

Comparing Lower Limb Characteristics in Jumping Athletes and Non-Athletes during Single-Leg Drop Landing Tasks: Implication for Anterior Cruciate Ligament (ACL) Injury Prevention

Miss TAI Wing Yi, BSocSc (Hons) in Sports and Recreation Management,
Department of Sport and Recreation
Supervisor: Mr HO Man Kit Indy, Assistant Professor

Background



ACL injuries are common in sports involving jumping and pivoting actions (Pontillo et al., 2021).

Single-leg drop landings are associated with an elevated risk of non-contact ACL injuries (Nedergaard et al., 2022). Dual-task scenarios can impact landing performance and increase ACL injury risk (Talarico et al., 2019). Biomechanical factors such as dynamic knee valgus and stiff landings (Larwa et al., 2021).

Integrating Inertial Measurement Units (IMU) with force plates (FP) can enhance the analysis of kinematics and kinetics during jump-landing tasks (Van den Tillaar et al., 2021).

Purpose



- Assessing potential ACL injury risk during single-leg drop landing with and without dual tasks
- Comparing biomechanical differences between jumping athletes and non-athletes

Methods



- Repeated measures designed with conditions in a random order
- Two-way repeated measures ANOVA > Post hoc & effect size
- 26 subjects were jumping athletes (n=13) and non-athletes (n=13) with no musculoskeletal conditions
- Familiarization session with IMU and FP
- Drop landing from 30cm height (Dominant leg)



Task 1
Single-leg drop landing (SLL)

Task 2
SLL with a dual task (DT):
Ball Catching



Results



Interaction Effect between subject groups and task conditions

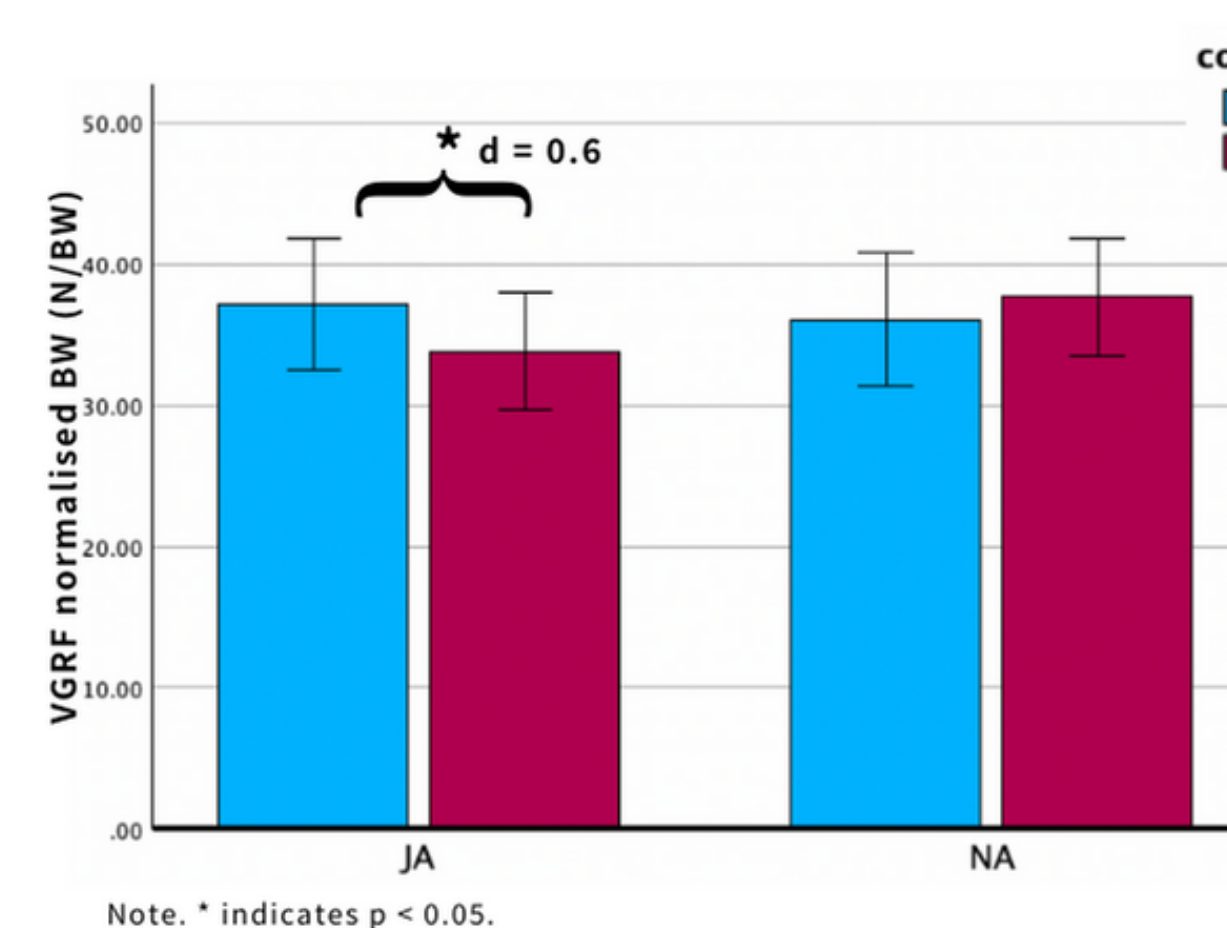
Peak Vertical Ground Reaction Force (vGRF)

- No significant difference was found between groups
- A significant difference was found between conditions

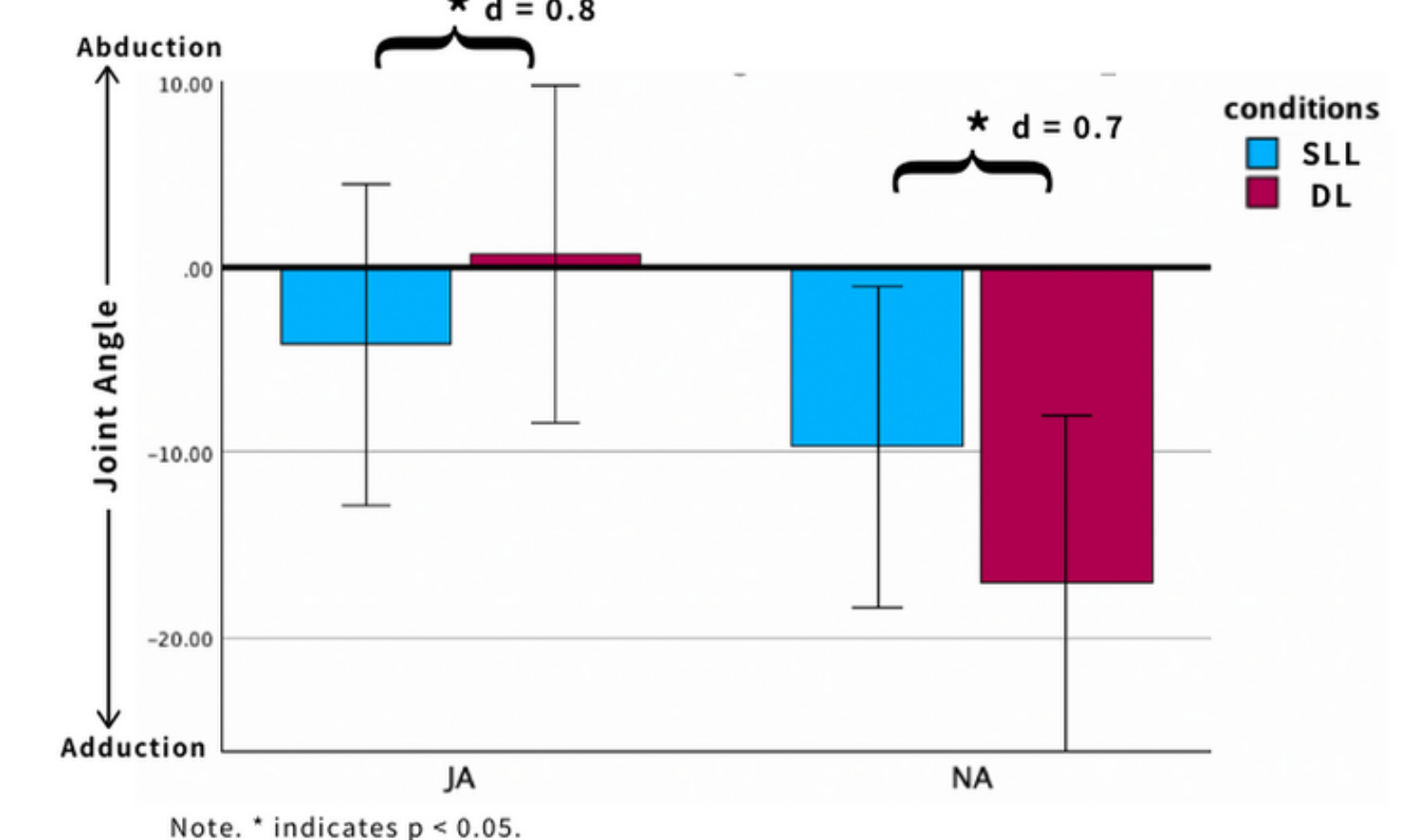
Hip Abduction/Adduction Angle

- A significant difference was found between groups
- A significant difference was found between conditions

Peak Vertical Ground Reaction Force



Hip Abduction/Adduction Angle



Discussion



Jumping Athletes

Lower peak vGRF, Higher hip abduction degrees in DT

- Softer landing with more knee flexion (Milner et al., 2012)
- Better pre-motor cortex control (Piskin et al., 2022)
- Lower cognitive-motor interference effort, Faster reaction time (Al-Yahya et al., 2011)
- Maintain hip angles, and prevent stiff landing (Larwa et al., 2021)

➤➤ Reducing potential risk of ACL injury

Non-athletes (NA)

Higher peak vGRF, Higher hip adduction degrees in DT

- Potentially greater stress on their lower extremities
- Indicating knee valgus motion and potential deficits in neuromuscular control (Piskin et al., 2022; Wilczyński et al., 2020)
- Added cognitive demands can further disrupt movement coordination & compromise landing mechanics (Lustig et al., 2023)

➤➤ Increased potential risk of ACL injury

Practical Application



Due to NA results, integrating neurocognitive tasks into training can enhance neuromuscular control and reduce ACL injury risk. Dual-task exercises improve athletes' ability to maintain optimal landing mechanics under cognitive demands. Further research can study the effect and effort of cognitive tasks on lower peak vGRF.

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