the asymmetry literature is to determine the ‘direction of asymmetry’ (29), which refers to the notion of one limb scoring consistently higher than the other (i.e., left or right). Given asymmetry is a ratio (i.e., a product of two constituent parts), it stands to reason that this line of investigation would be useful, by providing an interpretation of perceived limb dominance in a given task. Bishop et al. (6) used 28 recreational soccer and rugby athletes to investigate how consistently asymmetry favoured the same side for force and impulse metrics between the unilateral isometric squat, unilateral CMJ and unilateral broad jump tests. Kappa coefficients predominantly showed slight or poor levels of agreement, indicating that limb dominance (and therefore, the direction of asymmetry) can often vary between tasks. However, previous research has highlighted the task-specific nature of asymmetry (10,17,25,27); thus, it does not seem surprising that levels of agreement for asymmetry would be largely poor between tasks. Therefore, further research is warranted to understand the consistency of asymmetry for the same tests, between sessions. Such investigations may help to understand what is consistent asymmetry and what may simply be accounted for as fluctuations in performance variability (20).

In order to monitor physical performance and inter-limb asymmetries, several technologies such as timing-gates, force platforms or other laboratory-based equipment have been commonly used in the literature (3,7,12,14,28). Despite the common use of these methods, all have an associated cost which can be too high for practitioners with limited budgets. To combat this, smartphone apps have been recently developed to measure jumping and CODS performance (1,2,21). However, although these apps have shown excellent levels of agreement with laboratory equipment (e.g., force platforms for jumping and timing gates for CODS tasks), no study has determined the between-session consistency for the measurement of inter-limb asymmetries and their relationships with surrogate measures of athletic performance.

Thus, the aims of the present study were to: 1) quantify the magnitude and direction of asymmetry from jump and CODS tests in a test-retest design, 2) determine the relationship between these asymmetries and jump and CODS performance, again in a test-retest design. Given the conflicting evidence surrounding asymmetry, developing a true hypothesis was challenging. However, it was thought that the magnitude of asymmetry would appear consistent between test sessions, but the direction of asymmetry would highlight its variable nature. In addition, it was thought some significant correlations between asymmetry and jump/CODS performance would exist, but that these were unlikely to be consistent between test sessions.

Methods

Experimental Approach to the Problem

The present study used a test-retest design separated by 72 hours between test sessions during the pre-season period in a competitive basketball season. Each test session involved the measurement of the SLCMJ, SLDJ and 505 tests in a randomized order, to measure unilateral jump height, reactive strength and CODS performance. The selected tests have been shown to be valid for basketball athletes (32), with the use of My Jump 2™ and the CODTimer™ smartphone apps shown to be valid and reliable methods of assessing jump height [r = 0.99; ICC = 0.99] (2), reactive strength index [r = 0.94; ICC =0.95] (21) and total time during CODS performance [r = 0.96; ICC = 0.97] (1). All athletes were familiar with test protocols; thus, familiarization was deemed appropriate on the day of testing after a 10-minute standardized warm-up which consisted of jogging, dynamic stretching, and practice trials of each test at 60, 80, and 100% of perceived maximal intensity. Subjects were given five minutes rest after the completion of the warm-up and the start of data collection procedures.

Subjects

Thirty national level youth basketball athletes volunteered to participate in this study (age = 17.67 ± 1.32 years; height = 1.81 ± 0.10 m; body mass = 73.33 ± 13.34 kg). A minimum of 27 subjects was determined from a priori power analysis using G*Power (Version 3.1, University of Dusseldorf, Germany) implementing statistical power of 0.8, a type 1 alpha level of 0.05 which was able to determine an effect of 0.5. This was used to minimize the risk of type II error and has been used in comparable literature (19). Inclusion criteria required all subjects to have a minimum of at least 4 years' competitive basketball experience and at least 2 years' structured strength and conditioning training experience. No injuries were reported at the time of either test session or the preceding six weeks. For subjects over the age of 18, written informed consent was provided and for subjects under 18, written parental consent was obtained in addition to subject ascent. This study was approved by the [*deleted for peer review*] research and ethics committee.

Procedures

To analyse the jump and CODS tests, a trained sports scientist with 2 years' of experience in slow motion video apps recorded a video of each test for its analysis using the My Jump 2™ (for jump testing) and CODTimer™ apps (for change of direction testing). My Jump 2™ version 5.0 and CODTimer™ version 2.0 were installed on an iPhone X with iOS 13.0 operative system for that purpose. Those apps were designed to record videos at 240 frames per second, and to manually select the beginning and end of the movement to calculate flight (for jump testing) or sprint (for change of direction testing) times.

Single leg countermovement jump (SLCMJ). Subjects were asked to perform 3 SLCMJ on each leg, with the reported metric being jump height. An average of all trials were used for subsequent analysis, as this helped to capture some of the variation between trials and is in line with previous empirical research on asymmetry (4,28). Subjects were instructed to place their hands on hips and the jump was initiated by performing a countermovement to a self-selected depth, with further instructions to "jump as high as possible". The jumping leg was required to remain fully extended during the flight phase of the jump, with the non-jumping limb slightly flexed at the hip and knee, so that the foot was positioned just above ankle height. No swinging of the non-jumping limb was allowed. One minute of passive rest was allowed between attempts and left and right limbs were alternated until all trials were completed. A trained sports scientist recorded all the jumps by laying prone on the ground with an iPhone X facing the participants (in the frontal plane), at a distance of 1.5-m, zooming in on their feet which was consistent across all trials. All trials were evaluated by a certified strength and conditioning coach, and if any jump did not meet the aforementioned criteria, it was repeated after a 1-minute rest.

Single leg drop jump (SLDJ). Subjects performed 3 SLDJ with each leg, with the reported metrics being jump height and reactive strength index (RSI), with RSI calculated from the equation jump height/contact time. An average of all trials were used for subsequent analysis with all trials filmed using the same methods as outlined for the SLCMJ. All trials were conducted from a box height of 0.3-m, in line with previous research (31). Upon instruction, subjects stepped out from the box with their hands on their hips and landed on the same leg below, before jumping as high as possible immediately after. Specific instructions were to “minimize ground contact time and maximize jump height” in line with previous research (28). One minute of passive rest was allowed between attempts and left and right limbs were alternated until all trials were completed.

505 change of direction speed test. Subjects performed 6 repetitions of the 505 CODS test; 3 trials on their left and right legs each. Each subject started in a two-point stance 0.3-m behind the starting line of a 1.5-m wide running lane and was instructed to perform each trial “as fast as possible”, with 3 minutes of passive rest between each trial. When capturing data, a trained sports scientist placed an iPhone X in a tripod 5-m away perpendicular from the lane, and at a distance of 10-m from the starting line in the 505 test. The height of the tripod was individualized for each subject to match the height from the floor to their greater trochanter. A vertical marker (i.e., a 1.5-m stick) was placed at that 10-m distance, and the researcher in charge of the video analyses was instructed to select the first frame in which the participant crossed the vertical marker with any part of his body before and after the subsequent change of direction. That way, the time to cover the final 10-m (5+5) in the 505 was computed with the CODTimer™ app as described elsewhere (1).

Statistical Analyses

All data was initially collected in Microsoft Excel and later transferred to SPSS (version 25.0; SPSS, Inc., Armonk, NY, USA). Normality was assessed using the Shapiro-Wilk test and showed asymmetry data to not be normally distributed ($p < 0.05$). All other test data was normally distributed. Within and between-session reliability of test measures were computed using an average measures two-way random intraclass correlation coefficient (ICC) with absolute agreement and 95% confidence intervals, and the coefficient of variation (CV). Interpretation of ICC values was in accordance with previous research by Koo and Li (24) where values > 0.9 = excellent, 0.75-0.9 = good, 0.5-0.75 = moderate, and < 0.5 = poor. The CV was calculated via the formula:

(SD[trials 1–3]/average[trials 1–3]*100) with values ≤ 10% suggested to be considered acceptable (14).

Paired sample *t*-tests were used to determine differences between test sessions for fitness test data, whilst Mann-Whitney U tests were used to determine differences in asymmetry between test sessions, with alpha levels set at $p < 0.05$. Cohen's *d* effect sizes (ES: 95% confidence intervals) were also used to determine differences between test sessions, with values interpreted in line with suggestions by Hopkins et al. (22) where < 0.20 = trivial, 0.20-0.60 = small, 0.61-1.20 = moderate, 1.21-2.0 = large, 2.01-4.0 = very large, and > 4.0 = near perfect. For asymmetry, partial eta squared values were used to compute effect sizes between test sessions, owing to data not being normally distributed.

Spearman's rank order correlations (ρ) were conducted to establish the relationship between inter-limb asymmetries and fitness test scores in each test session. Bonferroni corrections were applied to all correlations to account for multiple comparisons and the familywise type I error rate, resulting in statistical significance being set at $p < 0.0125$. Correlation values were interpreted in line with suggestions from Hopkins et al. (22) where 0-0.10 = trivial, 0.11-0.30 = small, 0.31-0.50 = moderate, 0.51-0.70 = large, 0.71-0.90 = very large and 0.91-1.0 = nearly perfect.

Kappa coefficients were used to determine how consistently asymmetry favoured the same limb between test sessions, as they enable any levels of agreement that have occurred by chance to be removed (13). Values were interpreted in line with suggestions from Viera and Garrett, (34) where ≤ 0 = poor, 0.01-0.20 = slight, 0.21-0.40 = fair, 0.41-0.60 = moderate, 0.61-0.80 = substantial and 0.81-0.99 = nearly perfect. This was deemed a more appropriate measure of assessing reliability for asymmetry, because it was able to account for consistency in limb dominance between test sessions, something which the absolute asymmetry value is unable to do, owing to it being a ratio.

Results

Table 1 shows within and between-session reliability data. For relative reliability, all ICC values were good to excellent. For absolute reliability, all CV values were considered acceptable in test session 1 (CV range = 2.1-9.9%) and test session 2 (CV range = 2.2-9.8%). Slightly larger variability was seen between-sessions (CV range = 2.0-13.3%).

Table 2 shows mean test and inter-limb asymmetry scores for both test sessions. No significant differences in test or asymmetry data were evident; thus, highlighting the repeatable nature of using smartphone apps to measure jump and CODS performance. However, the SD for asymmetry was consistently high relative to the mean, indicating substantial within-group variability. Thus, Kappa coefficients were used to detect the consistency of asymmetry favouring the same limb between test sessions. Jump height asymmetry for the SLCMJ showed *fair* levels of agreement (Kappa = 0.29); jump height asymmetry for the SLDJ showed *substantial* levels of agreement (Kappa = 0.72); reactive strength asymmetry showed *fair* levels of agreement (Kappa = 0.25); and 505 asymmetry showed *slight* levels of agreement (Kappa = 0.18).

When reporting associative analysis, the only asymmetry metric to show significant relationships with fitness test scores was jump height asymmetry from the SLDJ. During test session 1, significant relationships were evident between SLDJ jump height asymmetry and SLDJ jump height on the left (r = -0.44; p = 0.008), RSI on the left (r = -0.46; p = 0.007) and 505 on the left (r = 0.45; p = 0.008) and right (r = 0.48; p = 0.005). During test session 2, significant relationships were evident between SLDJ jump height asymmetry and RSI on the left (r = -0.42; p = 0.01) and 505 on the left (r = 0.40; p = 0.012). Figures 1-4 show the individual asymmetry scores for both test sessions and clearly highlight the task-specific and individual nature of asymmetry.

***** Insert Tables 1-4 about here *****

***** Insert Figures 1-4 about here *****

Discussion

The aims of the present study were to: 1) quantify the magnitude and direction of asymmetry from jump and CODS tests in a test-retest design, 2) determine the relationship between these asymmetries and jump and CODS performance. Results showed that the magnitude of asymmetry appears consistent between test sessions; however, the direction of asymmetry exhibits notable variability. When determining the associations between asymmetry and performance tests, jump height asymmetry from the SLDJ showed significant correlations with reduced jump and CODS performance in both test sessions.

Within and between-session reliability data are presented in Table 1 and highlight that the use of smartphone applications are highly reliable for collecting unilateral vertical jump, reactive strength and CODS test data. Although in line with previous research using this technology, to the authors' knowledge, this is the first study using smartphone apps to have reported such data from unilateral jump tests. CV values were slightly greater than previously reported reliability data using these apps (1,2,21); especially for the jump testing. However, this may be because previous validation studies used bilateral jump tests and with unilateral jumping comes an inherent increase in instability; thus, an increase in variability can often be expected. However, it is worth reiterating that these within and between-session CV values are comparable from recent studies using unilateral tests on force platforms (7,8), which have shown CV values ranging from 4.2-9.7% for jump height in both the SLCMJ and SLDJ tests. Furthermore, given the good to excellent relative reliability data, it is no surprise that no significant differences were observed between test sessions (Table 2), with only trivial to small differences evident.

Table 3 shows Spearman's correlations between inter-limb asymmetry data and test scores in test sessions one and two, respectively. Jump height asymmetry from the SLDJ showed that asymmetries were negatively associated with jump height and RSI scores on the left leg of the SLDJ test. In addition, the same asymmetry metric was positively associated with 505 times on both sides. These data indicate that side-to-side differences in jump height are associated with reduced SLDJ performance (albeit on the left leg only) and slower 505 times. Explaining these findings conclusively is challenging; however, drop jumps require a very specific transition from braking (upon landing) to reapplying propulsive force (during the jump), and a similar notion could be suggested during CODS tasks. For example, during the 505 test, athletes are required to brake as they approach the 180° turn and then reapply force in order to reaccelerate again (16). Thus, it might stand to reason that if an athlete is exhibiting larger asymmetries during the SLDJ because of reduced capacity on one side (29), that this limb would find it harder to reapply propulsive forces during a timed test, such as the 505. Further to this, recent research has reported similar findings, with larger drop jump asymmetries associated with slower CODS performance in recreational (8,28) and professional cricket athletes (7). Thus, the present investigation further adds to the existing body of evidence, highlighting the detrimental association between SLDJ asymmetries and performance scores in basketball athletes.

Where the present study improves on the majority of literature in this regard, is that the association between asymmetry and fitness testing scores was repeated for a second test session (Table 4), noting that previous literature has highlighted that all comparable literature has only been conducted over a single time point (11). Similar to session 1, jump height asymmetry was significantly associated with reduced RSI and 505 performance, but only on the left leg. These data do provide some indication that jump height asymmetries from the SLDJ test are consistently associated with reduced physical performance. This can likely be explained from the Kappa Coefficient value, which was the only metric to show *substantial* levels of agreement (Kappa = 0.72), in the direction of asymmetry. Essentially, this means that asymmetry regularly favoured the same limb between test sessions, highlighting the consistent nature of limb dominance for SLDJ height as a metric. Again, although somewhat challenging to fully explain, it maybe that the complexity of performing a SLDJ task, negates room for multiple compensation strategies (27). In contrast, all other asymmetry metrics showed only *slight* to *fair* levels of agreement (Kappa range = 0.18-0.29), highlighting the variable nature of asymmetry, which is in line with previous findings (6,7,8,17,25,27). Further to this, this varying nature in the direction of asymmetry may also provide some reasoning as to why no significant correlations were evident between asymmetry metrics from the SLCMJ and 505 tests, and fitness testing scores.

Figures 1-4 show individual data for each asymmetry metric in both test sessions and clearly highlights the varying magnitude and direction of asymmetry for each subject. Given the inherent variability of asymmetry, this raises the question of how to interpret such data. Previous literature has suggested that an asymmetry may only be considered ‘real’ if greater than the test variability value (20), which in this instance is represented by the CV. Thus, any athlete who shows bars beyond the dashed lines in Figures 1-4, are likely to be exhibiting meaningful side-to-side differences. In addition, given SLDJ height asymmetry was the most consistent asymmetry metric (Kappa = 0.72) and the only one to be associated with reduced physical performance in both test sessions, it seems prudent to suggest that the reduction of inter-limb asymmetries in this sample of basketball athletes is warranted.

There are a couple of limitations that should be acknowledged in the present study. Firstly, given this study used smartphone applications, the data only relates to outcome measures and provides no understanding of task strategy. Given the consistency of the results from the SLDJ height, a more mechanistic investigation of side-to-side differences using this test would be a useful line of future research, especially given the number of studies which have reported significant associations between DJ asymmetry and reduced physical performance (7,8,28). Secondly, this study provided no measurement of strength asymmetry. Previous research has highlighted that improvements in strength are an effective way of reducing inter-limb deficits (3); thus, future research should also aim to measure force asymmetries where possible and determine associations with physical performance.

Practical Applications

These data highlight the cost-effective nature of obtaining reliable unilateral jump and CODS data using smartphone apps, when force plates and timing gates are unavailable. This is supported in the present study from test scores which showed only trivial to small differences between test sessions. Thus, the consistency of jump height, RSI and subsequent asymmetry data, can be reliably and accurately quantified if consistent and robust measures of data collection are adhered to using these smartphone apps. This enables practitioners to use quantitive methods to assess their athletes’ physical capacity and between-limb asymmetry during routine fitness testing sessions, even when limited by financial constraints.

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Table 1. Within and between-session relative (ICC) and absolute (CV) reliability data.

Fitness Test	Test Session 1		Test Session 2		Between-Session	
	ICC (95% CI)	*CV (%)*	*ICC (95% CI)*	*CV (%)*	*ICC (95% CI)*	*CV (%)*
SLCMJ:						
Jump height-L	0.96 (0.92-0.98)	9.0	0.97 (0.93-0.98)	8.4	0.97 (0.93-0.98)	7.0
Jump height-R	0.97 (0.93-0.98)	8.5	0.91 (0.83-0.96)	9.2	0.93 (0.85-0.97)	8.9
SLDJ:						
Jump height-L	0.97 (0.95-0.99)	9.9	0.98 (0.96-0.99)	9.5	0.98 (0.96-0.99)	10.0
Jump height-R	0.96 (0.91-0.98)	9.5	0.97 (0.95-0.99)	9.8	0.96 (0.91-0.98)	13.3
RSI-L	0.93 (0.86-0.97)	9.7	0.86 (0.74-0.93)	9.2	0.90 (0.80-0.95)	9.1
RSI-R	0.90 (0.80-0.95)	9.7	0.91 (0.82-0.95)	7.8	0.83 (0.66-0.92)	10.2
CODS:						
505-L	0.91 (0.83-0.96)	2.9	0.92 (0.85-0.96)	2.2	0.84 (0.71-0.94)	2.4
505-R	0.93 (0.86-0.97)	2.1	0.93 (0.86-0.97)	2.4	0.94 (0.87-0.97)	2.0

ICC = intraclass correlation coefficient; CI = confidence intervals; CV = coefficient of variation; L = left; R = right; SLCMJ = single leg countermovement jump; RSI = reactive strength index; CODS = change of direction speed.

Table 2. Mean test and inter-limb asymmetry data ± standard deviations (SD), between-session Cohen's *d* effect sizes with 95% confidence intervals and partial eta squared effect sizes.

Fitness Test	Mean Test Scores			Asymmetry %		
	Session 1	*Session 2*	*Cohen's d (95% CI)*	*Session 1*	*Session 2*	*Partial Eta Squared*
SLCMJ:						
Jump height-L (m)	13.67 ± 5.40	13.72 ± 5.87	0.01 (-0.50 to 0.51)	10.64 ± 8.56	10.93 ± 9.17	< 0.01
Jump height-R (m)	14.15 ± 5.30	13.34 ± 4.74	-0.16 (-0.67 to 0.35)			
SLDJ:						
Jump height-L (m)	11.61 ± 6.02	10.98 ± 5.69	-0.11 (-0.61 to 0.40)	14.28 ± 10.28	11.07 ± 9.44	-0.03
Jump height-R (m)	12.10 ± 5.86	11.34 ± 5.66	-0.13 (-0.64 to 0.37)			
RSI-L	0.78 ± 0.22	0.74 ± 0.20	-0.19 (-0.70 to 0.32)	10.19 ± 7.22	9.24 ± 7.74	< 0.01
RSI-R	0.83 ± 0.23	0.77 ± 0.20	-0.28 (-0.79 to 0.23)			
CODS:						
505-L (s)	2.85 ± 0.24	2.86 ± 0.25	0.04 (-0.47 to 0.55)	3.27 ± 2.66	2.60 ± 1.79	-0.02
505-R (s)	2.80 ± 0.23	2.84 ± 0.25	0.17 (-0.34 to 0.67)			

CI = confidence intervals; L = left; R = right; SLCMJ = single leg countermovement jump; RSI = reactive strength index; CODS = change of direction speed.

Table 3. Spearman's (ρ) correlations between asymmetry data and raw jump and change of direction speed data in test session 1.

	SLCMJ		SLDJ				CODS	
Asymmetry Metric (%)	*JH (left)*	*JH (right)*	*JH (left)*	*JH (right)*	*RSI (left)*	*RSI (right)*	*505 (left)*	*505 (right)*
SLCMJ-JH	-0.37	-0.20	-0.31	-0.29	-0.28	-0.24	0.25	0.34
SLDJ-JH	-0.22	-0.35	-0.44*	-0.37	-0.46*	-0.38	0.45*	0.48*
SLDJ-RSI	0.01	-0.05	-0.10	-0.02	-0.20	-0.01	0.07	0.23
505	0.07	0.03	0.23	0.09	0.11	0.16	0.19	-0.09

* significant at $p < 0.0125$.

SLCMJ = single leg countermovement jump; SLDJ = single leg drop jump; CODS = change of direction speed; JH = jump height; RSI = reactive strength index.

Table 4. Spearman's (ρ) correlations between asymmetry data and raw jump and change of direction speed data in test session 2.

	SLCMJ		SLDJ				CODS	
Asymmetry Metric (%)	*JH (left)*	*JH (right)*	*JH (left)*	*JH (right)*	*RSI (left)*	*RSI (right)*	*505 (left)*	*505 (right)*
SLCMJ-JH	0.10	0.01	0.11	0.06	0.14	0.08	-0.12	-0.07
SLDJ-JH	-0.17	-0.17	-0.26	-0.14	-0.42*	-0.26	0.40*	0.36
SLDJ-RSI	-0.04	-0.03	-0.05	0.01	-0.23	-0.03	0.04	0.01
505	-0.17	-0.30	-0.19	-0.25	-0.19	-0.28	0.35	0.30

* significant at $p < 0.0125$.

SLCMJ = single leg countermovement jump; SLDJ = single leg drop jump; CODS = change of direction speed; JH = jump height; RSI = reactive strength index.

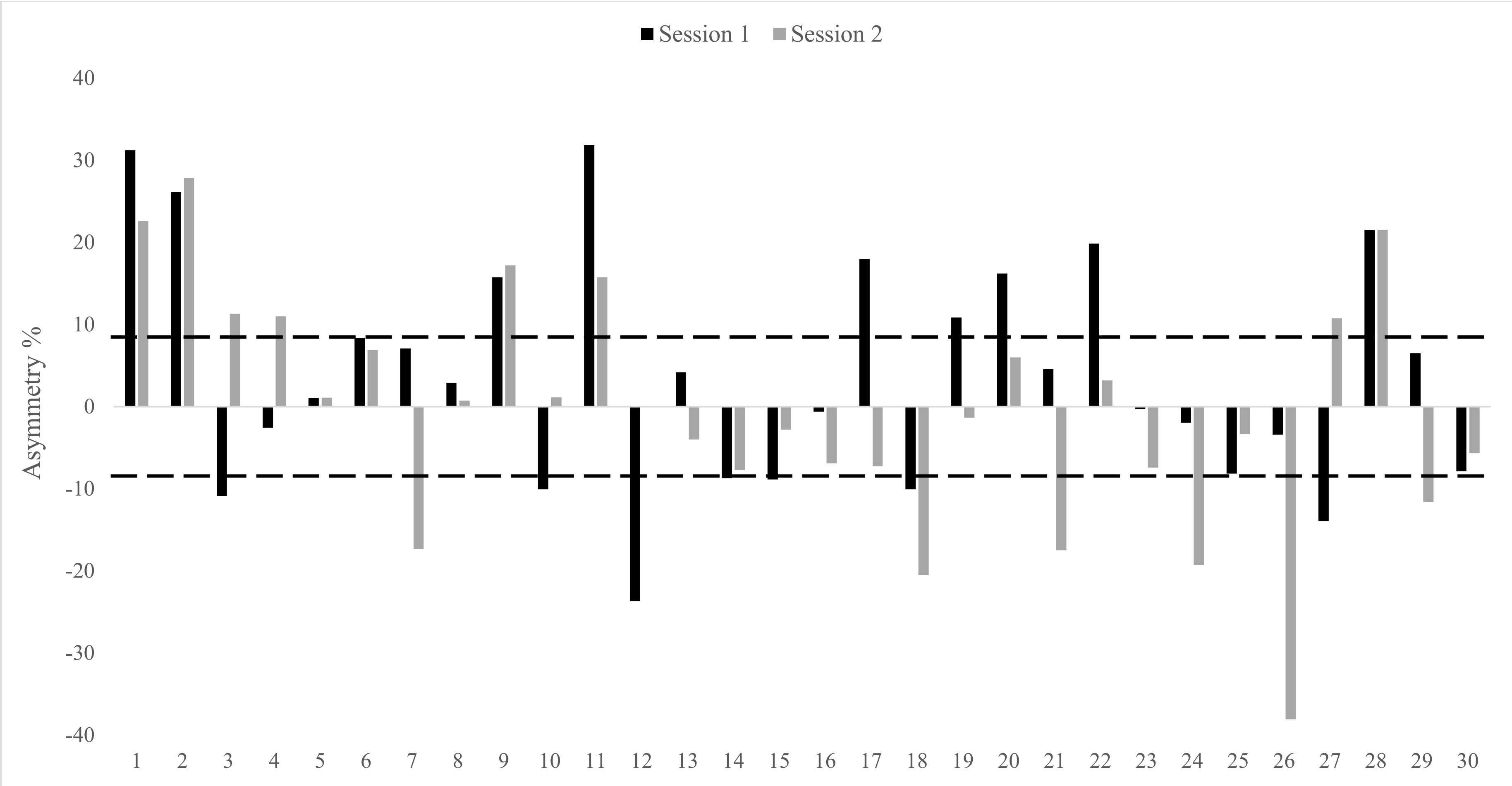

Figure 1. Individual inter-limb asymmetry data for jump height during the single leg countermovement jump. Above 0 means the asymmetry favours the right limb and below 0 means asymmetry favours the left limb. Dashed lines indicates the largest between-session CV value (8.9%).

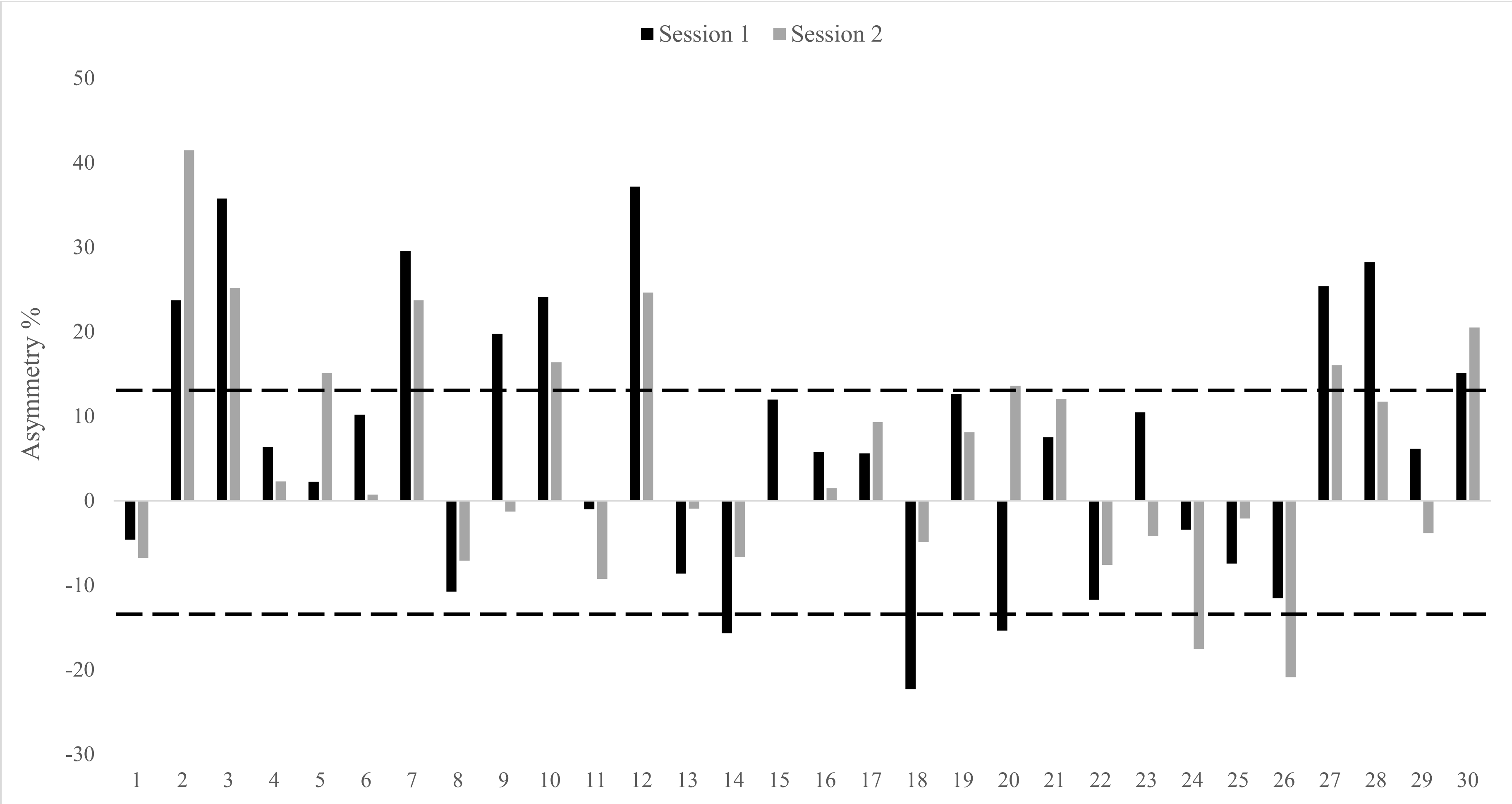

Figure 2. Individual inter-limb asymmetry data for jump height during the single leg drop jump. Above 0 means the asymmetry favours the right limb and below 0 means asymmetry favours the left limb. Dashed lines indicates the largest between-session CV value (13.3%).

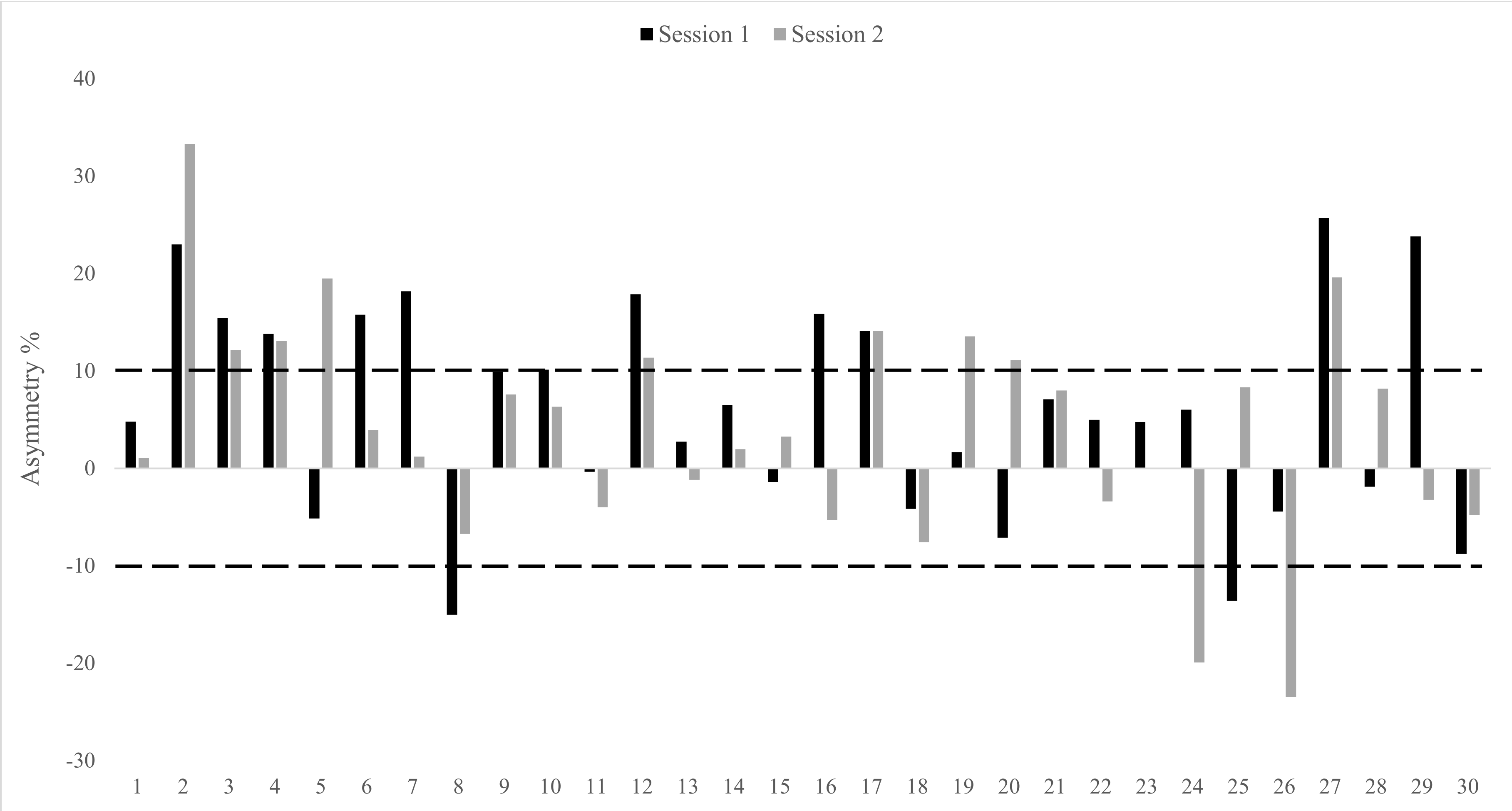

Figure 3. Individual inter-limb asymmetry data for reactive strength during the single leg drop jump. Above 0 means the asymmetry favours the right limb and below 0 means asymmetry favours the left limb. Dashed lines indicates the largest between-session CV value (10.2%).

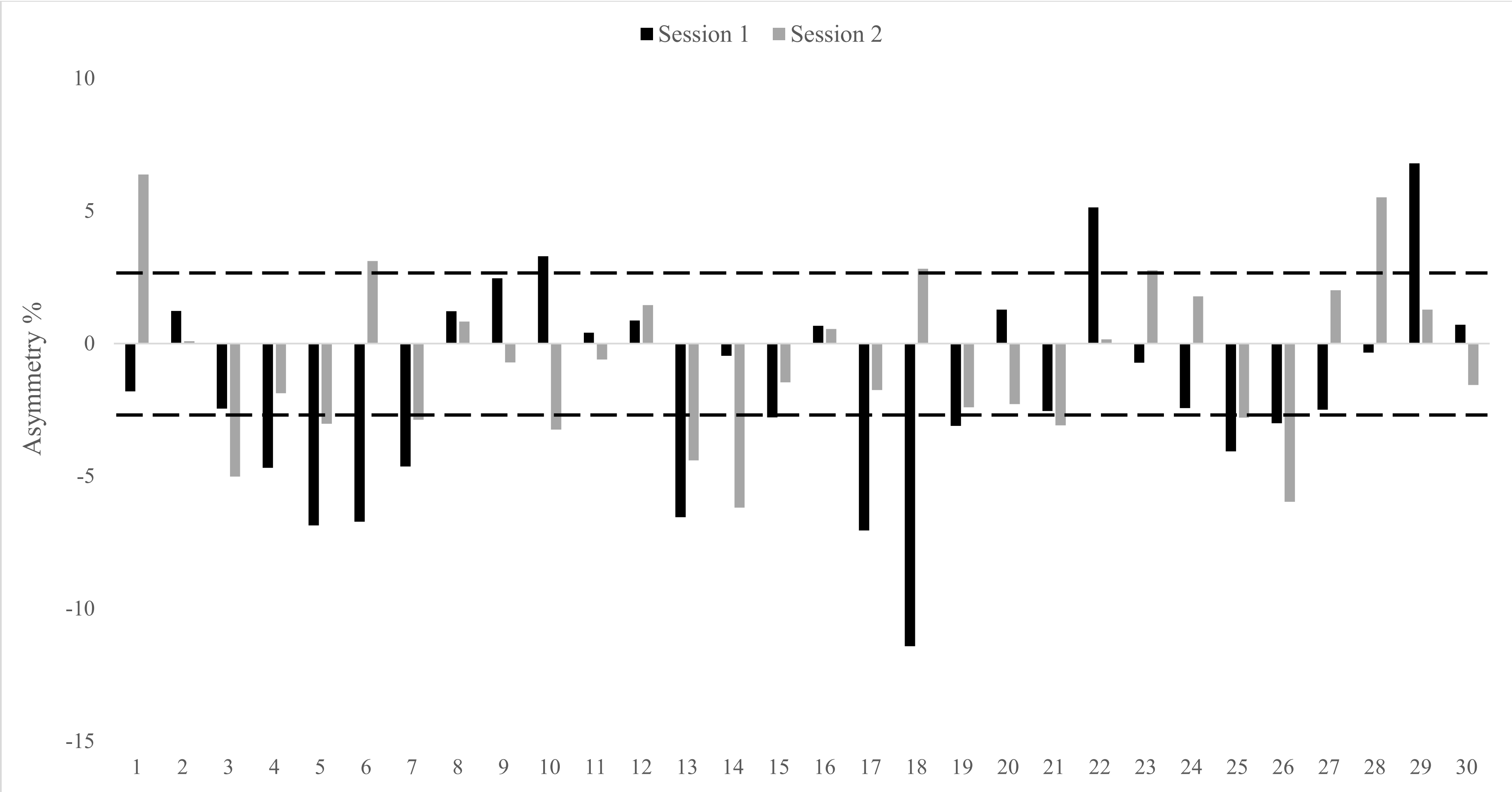

Figure 4. Individual inter-limb asymmetry data for total time during the 505 test. Above 0 means the asymmetry favours the right limb and below 0 means asymmetry favours the left limb. Dashed lines indicates the largest between-session CV value (2.4%).