

THE RELIABILITY OF THREE VARIATIONS OF AN ISOMETRIC PUSHUP TO MEASURE UPPER BODY INTERLIMB ASYMMETRIES



College for Health,
Community and Policy

¹Matthew P. Gonzalez, PhD, CSCS*D, ¹Maya Schell, BS, ²Martin Dietze-Hermosa, PhD, CSCS*D, ³Samuel Montalvo, PhD, CSCS*D, CPSS & ¹Sandor Dorgo, PhD, CSCS*D, FNCSA

¹The University of Texas at San Antonio, San Antonio TX, ²Brigham Young University – Idaho, Rexburg, ID, ³Wu Tsai Human Performance Alliance, Stanford Medicine, Stanford University, CA



INTRODUCTION

- Interlimb asymmetries are often examined to determine their relationship with athletic performance predominantly through lower body assessments.
- While researchers have examined muscular strength asymmetries in the upper body, these have been conducted through single joint movements
- This may be due to a lack of multi-joint movements that can be utilized for this assessment.

PURPOSE

- To examine if an isometric pushup can provide reliable within- and between- session measurements of upper body strength asymmetries.

METHODS

- A group of 25 recreationally active individuals (male = 14, female = 11) participated in this study.
- Attended three sessions consisting of a familiarization session and two testing sessions.
- During each session, participants performed three trials of an isometric pushup with two to three minutes of rest between trials.
- These were conducted using three different set ups consisting of a fully lowered position (elbows ~45 degrees), an approximately halfway lowered position (elbows ~90 degrees), and the starting position of a pushup with elbows fully extended (~180 degrees).
- These isometric pushups were conducted with the individual's hands on separate force platforms pressing against the force platforms while a strap was fixed to the upper portion of the participants back holding the individual in place. (See Figure 1).

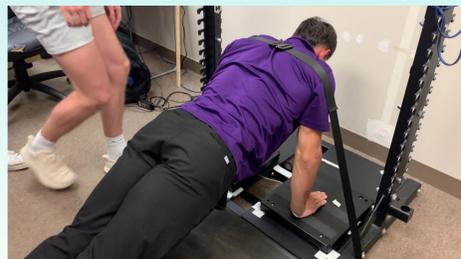


Figure 1. Illustrates the testing set up for isometric pushup.

Statistical Analysis

- From these trials, the peak force produced of each limb was determined, and the interlimb asymmetry was quantified using the symmetry index equation $[(\text{higher value} - \text{lower value}) / \text{total} * 100]$.
- Using these asymmetries, within- and between- session reliability was quantified using two-way random effects intraclass correlations (ICC_{2,k}) and coefficient of variation (CV).
- Additionally, kappa coefficients were quantified to examine the level of agreement for the direction (dominant limb) of the asymmetries both within- and between- sessions.

RESULTS

- The fully lowered isometric pushup displayed moderate within-session reliability (ICC = 0.59-0.75) as well as between session reliability (ICC = 0.70) with acceptable variability (CV= <10%) (See Table 1 & Table 2)
- Additionally, the other two variations had good to excellent within- (ICC = 0.80-0.93) and between session reliability (ICC = 0.85-0.93) and acceptable variability (CV<10%).
- All three variations displayed moderate to substantial level of agreement within- (Kappa coefficient = 0.45-0.83) and between- sessions (Kappa coefficient = 0.45-0.58) (See Table 3).

Table 1. Illustrates the within-session reliability of the isometric pushup peak force asymmetry measures.

	Session 1				Session 2			
	ICC _{2,k}	Lower 95% CI	Upper 95% CI	CV %	ICC _{2,k}	Lower 95% CI	Upper 95% CI	CV %
~45 Degrees	0.756	0.529	0.884	1.033	0.599	0.226	0.810	0.814
~90 Degrees	0.918	0.842	0.961	0.843	0.933	0.870	0.968	0.226
~180 Degrees	0.914	0.833	0.959	0.866	0.800	0.614	0.905	0.695

ICC = Intraclass Correlation Coefficient; CV = Coefficient of Variation; CI = Confidence Interval

Table 2. Illustrates the between-session reliability of the isometric pushup peak force asymmetry measures.

	Between Session			
	ICC _{2,k}	Lower 95% CI	Upper 95% CI	CV %
~45 Degrees	0.704	0.480	0.852	1.126
~90 Degrees	0.932	0.880	0.966	0.953
~180 Degrees	0.852	0.741	0.926	0.787

ICC = Intraclass Correlation Coefficient; CV = Coefficient of Variation; CI = Confidence Interval

Table 3. Illustrates the level of agreement for the direction of the peak force asymmetries.

	Session 1 Average Kappa Coefficient	Session 2 Average Kappa Coefficient	Between Sessions Average Kappa Coefficient
~45 Degrees	0.592 (Moderate)	0.459 (Moderate)	0.488 (Moderate)
~90 Degrees	0.601 (Substantial)	0.628 (Substantial)	0.527 (Moderate)
~180 Degrees	0.839 (Almost Perfect)	0.700 (Substantial)	0.581 (Moderate)

CONCLUSION

- The isometric pushup provides reliable within- and between-session measures of peak force interlimb asymmetries.
- Additionally, this assessment appears to display good levels of agreement for the direction of asymmetries.

PRACTICAL APPLICATIONS

- The isometric pushup can provide practitioners a new method of determining upper body strength asymmetries and may have the potential to be a new monitoring tool for practitioners.