

The Relationship Between Isometric Hip Strength and Incidence of Noncontact ACL injuries in Female Athletes: A Critically Appraised Topic



Cayla A. Lee, ATS, Jessica L. Jacobs, ATS, Jennifer L. Volberding, PhD, LAT, ATC, NREMT

Department of Athletic Training

INTRODUCTION

Noncontact ACL injuries are prevalent among athletes in multi-planar sports, but especially among female athletes. Hip strength may be a factor that contributes to the incidence of noncontact ACL injuries because of the dynamic movement patterns it creates at the knee.

FOCUSED CLINICAL QUESTION

Does hip strength impact the incidence of noncontact ACL injuries in female athletes?

SEARCH STRATEGY

Sources: Science Direct and PubMed

Search Terms: hip strength, noncontact ACL

Inclusion Criteria: incidence of ACL injury as the outcome, gluteus maximus or gluteus medius strength, hip abduction strength and/or hip external rotation strength, studies within the last 10 years (2012-2022), articles in the English language only

Exclusion Criteria: ACL post-operative cases, patellofemoral pain, knee osteoarthritis, bracing or taping interventions, return to sport or play, knee injury indicators as the main outcome

EVIDENCE OF QUALITY ASSESSMENT

Level 3 evidence, as determined by the Oxford Centre for Evidence-Based Medicine,⁹ that assessed measurements of hip strength and the relationship to the incidence of noncontact ACL injuries was considered for inclusion. Three prospective cohort studies^{10,11,13} were included in this study and are outlined in Table 1.

RESULTS

One study found that a lower isometric hip adductor to abductor ratio was associated with noncontact ACL injuries. Two studies found that subjects who sustained noncontact ACL injuries had greater isometric hip strength measures.

TABLE 1: SUMMARY OF BEST EVIDENCE

Authors	Participants	Injury risk factors investigated	Outcome measures	Main findings
Collings et. al. ¹⁰	322 elite junior and senior female Australian Rules Football and soccer players (149 Australian Rules Football players, 44 senior soccer players from the women's league, 84 junior soccer players from state representative Under-17 teams)	Knee Injury and Osteoarthritis Outcome Score (KOOS) (pain and sport/rec subsections); isometric hip adductor (ADD) strength (N); isometric hip abductor (ABD) strength (N); isometric hip ADD:ABD ratio; eccentric knee flexor strength (N); Countermovement jump (CMJ) kinetics; hop kinematics	New ACL injuries from a noncontact mechanism (included index injuries, reinjuries (on same side and contralateral side), and injuries sustained from tackling (subsequent noncontact mechanism as a result of a tackle), landing, or changing direction) from 2019 to 2021; data was collected 18 months after the baseline testing	There were 15 subjects that suffered from a noncontact ACL injury; 10 were first-time injuries, 1 was a reinjury to a previous ACLR, and 4 were injuries to the contralateral side of a previous ACL injury; 12 of these injuries were due to change of direction Isometric hip adduction strength ($P=0.149$) and isometric hip abduction strength ($P=0.658$) as separate risk factors did not have a significant effect on the incidence of ACL injury; Lower isometric hip adductor to abductor strength ratio was associated with an increased incidence of ACL injury ($P=0.022$); $P<0.05$
Steffen et. al. ¹¹	867 Norwegian elite female handball and football players (420 handball players, 447 football players)	Isokinetic knee extension torque (N^*m); isokinetic knee flexion torque (N^*m); Hamstring to quadriceps (H:Q) concentric strength ratio; isometric hip abduction strength (kg); functional lower extremity (LE) strength (one-repetition maximum on a seated leg press machine) (kg)	New noncontact/indirect contact ACL injuries (included index injuries and reinjuries) from 2007 to 2015	There were 80 total ACL injuries total; 67 index (first-time) injuries were recorded, 11 subjects had second ACL injuries, and 1 subject had three; 58 of these 67 index injuries were noncontact/indirect contact, but only 57 subjects' data were included in analysis Isometric hip abduction strength of all ACL injured legs was not significantly different from the non-injured legs ($P=0.10$); In the handball players specifically, there was a significant difference in isometric hip abduction strength between ACL injured and uninjured legs ($P=0.03$) with ACL injured legs having greater strength; $P<0.05$
Shimozaki et. al. ¹³	171 15-year-old female Japanese high-school basketball players	Anatomical assessments (height, body weight, body mass index (BMI), anterior knee laxity, general joint laxity, femoral anteversion, navicular drop); isometric hip abductor strength (Nm/kg); maximal knee flexion strength (nm/kg); maximal knee extension strength (Nm/kg); static balance	New noncontact ACL injuries (excluded ACL injuries that occurred from contact and bilateral ACL injuries) from 2009 to 2011	There were 16 ACL injuries across 15 subjects; 2 injuries were caused by contact and 1 subject had bilateral ACL injuries; 12 noncontact ACL injuries were recorded, 10 occurred after cutting and 2 occurred after landing Hip abductor strength was significantly greater in athletes that suffered an ACL injury ($P=0.04$); $P<0.05$

CLINICAL BOTTOM LINE

The evidence suggests that greater isometric hip strength and poor isometric hip adductor to abductor strength ratio may be a risk factor that is associated with noncontact ACL injuries in female athletes. Future research should continue to study the impact that hip strength has on the incidence of noncontact ACL injuries, across all genders, and why.

REFERENCES

- Larwa J, Stoy C, Chafetz RS, Boniello M, Franklin C. Stiff Landings, Core Stability, and Dynamic Knee Valgus: A Systematic Review of Documented Anterior Cruciate Ligament Ruptures in Male and Female Athletes. *Int J Environ Res Public Health*. 2021;18(7):3826. doi:10.3390/ijerph18073826
- Edison BR, Pandya N, Patel NM, Carter CW. Sex and Gender Differences in Pediatric Knee Injuries. *Clin Sports Med*. 2022;41(4):769-787. doi:10.1016/j.csm.2022.06.002
- Montalvo AM, Schneider DK, Yut L, et al. "What's my risk of sustaining an ACL injury while playing sports?" A systematic review with meta-analysis. *Br J Sports Med*. 2019;53(16):1003-1012. doi:10.1136/bjsports-2016-096274
- Ellison TM, Flagstaff I, Johnson AE. Sexual Dimorphisms in Anterior Cruciate Ligament Injury: A Current Concepts Review. *Orthop J Sports Med*. 2021;9(12):23259671211025304. Published 2021 Dec 17. doi:10.1177/23259671211025304
- Alentorn-Geli E, Myer GD, Silvers HJ, et al. Prevention of non-contact anterior cruciate ligament injuries in soccer players. Part 1: Mechanisms of injury and underlying risk factors. *Knee Surg Sports Traumatol Arthrosc*. 2009;17(7):705-729. doi:10.1007/s00167-009-0813-1
- Dix J, Marsh S, Dingemans B, Malliaras P. The relationship between hip muscle strength and dynamic knee valgus in asymptomatic females: A systematic review. *Phys Ther Sport*. 2019;37:197-209. doi:10.1016/j.ptsp.2018.05.015
- Wilczyński B, Zorena K, Słezak D. Dynamic Knee Valgus in Single-Leg Movement Tasks. Potentially Modifiable Factors and Exercise Training Options. A Literature Review. *Int J Environ Res Public Health*. 2020;17(21):8208. doi:10.3390/ijerph17218208
- Alzahrani AM, Alzahrani M, Alshahrani SN, Alghamdi W, Alqahtani M, Alzahrani H. Is Hip Muscle Strength Associated with Dynamic Knee Valgus in a Healthy Adult Population? A Systematic Review. *Int J Environ Res Public Health*. 2021;18(14):7669. doi:10.3390/ijerph18147669
- OCEBM levels of evidence. Centre for Evidence-Based Medicine (CEBM), University of Oxford. <https://www.cebm.ox.ac.uk/resources/levels-of-evidence/ocebml-levels-of-evidence>. Published October 1, 2020. Accessed December 10, 2022.
- Collings TJ, Diamond LE, Barrett RS, et al. Strength and Biomechanical Risk Factors for Noncontact ACL Injury in Elite Female Footballers: A Prospective Study. *Med Sci Sports Exerc*. 2022;54(8):1242-1251. doi:10.1249/MSS.0000000000002908
- Steffen K, Nilstad A, Kristianslund EK, Myklebust G, Bahr R, Krosshaug T. Association between Lower Extremity Muscle Strength and Noncontact ACL Injuries. *Med Sci Sports Exerc*. 2016;48(11):2082-2089. doi:10.1249/MSS.0000000000001014
- Khayambashi K, Ghoddosi N, Straub RK, Powers CM. Hip Muscle Strength Predicts Noncontact Anterior Cruciate Ligament Injury in Male and Female Athletes: A Prospective Study. *Am J Sports Med*. 2016;44(2):355-361. doi:10.1177/0363546515616237
- Shimozaki K, Nakase J, Takata Y, Shima Y, Kitaoka K, Tsuchiya H. Greater body mass index and hip abduction muscle strength predict noncontact anterior cruciate ligament injury in female Japanese high school basketball players. *Knee Surg Sports Traumatol Arthrosc*. 2018;26(10):3004-3011. doi:10.1007/s00167-018-4888-4
- Hollman JH, Beise NJ, Fischer ML, Stecklein TL. Hip extensor fatigue alters hip and knee coupling dynamics during single-limb step-downs: A randomized controlled trial. *J Biomech*. 2020;100:109583. doi:10.1016/j.jbiomech.2019.109583