


# Relationship between hip muscle strength and lower extremity injuries in soccer players: Systematic review



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## ABSTRACT

The objective of this review was to analyse the relationship between hip strength and lower extremity injuries in soccer players. PubMed, Scopus and WOS databases were reviewed. The initial search yielded a total of 613 studies, of which 6 were selected. The studies evaluated the movements of hip adduction, abduction, flexion and extension, in different positions, through dynamometry, concluding that the decrease in hip strength is a risk factor for lower extremity injuries in youth and professional soccer players, which can be determined through isometric, concentric, and eccentric strength testing.

**Keywords:** Lower extremity injury, Isokinetic strength, Football, Muscle strength.

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## INTRODUCTION

Soccer is characterized by being a sport that demands great physical abilities in its athletes, which they must maintain during their sports career (Turner and Stewart, 2014). Being a soccer player implies having the strength and muscular power necessary to kick a ball, execute changes of direction, perform jumps and high-intensity runs (Rønnestad et al., 2008). On the other hand, having high levels of muscular strength is directly related to a decrease in musculoskeletal injuries produced during training and competition (Turner and Stewart, 2014).

Currently, the rate of injuries in football is high, with an incidence of 8.1 injuries per 1,000 hours of exposure, with the lower extremities being the most frequent location, with an incidence of 6.8 injuries per 1,000 hours of exposure. (López-Valenciano et al., 2020). However, the cause of injuries has a multifactorial origin, that is, there are many risk factors that can generate injuries (Pfirrmann et al., 2016) and the best way to prevent them is through the development of muscle strength (Turner and Stewart, 2014).

Within the muscles of the lower limb, the hip plays an important role in sports performance (Serin, 2017), having high levels of muscle strength in flexors (Deane et al., 2005) and hip extensors (Neto et al., 2019) improves the technical gesture and decreases race times. On the other hand, having high levels of muscle strength in the hip abductors and adductors improve stabilization and changes of direction (Karatrantou et al., 2019). However, these muscles are not only related to better performance on the field of play, but they also seem to play a key role in injury prevention (Thorborg et al., 2011), and may be the cause of hamstring injury. when there is an imbalance between hip flexors and extensors (Askling et al., 2007) and origin of adductor injury (Lavoie-Gagne et al., 2021) when there is a strength deficit in this muscle group.

Therefore, the objective of this review was to determine the relationship described in the literature between hip muscle strength and lower extremity injuries in amateur and professional soccer players, in order to establish strategies to reduce the rate injury and maintain or improve athletic performance.

## METHODOLOGY

### **Search strategy**

The search was carried out during the months of May to July 2021, applying the guidelines established in the PRISMA declaration (Page et al., 2021). This review does not have a registration protocol number. The databases used were PubMed, Scopus, Web of Science, selecting articles with an age of 10 years, from May 2011 to May 2021. The following MeSh terms in English combined with different Boolean operators were used "*(Muscle strength OR Muscle strength dynamometer) AND (injuries) AND (Lower extremity OR Lower Limb) AND (Soccer)*". The search was limited to clinical trials and observational studies available in full text, in English and Spanish. Four authors examined the title and Summary of the articles found (A.Y.), (C.P.), (E.A.), (F.B). If there was uncertainty about the eligibility of an article, the opinion of a fifth reviewer (G.C.) was used to reach a consensus.

### **Eligibility criteria**

The inclusion criteria were a) clinical trials and observational studies, b) amateur or high-performance soccer players, c) both genders, d) ages 15 to 35 years, e) and that the intervention included muscle strength assessments. of hip quantified by dynamometer, together with the relationship with injuries in lower extremities. Lectures, presentations, literature reviews, subjects with surgical interventions or acute injuries, and studies that did not relate hip strength to lower extremity injuries were excluded. (Table 1).

Table 1. Eligibility criteria for study selection.

Topic	Inclusion criteria
Participants	Amateur or high-performance soccer players of both sexes from 15 to 35 years old.
Intervention	Hip muscle strength assessment by dynamometry.
Comparison	Does not exist.
Outcome or result	Relationship of lower extremity injuries.
Design	Clinical studies and randomized experimental trials.
Topic	Exclusion criteria
Participants	Soccer players with acute injury.
Intervention	Surgical interventions.
Design	Conferences, presentations and bibliographic reviews.

**Methodological quality assessment**

The methodological quality of the studies was evaluated through the PEDro scale, which consists of 11 criteria to determine the internal quality of the studies and identifies enough statistical information to know that the results are interpretable (Maher et al., 2003).

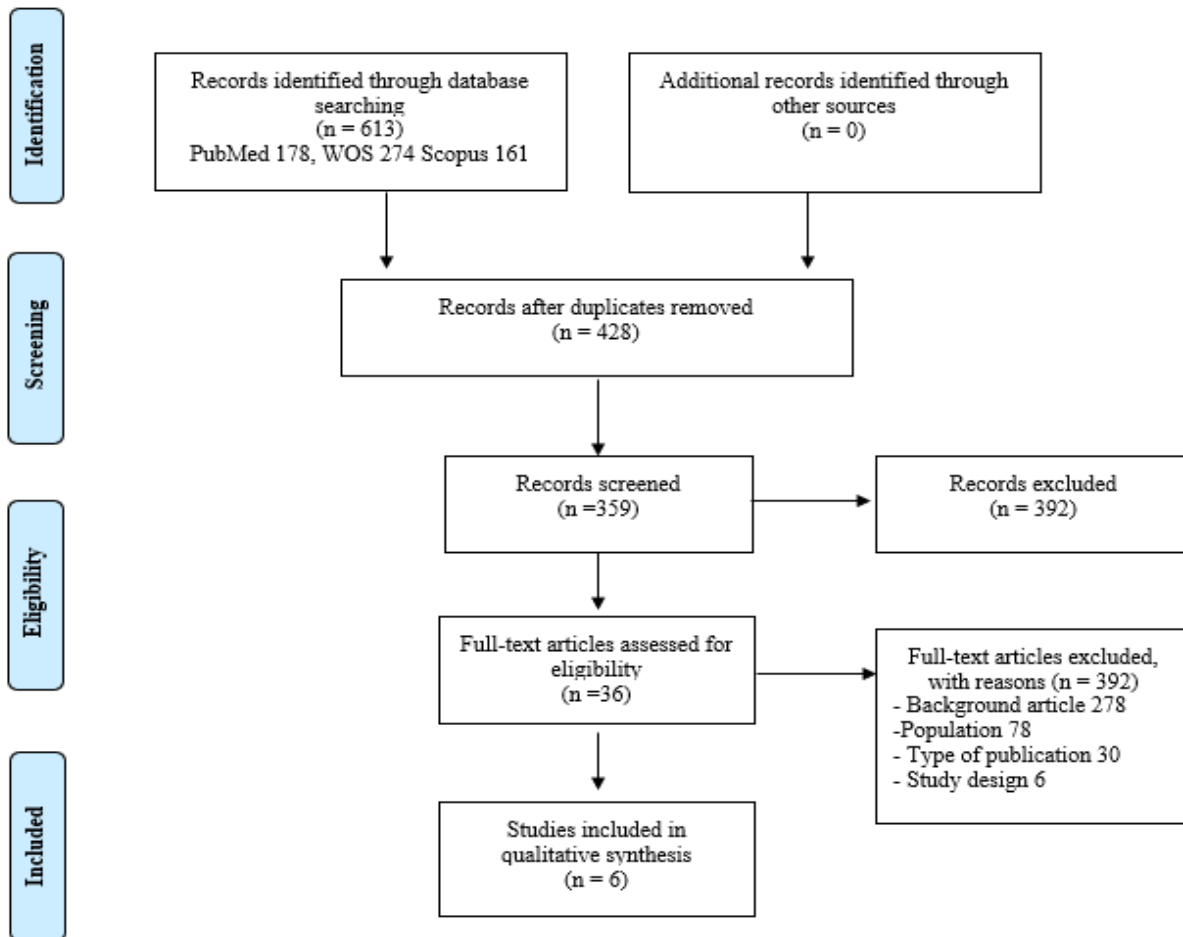


Figure 1. PRISMA Flow diagram of literature search and selection process.

## RESULTS

### **Selection of articles**

For this review, 613 articles were identified from 3 databases (Web of science, PubMed and Scopus), after eliminating duplicates, the review began with 428 articles, of these, 36 articles qualified according to the information provided in the title. and Summary, finally when reading the complete studies, only 6 articles were selected, which met all the inclusion and exclusion criteria (Figure 1).

The articles used were experimental from a prospective cohort, these were in English and were published in a range of less than 5 years (2017-2021). The results of the evaluation of the methodological quality are found in Table 2, where it is shown that of a total of 6 articles, 2 of them obtained a low risk of bias (6 to 11 points) and the other 4 were classified as high. risk of bias (0 to 5 points) on the PEDro scale (Table 2).

Table 2. PEDro scale score.

<b>Study</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>Total</b>
Markovic et al. (2020)	1	1	0	1	0	0	0	0	0	1	1	5
Moreno-Pérez et al. (2019)	1	0	0	1	0	0	0	0	0	1	1	4
Mosler et al. (2018)	1	1	0	1	0	0	0	0	0	1	1	5
Namazi et al. (2019)	1	1	1	0	0	1	1	1	0	1	1	8
Powers et al. (2017)	1	1	0	1	0	0	0	0	0	1	1	5
Wollin et al. (2018)	1	1	0	1	0	0	0	1	0	1	1	6

### **Characteristics of the studies**

Among the selected articles, there was a great variety in the size of the population studied, ranging from groups of 25 to 438 participants, with the presence of male professional and youth soccer players, between 14 and 35 years old, competitors from different leagues, soccer or tournaments (Table 3).

### **Hip strength measurement**

Earlier in the season, Markovic et al. (2020) performed bilateral isometric hip adductor strength tests, requesting one repetition maximum (RM) through fixation dynamometry, the participants were positioned supine with hips and knees extended. Moreno-Perez et al. (2019) evaluated the maximum isometric strength of the adductors through a squeeze test, which was quantified by a portable dynamometer fixed at the height of the knees, placing the patient in a supine position with the hip neutral and in 45° flexion and knees at 90°. Mosler et al. (2018) carried out 2 tests, a bilateral isometric adduction using the squeeze test with a hand dynamometer between the knees, without specifying the position of the participant, and another of eccentric adduction and abduction strength with a hand dynamometer located laterally. to the knee, positioning the participant in lateral decubitus. Namazi et al. (2019) evaluated hip flexion, extension, abduction, and adduction movements of the dominant leg isokinetically at 30, 60, and 90°/sec, where they did not specify the position used with the participants. Powers et al. (2017) evaluated bilateral isometric abduction strength, using a handheld dynamometer positioned proximal to the lateral femoral epicondyle, players were tested in the lateral decubitus position with the pelvis stabilized, the hip was abducted to 30°, then the participant abducted the hip with maximum effort for 5 seconds against manual resistance. Wollin et al. (2018) evaluated hip adduction strength through an adductor squeeze test, a dynamometer was used which was fixed 5 cm proximal to the medial malleolus of the dominant leg to capture the maximum force in Newton (N), the participants located in 0° hip flexion (Table 3).

### **Relationship between hip strength and lower extremity injuries**

Marković et al. (12) noted 10 groin injuries during the season, of which 7 were adductor-related. Injured players had lower adductor isometric strength compared to the contralateral limb. Moreno-Perez et al. (2019) point out that most of the players did not present injuries (76.6%), however, a lower percentage suffered different types of groin injuries, such as tendinopathies, osteitis-pubica and femoroacetabular impingement, but there was not a relationship of these injuries with games or training. Mosler et al. (2018) indicate that both the increase and decrease in normal values of eccentric adduction force represent risk factors in groin injuries, in addition, the increase in this force is also a predisposing factor for hip injuries. Namazi et al. (2019) mention that there is a significant relationship between the hip abduction/adduction isokinetic force at a speed of 30°/second, therefore, increasing one unit of abduction force decreases lower extremity injuries by 10%. Powers et al. (2017) describe 2 determining factors in players injured with non-contact lateral ankle sprains during the season, these factors are the higher body weight of the injured players and the lower strength of the hip abductors compared to uninjured players. Wollin et al. (2018) reported groin pain during tournament play, this changed adductor strength over time, leading to a history of injury, but indicated that higher maximal adductor strength is less likely to report pain (Table 3).

Table 3. Summary main results.

Study	Study design	Participants in the study	Evaluation instrument	Assessed hip movement	Results
Markovic et al (2020)	Prospective cohort study	Male professional soccer players from 3 Croatian league teams, with an average age of 22.8 years. (45 participants)	Hand dynamometer (Micro FET2, Hoggan Health)	Adduction	Injured players had lower adductor isometric strength versus uninjured players. During the adductor muscle strength test, the affected side was weaker in the injured group. It is explained that 45.2% of the variation in the appearance of injuries in the groin, corresponding to 60% of the cases, age, previous groin injury and asymmetry of strength in adductors between limbs, had no relation to future injuries. groin.
Moreno-Pérez et al. (2019)	Prospective Study	Professional, healthy soccer players with a mean age of 24.8 years. (71 participants)	Hand dynamometer (Smart Groin Trainer, Neuro Excellence, Portugal)	Adduction	The 1N increase in maximal force of the isometric adductors decreases the chance of sustaining a groin injury by 1,005 times. A 1N/kg increase in force relative to body mass decreases the chance of sustaining a groin injury by 6.8-fold.
Mosler et al. (2018)	Prospective cohort study	Male professional soccer players, aged 18. (438 participants)	Hand dynamometer using an eccentric rupture test.	Adduction Adduction	Lower than normal eccentric adduction strength increases the risk of adductor-related groin injury. A higher than normal eccentric adduction force is associated with an increased risk of hip/groin injury. A previous hip/groin injury it is also a risk factor for adductor injuries.

Namazi et al. (2019)	Prospective Study	Young footballers from Iran's top U-21 league aged between 18 and 21. (73 participants)	Biodex Isokinetic System	Adduction Adduction Flexion Extension	Low isokinetic strength of the abd/add muscles at 30°/sec is associated with lower leg injuries. The increase of a unit of force decreases the lesions of the lower limbs by 10%. The maximum moment of force of adduction at 30°/sec/s and abduction at 90°/sec/s are related to lower limb injuries.
Powers et al. (2017)	Prospective Study	Male soccer players of different age categories (junior, high junior and adult; ages 14 to 34). (210 participants)	Hand dynamometer (model Commander Power Track II; JTECH Medical Industries, Salt Lake City, UT)	Adduction	Injured soccer players with a sprained ankle had lower hip abductor strength.
Wollin et al. (2018)	Study Experiment	Youth international footballers. (25 participants)	Hand dynamometer (Micro FET2, Hoggan Health)	Adduction	In the adductor squeeze test, the maximum adductor force was reduced by 0.8 N during the tournament. The higher the adductor strength, the less likely you are to experience groin pain during the test.

Abbreviations: N: Newton, Kg: Kilogram, EEII: lower extremity.

### Methodological quality assessment

When performing the analysis of the articles selected in this review with the PEDro scale, 4 articles classified with high risk of bias (0 to 5 points) were obtained, when presenting this score the results of these lose reliability, in addition to adding that, the criteria less fulfilled are number 5, mentioning that all subjects were blinded, number 7, which mentions that the evaluators who measured at least one outcome were blinded, and number 9, where it indicates that all subjects received treatment or were assigned to treatment. a control group (Table 2).

## DISCUSSION

The objective of this study was to analyse the relationship between hip muscle strength and lower extremity injuries in amateur or professional soccer players. It was evidenced that the investigations evaluated different hip movements adopting different positions and using different dynamometric evaluation techniques to characterize the force, evidencing the lack of consensus in said evaluation.

Regarding the comparison of hip strength and lower extremity injuries, 5 articles evaluated hip adduction, in which it is concluded that the decrease in strength in these muscle groups is an indicator for groin pain (Powers et al., 2017), groin injuries (Markovic et al., 2020; Moreno-Pérez et al., 2019; Mosler et al. 2018) and lower extremity injuries in general (Namazi et al., 2019), but in turn it is indicated that greater than normal eccentric adduction strength is a risk factor for hip/groin injuries (Mosler et al., 2018). Another muscle group evaluated was abduction, according to the authors, its strength deficit can be associated with non-contact ankle sprains (Powers et al., 2017) and can also be a risk factor for lower extremity injuries generally together

with the adductors (Namazi et al., 2105). Only the study by Namazi et al. (2019) evaluated the relationship of eccentric hip flexion and extension strength compared to lower extremity injuries, this does not refer to movements as causes or risk factors for lower extremity injuries, however, the Ridder study et al. (2017), on the other hand, points out that the eccentric strength deficit of the hip flexor muscles is associated with chronic ankle instability and the decrease in isometric strength of the hip extensors is related to ankle sprains.

Within the limitations of this systematic review, it can be mentioned that the hand dynamometer was the most used device, despite the fact that it provides less reliability when evaluating muscle strength, being less specific compared to an isokinetic device that is considered as the most used. Reference or Gold standard in tests of muscular strength. In addition, the included studies did not evaluate female participants, consequently, no information is obtained on hip strength results and incidence of lower extremity injuries with which they correlate, in addition to not having an effective training plan for prevention in athletes of this gender or make a comparison of the incidence of injuries between female and male participants. We can also add that the studies focused mainly on evaluating abduction and adduction, excluding hip flexion and extension movements, therefore, the measurement of strength and relationship with injuries in the lower extremities is not obtained, since either by an increase or a deficit of it. Finally, not all authors evaluate bilaterally, most focused only on the dominant leg of the participants.

Therefore, for future research, it is recommended to incorporate information on the relationship between strength and injuries in the lower extremity in female soccer players, whether youth, professionals or amateurs, in addition to evaluating internal and external rotation movements of the hip, also including the evaluation of hip flexion and extension strength that have not presented much evidence, researchers are recommended to evaluate bilaterally using an isokinetic dynamometer since it is a highly reliable tool to perform muscle strength tests isometrically, concentric and eccentric.

## CONCLUSIONS

The results obtained in this systematic review provide us with concrete data on the relationship between hip muscle strength and lower extremity injuries in soccer players, mainly as the decrease in strength in abductors and adductors will increase the risk of injury. in the lower extremity, likewise, by presenting a higher abduction force than normal or an asymmetry between hip abductors and adductors, it is also considered a risk factor in the participants. Therefore, isometric strength evaluations of the hip adductors and abductors through a dynamometer are an effective tool for early detection of weak or unbalanced soccer players who are prone to future injuries, saving costs and time off the field of play. game when performing rehabilitation, being detrimental to the performance of the athlete. Finally, with the information acquired, soccer teams and coaches will be able to implement new injury prevention strategies to their training plans, however, more research is required in the area in order to confirm these preliminary findings.

## AUTHOR CONTRIBUTIONS

A.Y.U., E.A.M., C.P.P., and F.B.S. manuscript writing, collected the data, preparation and research design; G.C.D., and N.B.F.S. critically reviewed the work, result interpretation and manuscript writing and M.J.G.G. manuscript writing and critically reviewed the work.

## SUPPORTING AGENCIES

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## DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

## REFERENCES

- Askling, C. M., Tengvar, M., Saartok, T., & Thorstensson, A. (2007). Acute first-time hamstring strains during high-speed running: a longitudinal study including clinical and magnetic resonance imaging findings: A longitudinal study including clinical and magnetic resonance imaging findings. *Am J Sports Med*, 35(2), 197–206. <https://doi.org/10.1177/0363546506294679>
- De Ridder, R., Witvrouw, E., Dolphens, M., Roosen, P., & Van Ginckel, A. (2017). Hip strength as an intrinsic risk factor for lateral ankle sprains in youth soccer players: A 3-season prospective study. *Am J Sports Med*, 45(2), 410–416. <https://doi.org/10.1177/0363546516672650>
- Deane, R. S., Chow, J. W., Tillman, M. D., & Fournier, K. A. (2005). Effects of hip flexor training on sprint, shuttle run, and vertical jump performance. *J Strength Cond Res*, 19(3), 615–621. <https://doi.org/10.1519/14974.1>
- Kararantou, K., Gerodimos, V., Katsareli, E., Manouras, N., Ioakimidis, P., & Famisis, K. (2019). Strength profile of hip abductor and adductor muscles in youth elite soccer players. *J Hum Kinet*, 66(1), 31–41. <https://doi.org/10.2478/hukin-2018-0069>
- Lavoie-Gagne, O., Mehta, N., Patel, S., Cohn, M. R., Forlenza, E., Nwachukwu, B. U., & Forsythe, B. (2021). Adductor muscle injuries in UEFA soccer athletes: A matched-cohort analysis of injury rate, return to play, and player performance from 2000 to 2015. *Orthop J Sports Med*, 9(9), 23259671211023096. <https://doi.org/10.1177/23259671211023096>
- López-Valenciano, A., Ruiz-Pérez, I., García-Gómez, A., Vera-García, F. J., De Ste Croix, M., Myer, G. D., & Ayala, F. (2020). Epidemiology of injuries in professional football: a systematic review and meta-analysis. *Br J Sports Med*, 54(12), 711–718. <https://doi.org/10.1136/bjsports-2018-099577>
- Maher, C. G., Sherrington, C., Herbert, R. D., Moseley, A. M., & Elkins, M. (2003). Reliability of the PEDro scale for rating quality of randomized controlled trials. *Physical Therapy*, 83(8), 713–721. <https://doi.org/10.1093/ptj/83.8.713>
- Markovic, G., Šarabon, N., Pausic, J., & Hadžić, V. (2020). Adductor muscles strength and strength asymmetry as risk factors for groin injuries among professional soccer players: A prospective study. *Int J Environ Res*, 17(14), 4946. <https://doi.org/10.3390/ijerph17144946>
- Moreno-Pérez, V., Travassos, B., Calado, A., Gonzalo-Skok, O., Del Coso, J., & Mendez-Villanueva, A. (2019). Adductor squeeze test and groin injuries in elite football players: A prospective study. *Phys Ther Sport*, 37, 54–59. <https://doi.org/10.1016/j.pts.2019.03.001>
- Mosler, A. B., Weir, A., Serner, A., Agricola, R., Eirale, C., Farooq, A., Bakken, A., Thorborg, K., Whiteley, R. J., Hölmich, P., Bahr, R., & Crossley, K. M. (2018). Musculoskeletal screening tests and bony hip morphology cannot identify male professional soccer players at risk of groin injuries: A 2-year prospective cohort study. *Am J Sports Med*, 46(6), 1294–1305. <https://doi.org/10.1177/0363546518763373>



- Namazi, P., Zarei, M., Hovanloo, F., & Abbasi, H. (2019). The association between the isokinetic muscle strength and lower extremity injuries in young male football players. *Phys Ther Sport*, 39, 76–81. <https://doi.org/10.1016/j.ptsp.2019.06.013>
- Neto, W. K., Vieira, T. L., & Gama, E. F. (2019). Barbell Hip Thrust, Muscular Activation and Performance: A Systematic Review. *J Sports Sci Med*, 18(2), 198–206.
- Pfaffmann, D., Herbst, M., Ingelfinger, P., Simon, P., & Tug, S. (2016). Analysis of injury incidences in male professional adult and elite youth soccer players: A systematic review. *J Athl Train*, 51(5), 410–424. <https://doi.org/10.4085/1062-6050-51.6.03>
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., ... Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ (Clinical Research Ed.)*, 372 (71). <https://doi.org/10.1136/bmj.n71>
- Powers, C. M., Ghoddosi, N., Straub, R. K., & Khayambashi, K. (2017). Hip strength as a predictor of ankle sprains in male soccer players: A prospective study. *J Athl Train*, 52(11), 1048–1055. <https://doi.org/10.4085/1062-6050-52.11.18>
- Rønnestad, B. R., Kvamme, N. H., Sunde, A., & Raastad, T. (2008). Short-term effects of strength and plyometric training on sprint and jump performance in professional soccer players. *J Strength Cond Res*, 22(3), 773–780. <https://doi.org/10.1519/JSC.0b013e31816a5e86>
- Serin, E. (2017). Relationship between the hip anatomy and sporting performance. *European Journal of Physical Education and Sport Science*, 3(10). <https://doi.org/10.5281/zenodo.1043342>
- Thorborg, K., Couppé, C., Petersen, J., Magnusson, S. P., & Hölmich, P. (2011). Eccentric hip adduction and abduction strength in elite soccer players and matched controls: a cross-sectional study. *Br J Sports Med*, 45(1), 10–13. <https://doi.org/10.1136/bjism.2009.061762>
- Turner, A. N., & Stewart, P. F. (2014). Strength and conditioning for soccer players. *J Strength Cond Res*, 36(4), 1–13. <https://doi.org/10.1519/ssc.0000000000000054>
- Wollin, M., Pizzari, T., Spagnolo, K., Welvaert, M., & Thorborg, K. (2018). The effects of football match congestion in an international tournament on hip adductor squeeze strength and pain in elite youth players. *J Sports Sci*, 36(10), 1167–1172. <https://doi.org/10.1080/02640414.2017.1363452>

