Original Article

Injury in elite women soccer and national women soccer in the lower extremity

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ABSTRACT

Purpose: Analyse the epidemiology of women's soccer harmful depending on the category of game. Materials and Methods: There were 26 participants (38 Super League and 32 National League women) with a mean age of 21.20 ± 4.64 years and body mass index (BMI) of 21.94 ± 1.79 kg/m^2. There are several reasons why the health problems of the women's soccer must be taken into account. Among these reasons, we think that the speed actions in this sport will have a great impact on the health of competitors. In addition, the women are more prone to overuse injuries due to the morphological characteristics. Results: Musculoskeletal injuries and pain were importance to women's soccer of two levels. This was reflected in our study, the high percentage of activation muscle shortening, especially at hip external right and left rotators (100%), also at internal hip right and left rotators (100%) in the premier league. However, in national league the high percentage was at hip external right and left rotators (78.1%) and shortening in internal hip right and left rotators (90.6%). Conclusions: It is important to continue hearing the ergogenesis of this sport and particularly of women's soccer, to reduce its lesional index. **Key words:** SOCCER, WOMEN, INJURY, PAIN.

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INTRODUCTION

Soccer is the most popular sport in the world, so perform at the levels required by this sport requires high levels of tactical, technical and physiological (Strauss, Jacobs, & Van Den Berg, 2012).

The increased requirements are characterized by a sport with high efforts and moderate intensity, short and long actions (Calahorro, Torres-Luque, Lara, & Zagalaz, 2011). This feature next to that the soccer player should have a good aerobic base capacity, in addition to an optimal anaerobic capacity. This anaerobic capacity and muscle strength are critical to the realization of soccer treasury actions, more explosive and repetitive factors: jumps, sprints, changes of direction and shoot (Strauss et al., 2012).

Beating or shoot of the ball is one of the most important skills in this sport, as it is considered as the technically necessary to develop the game gesture, poor coordination of this gesture can cause muscle injury, especially in the hamstring.

The vertical jump is one of the most common actions when the mobile is above the heads of the players. It should be noted that there are biomechanical differences with regard to gender, a revised work (Smith, Gilleard, Hammond, & Brooks, 2006) notes that ACL injuries are most common in women's soccer, many of them occurring during the subsequent landing the jump.

The sprint with changes of direction are some of the actions that occur more in football, regarded as one of the most decisive actions in the game (Sasaki, Nagano, Kaneko, Sakurai, & Fukubayashi, 2011). When the body is forced to conform to the curve by the football player in any action of a match or training, generate hamstring knee rotation for the turning for. The hamstring muscles act of attachment between the back of the pelvis and tibia, adjusting the ratio between the two bony structures consequently suffer injuries hamstring (Field, Soames, & Palastanga, 2000).

Because of these actions highly explosive and physical contact that occurs, soccer is listed as a contact sport, it is one of the sports that has more catastrophic injuries, according to *National Center for Catastrophic Injury Research*, being 2 to 6 times the rate in women lesional (Nshimiyimana & Frantz, 2012), considering the high-risk rate.

In this sense, epidemiology of soccer has been the focus of study in many studies analysed (Jacobs & Van der Berg, 2012; Walden, Hägglund, Wener, & Ekstrand, 2011) in men soccer, which did not happen in the women world, although his injury incidence is higher (Giza, Mithöfer, Farrell, Zarins, & GiIl, 2005).

Among this lesion incidence, the risk factors to which they are exposed soccer are set to suffer an injury, dividing human, environmental factors and related sporting gesture biomechanical and neuromuscular training (Walden et al., 2011). Although the causes of these injuries are not 100% certain, since there is no single cause but may be due to several aspects such as existence of previous injuries, genders of the players, playing surface region where the competition takes place, type of footwear or sports calendar density (Mallo, Gonzalez, Veiga, & Navarro, 2011).

In the *premier league*, players suffer an average of 1.3 injuries per season, suffering losses of hours of training and competition (Price, Hawkins, Hulse, & Hodson, 2004). Another important thing is that the soccer players as 15.3 suffer injuries per 1000 hours of competitive exhibition, 1.1 injuries being of a serious nature

(Clausen et al. (2014). Approximately, 47% of injuries occur during competitions and 53% during training sessions (Tegnander, Egil, Trine, Moholdt, Engebretsen, & Bahr, 2007).

Regarding the location of these lesions should be noted that the muscle areas where there are higher incidences (Clausen et al., 2014) are the legs, approximately 86% of total injuries, with thighs and knee area of broad impact, 25%, and ankles and feet, 20%, the most frequent mechanisms damaging the sprint and hit the goal (Zahínos, González, & Salinero, 2010).

In women's soccer, more concretely, 80% of the lesions also affect the lower limbs, being 47% of these injuries occurred in the region of the hamstring, this may be due to the reduction in range of motion due to a decreased mobility or weakness in the leg muscles (Colak, 2012).

There are many discrepancies about the most important factors in the incidence of injury in soccer player: anatomical characteristics of women (Q angle), biomechanical factors, muscular decompensation between hamstrings and quadriceps, hormonal factors, laxity of the soft structures, BMI (body mass index), neuromuscular fatigue and its consequences, recurrences, age and especially a decrease in the ROM (range of motion) which results in a lack of flexibility in the muscles involved (Nilstad, Bahr & Andersen 2014; Khalid, Harris, Michael, Joseph & Qu, 2015; Dallinga, Benjaminse & Lemmink, 2012; Hägglund, Waldén & Ekstrand, 2006; Bittencourt, Ocarino, Mendonca, Hewett, & Fonseca, 2014; Woods, Hawkins, Maltby, Hulse, Thomas, & Hodson, 2013).

The percentage of lesions caused by intrinsic factors (26-59%) occurred during the races, explosive actions such as high-speed racing, sprints, changes of direction post jump landings, decelerations … All other lesions (20-25%) are due to relapses or recurrences (Junge & Dvorak, 2004; Clausen et al., 2014).

An 20-25% of all injuries are recurrences of the same type and in the same place, and 75-80% occur first. The importance of injury prevention as well as adequate rehabilitation of these is a key factor to prevent future injuries (Clausen et al., 2014).

The aim of this study was to analyse the epidemiology of women's soccer harmful depending on the category of game that the player is subjected, both Super League and National League, to involve differences in training and competition loads, so for it beyond data related injuries have been analysed involved with workloads that are subject.

METHODS

Participants

There were 70 participants (38 Super League and 32 National League women) with a mean age of 21.20 ± 4.64 years and body mass index (BMI) of 21.94 ± 1.79 kg/m^2, with different trainings values. In the following table (Table 1) all data concerning sporting habits are listed. These data indicate that the sample engages in a high level of sport activity have an average of 15.42 ± .576 years of practice in Super League and National League 9.91 ± .601. It can be seen that Super League spend as many hours per week on the specific training (8.87 ± .161) compared to National League (7.16 ± .360). Thus, all the participants consider their physical condition to be good (57.9% and 50% respectively). One thing to note is the high percentage of participants (94.7%) and women (93.8%) that "always" engage in stretching.

A 16-question observational survey was conducted. Five questions asked about the sporting habits, 4 football history, 4 current pain and injuries, 1 knowledge of clinical history, and 2 participants information.

Table 1. Demographic and Physical Information.

	Category	Variables	%
Soccer history	SL	≤ 10 years	8%
		> 10 years	92%
	NL	≤ 10 years	90%
		> 10 years	10%
Complementary training	SL	No	21.1%
		Yes	78.9%
	NL	No	31.3%
		Yes	68.8%
Weekly training during competitive season	SL	≤ 5 hours	0%
		> 5 hours	100%
	NL	≤ 5 hours	0%
		> 5 hours	100%
Perception of physical fitness*	SL	very good	26.3%
		Good	57.9%
		Normal	13.2%
		Regular	2.6%
	NL	very good	18.8%
		Good	50%
		Normal	28.1%
		Regular	3.1%
Stretching	SL	Never	0%
		sometimes	5.3%
		Always	94.7%
	NL	Never	0%
		sometimes	6.3%
		Always	93.8%
Other sports practice#	SL	No	65.8%
		Yes	34.2%
	NL	No	71.9%
		Yes	28.1%

Recruitment was focused by random sampling from the two national's teams, premier Spanish league and national league. The selection criteria were: women right-handed soccer players who had not warmed up or competed prior to testing. The participants were evaluated distributed in three days, always maintaining the competition or training 48 hours before the measurement.

All study protocols and procedures met the requirements set out in the Helsinki Declaration of 1964 and all participants signed the informed consent form.

Measurements

Height and weight (Medical Seca Scales 761 model and a stadiometer with a 1 mm of sensitivity) were also measured. Range of motion (ROM) of the lower limb musculature was conducted using goniometry (Saehan with an accuracy of 5º and an angle up to 360º). For greater data collection reliability, all measurements were recorded by a single examiner.

For the knee flexors and hip extensors (semimembranosus, semitendinosus, biceps femoris), the participants were asked to lie in the supine position. The participant then raised the right leg with knee extended and foot tension free (Kendall, Kendall, & Geise, 2000). The leg that was not evaluated was held firmly on the thigh toward the stretcher. A value of 80° is considered to be normal value (Taboadela, 2007).

In the supine position, the participants performed hip abduction, avoiding rotation and laterally tilting the pelvis to evaluate the adductors magnus, longus and brevis (Taboadela, 2007). A range of 0° to 50° according to the Association for Osteosynthesis (AO, 1971) is considered to be normal value (Palmer & Epler, 2002).

Participants were measured in a sitting position with legs hanging, keeping the pelvis stable and fixed. The internal rotation movement develops wearing the leg and foot to the outside to evaluate Pyramidal, Obturator externus and internus, Quadratus femoris muscle and Gemellus inferior and superior. A range of 0° to 40° is considered to be a normal value (Palmer & Epler, 2002).

Participants were measured in a sitting position with legs hanging, keeping the pelvis stable and fixed (Palmer & Epler, 2002). External rotation of the hip is measured with the leg and foot bearing inside to evaluate Tensor fascia latae and Gluteus mediums and minimums. A normal range is between 0° and 50° (Palmer & Epler, 2002).

In the supine position, the knees were passively flexed to 80° (Kendall et al., 2000). The participants bent the knee into the trunk trying to stay the thigh in contact with the stretcher to evaluate Psoas, Iliacus and Rectus femoris. The original test was modified (Kendall et al., 2000), by recording a yes or no according to the existence of extension above the knee flexed at 80°.

Statistical analysis

Descriptive statistics are expressed as mean ± standard deviation and percentages. The results obtained in the study were analysed using the Shapiro-Wilk test to perform the normality test. Correlations between study variables were analysed by using Pearson's r or the Spearman analysis function. For all analyses, the significance level was $p < 0.05$. Statistical analysis was performed using the computer software SPSS version 20.0 (IBM, Somers, NY, USA).

RESULTS

Range of Motion

Table 2 shows the data related to muscle shortening by category. In Super League, there is a high percentage of muscle shortening in the right and left knee flexors and hip extensors (55.3% and 50%), right and left hip adductors (63.2% and 60.5%), and principal result is at hip external right and left rotators (100%) and shortening in internal hip right and left rotators (100%). In National league is too a very high percentage of muscle shortening in the right and left knee flexors and hip extensors (68.8% and 65.6%), right and left hip adductors (50% and 53%), and hip external right and left rotators (78.1%) and shortening in internal hip right and left rotators (90,6%). And in the two categories appear the existence of extension above the knee flexed at 80°, in Super League (right 81.6%, left 78.9) and national level (right 84.4%, left 81.3%).

Table 2. Range of Motion.

	Category	Shortening	No Shortening
Hip Flexors*	SL Right	31.6%	68.4%
	SL Left	42.1%	57.9%
	NL Right	18.8%	81.3%
	NL Left	21.9%	78.1%
Hamstrings#	SL Right	81.6%	18.4%
	SL Left	78.9%	21.1%
	NL Right	81.3%	18.8%
	NL Left	84.4%	15.6%
Hip Adductors	SL Right	63.2%	36.8%
	SL Left	60.5%	39.5%
	NL Right	53.1%	46.9%
	NL Left	50%	50%
Internal Hip Rotators^	SL Right	100%	0%
	SL Left	100%	0%
	NL Right	90.6%	9.4%
	NL Left	90.6%	9.4%
External hip Rotators+	SL Right	100%	0%
	SL Left	100%	0%
	NL Right	78.1%	21.9%
	NL Left	78.1%	21.9%

** Hip Flexors: Psoas, Iliacus and Rectus femoris*

 # Hamstrings: semimembranosus, semitendinosus, biceps femoris

^Internal Hip Rotators: Pyramidal, Obturator externus and internus, Quadratus femoris muscle and Gemellus inferior and superior

+External hip Rotators: Tensor fascia latae and Gluteus mediums and minimums

Regarding the results of the correlations performed among the muscle-joint variables by category, in Super League shows a positive correlation between shortening of the right and left knee flexors and hip extensors (r=.760). And a positive correlation between shortening of the right and left hip adductors (r= .830). Along with a positive correlation between shortening of the external hip right and left rotators (r=.371) and of the hip adductors (r =.525), and the internal hip right and left rotation (r=.431). And a positive correlation between external hip left rotators and internal hip right rotators (r=.460). And a positive correlation too between external hip right rotators and internal hip left rotators (r=.382) (View Table 3).

Table 3. Correlations in Super League.

Correlations Super League	Hip extensors	Hip rotators	External Hip Left Rotators	Internal Hip Left rotators	Left Hip adductors	Hip adductors
Right Knee flexors	r=.760					
Left Knee Flexor	r=.760					
Hips extensors						
External Hip Right rotators			r=.371	r=.382		r=.525
Right Hip adductors					r=.830	
Internal Hip Right rotators				r=.431		

In National League shows a positive correlation between shortening of the left knee flexors and hip extensors with external right hip (r=.541) and left rotators (r=.506), and left knee flexors and hip extensors with internal right hip (r=.618) and left rotators (r=506). And a negative correlation between shortening of the right and left hip adductors (r=. -591). Along with a positive correlation between shortening of the external hip right and left rotators (r=.837), and the internal hip right and left rotation (r=.721). And a positive correlation between external hip left rotation and internal right and left rotators (r=.588; r=.657). And a positive too correlation between external hip right rotation and internal right and left rotation (r=.712; r=.721) (View Table 4).

Table 4. Correlations in National league.

Correlations Super League	External right hip rotation	Internal right Hip rotation	Internal Left hip rotation	Left Rotators	Left Hip adductor
Left knee flexors with external right hip	r= .541			r= .506	
Left knee flexors and hip extensors		r=.618		r= .506	
Right hip adductor					r=. -591
External hip right rotation		r=. 712	r= .721	r= .837	
Internal hip Right rotation					r= .721
External hip left rotation		r=.588		r= .657	

Pain Location

In relation to the data obtained on bodily pain, 71.1% of Super League and 50% of National League showed an experienced pain through the questionnaire. For Super League, it can be observed that there is clear prevalence of pain isquiosural area (right 10.5%, left 15.8%). In contrast, National League displays a clear prevalence of knee pain (9.4%).

In addition, the injury data obtained shows 92.1% in Super League, with a clear prevalence in muscular injury in isquiosural area (21.1%) and articular injury in knee (34.2%), as opposed in National League, where it shows 78.1%, with a clear prevalence muscular injury in isquiosural area (9.4%) and articular injury in knee (37.5%).

DISCUSSION

The aim of this study was to identify, determine, and quantify the muscle shortening, body pain and sporting habits of women soccer. All studies reviewed show great discrepancy between the factors that determine injuries in women's soccer, in this sense one of the relevant factors in both categories present in our results is the reduced joint ROM resulting in a lack of flexibility in the muscles involved (Nilstad et al., 2014; Khalid et al., 2015; Woods et al., 2013).

These shortenings are produced both knee flexors and hip extensors, adductors, internal and external rotators of both legs, in both categories. These shortenings have been to highlight the shortening of the hip rotators, further shortening observed a higher level of play, as they noted in other papers reviewed where a decrease in joint mobility is appreciated because of the physical demands, and technical and tactical sport, as well as to the characteristics of the players (Colak, 2012; Dallinga et al., 2012; Khalid et al., 2015). Among these features, it has been to emphasize the importance of stretching to improve muscle extensibility, high incidence being in this sample, so these shortenings may be due to other factors such as the angle Q, hormonal factors, external factors underlying the game itself.

Another factor to note is the extension obtained in the thighs, it could be due to a reduction in range of motion coxal-femoral flexion with the knee extended in both categories studied. This fact has been highly related to athletes involved in explosive runs, sprints and actions that involve high extensibility of the hamstring, such as soccer (Miñarro, Alacid, Muyor, & López, 2007). In our study we have observed the same results as the articles reviewed (Grygorowicz, Piontek y Dudzinski, 2013; Van Beijsterveldt et al., 2012, Dallinga et al., 2012) denoting the lack of extensibility in the hamstring is a risk of causing a muscle injury, obtaining a greater retraction of the muscles, the further experienced and older have participants. These changes in flexibility, as shown in the literature, lead to changes in the normal functions with regard to joint range.

In this regard, the anatomical area where higher incidence of pain causes these shortenings is hamstring, 21.1% in the Super League and 9.4% in National League, like Arnason, Andersen, Holme, Engebretsen, & Bahr (2008) which determined that the area of the hamstring is the most vulnerable area and therefore more being injured by age, prior injuries and decreased joint mobility due to the lack of extensibility, among the most prominent risk factors. As the work of Woods et al., (2013) who also state that the hamstring injury is one of the most common with a high percentage (12%) of total lesions, like Hassabi, Mortazavi, Giti, Hassabi, Mansournia, & Shapouran, (2010) and Colak (2012).

Regarding joint injuries our results corroborate those found in the literature, showing a high percentage damaging the knee joint, both Super League (34.2%) and the National League (37.5%), as it is shown in the revised literature where soccer players have a higher incidence than men to suffer injuries knee joint, possibly due to muscle imbalances caused by these players sport itself ergogenesis (Hassabi et al., 2010).

In this sense, these imbalances in the strength of the thigh muscles could be prevented through specialized training programs in preventing injuries. It assumes the hamstring is decompensation or disadvantage to the quadriceps muscles in terms of co-activation during loading and preparation phases (Dauty, Potiron-Josse, & Rochcongar, 2003) the lack of eccentric strength in the hamstring is a cause of muscle and joint injuries in the structures involved.

CONCLUSION

All of the differences seen for the two levels analysed could be due to the charges of training, also to years of proven experiences and the control of the specific techniques. But we believe that especially to preventive work and proprioceptive work daily. One of the big differences found was the specialized staff. For all the exposed, the participants would work on proprioception and stretching exercises to strengthen their muscles and prevent injuries.

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REFERENCES

Arnason, A., Andersen, T.E., Holme, I., Engebretsen, L., & Bahr, R. (2008) Prevention of hamstring strains in elite soccer: an intervention study. Scandinavian Journal of Medicine and Science in Sports 18, 40-48. https://doi.org/10.1111/j.1600-0838.2006.00634.x

Bittencourt, N.F.N., Ocarino, J.M., Mendonca, L.D., Hewett, T.E., & Fonseca, S.T. (2012). Foot and hip contributions to high frontal plane knee projection angle in athletes: a classification and regression tree approach. Journal of Orthopaedic & Sports Physical Therapy, 42, (12). https://doi.org/10.2519/jospt.2012.4041

Calahorro, F. Torres-Luque, G. Lara, A., & Zagalaz, L. (2011). Functional and physiological parameters in young soccer players. International Sport Medicine Journal, 12 (4): 169-178.

Clausen, M.B., Zebism M.K., Moller, M., Krustrup, P., Hölmich, P., Wedderkopp, N., Andersen, L.L., Christensen, K.B., & Thorborg, K. (2014). High injury incidence in adolescent female soccer. American Journal Sports Medicine (2). https://doi.org/10.1177/0363546514541224

Colak, S. (2012). Effects of dynamic stretches on isokinetic hamstring and quadriceps femoris muscle strength in elite female soccer players. Suid-Afrikaanse Tydskrif vir Navorsing in Sport, Liggaamlike Opvoedkunde en Ontspanning, 34(2): 15-25.

Dauty, M., Potiron-Josse, M., & Rochcongar, P. (2003). Consequences and prediction of hamstring muscle injury with concentric and eccentric isokinetic parameters in elite soccer players. Annals of Physical and Rehabilitation Medicine, 46 (9): 601–606.

Dallinga, J.M., Benjaminse, A., & Lemmink, K. (2012). Which screening tools can predict injury to the lower extremities in team sports? Sports Medicine, 42, (9): 791-815. https://doi.org/10.1007/BF03262295

Field, F., Palastanga, N., & Soames, R. (2000). Anatomy and human Mmovement. Barcelona: Paidotribo.

Giza, E., Mitho, K., Farrell, L. Zarins, B., & Gill, T. (2005). Injuries in women's professional soccer. British Journal Sports Medicine, 39:212–216. https://doi.org/10.1136/bjsm.2004.011973

Grygorowicz, M., Piontek, T., & Dudzinski, W. (2013). Evaluation of functional limitations in female soccer players and their relationship with sports level – a cross sectional study. Plos-One. https://doi.org/10.1371/journal.pone.0066871

Hägglund, M., Waldén, M., & Ekstrand J. (2006). Previous injury as a risk factor for injury in elite football: a prospective study over two consecutive seasons. British Journal Sports Medicine, 40, 767-772. https://doi.org/10.1136/bjsm.2006.026609

Hassabi, M., Mortazavi, M., Giti, M., Hassabi, M., Mansournia, M., & Shapouran, S. (2010). Injury profile of a professional soccer team in the premier league of iran. Sports Medicine Research Center, 7, Al-e-Ahmad Highway, P.O. Box 14395-578, Tehran, IR Iran. https://doi.org/10.5812/asjsm.34837

Jacobs, S., & Van der Berg, L. (2012). Prevalence, severity and mechanism of acute injuries in elite male African youth soccer players. African Journal for Physical, Health Education, Recreation and Dance, 18 (2): 329-343.

Junge, A., & Dvorak, J. (2004). Soccer Injuries: A review on incidence and prevention. Sports Meicined, 34 (13): 929-938. https://doi.org/10.2165/00007256-200434130-00004

Khalid, A.B., Harris, S.I., Michael, L., Joseph, H., & Qu, X. (2015). Effects of neuromuscular fatigue on perceptual-cognitive skills between genders in the contribution to the knee joint loading during side-stepping tasks. Journal of Sports Sciences, 33 (13). https://doi.org/10.1080/02640414.2014.990485

Kendall, F., Kendall, E., & Geise, P. Músculos. Pruebas, funciones y dolor postural. Madrid: Marban; 2000.

Mallo, J., Gonzalez, P., Veiga, S., & Navarro, E. (2011) Injury incidence in a Spanish sub-elite professional team: a prospective study during four competitive seasons. Journal of Sport Sciences and Medicine, 10, 731-736.

Miñarro, P., Alacid, F., Muyor, J.M., & López, F.J. (2008). Criterion-related validity of the modified sit-and-reach test as hamstring muscle extensibility measure in young adults. Kronos. Rendimiento en el deporte, 9(17), 39-46.

Nilstad, A., Bahr, R. & Andersen, T.E. (2014). Text messaging as a new method for injury registration in sports: A methodological study in elite female football. Scandinavian Journal of Medicine & Science in Sports, 24(1): 243–249. https://doi.org/10.1111/j.1600-0838.2012.01471.x

Nshimiyimana, J., & Frantz, J. (2012). Epidemiology of soccer-related injuries among male high school players in Kigali, Rwanda. African Journal for Physical, Health Education, Recreation and Dance, 18: 597-603.

Palmer, M.L. & Epler, M.E. Fundamentos de las técnicas de evaluación musculoesquelética. Barcelona: Paidotribo; 2002.

Price, J., Hawkins, R. Hulse, M., & Hodson, A. (2005). The football association medical research programme: an audit of injuries in academy youth football. British Journal Sports Medicine, 38:466–471. https://doi.org/10.1136/bjsm.2003.005165

Sasaki, S. Nagano, Y. Kaneko, S. Sakurai, T., & Fukubayashi, T. (2011). The relationship between performance and trunk movement during change of direction. Journal of Sports Science and Medicine, 10, 112-118.

Smith, C., Gilleard, W., Hammond, J., & Brooks, L. (2006) The application of an exploratory factor analysis to investigate the inter-relationships amongst joint movement during performance of a football skill. Journal of Sports Science and Medicine, 5: 517-524.

Strauss, A., Jacobs, S., & Van der Berg, L. (2012). Anthropometric, fitness and technical skill characteristics of elite male national soccer players: A review. African Journal for Physical, Health Education, Recreation and Dance, 18; 365-394.

Taboadela, C.H. Goniometría. Una herramienta para la evaluación de las incapacidades laborales. Buenos Aires: Asociart ART; 2007.

Tegnander, A., Egil, O., Trine, O., Moholdt, T., Engebretsen, L., & Bahr, R. (2007). Injuries in Norwegian female elite soccer: a prospective one-season cohort study. Knee Surgery Sports Traumatology Arthroscopy, 16:194–198. https://doi.org/10.1007/s00167-007-0403-z

Van Beijsterveldt, A.M.C., Van de Port, I.G.L, Krist, M.R., Schmikli, S.L., Stubbe, J.H., Frederiks, J.E., & Backx, F.G.J, (2012). Effectiveness of an injury prevention programme for adult male amateur soccer players: a cluster-randomised controlled trial. British Journal Sports Medicine, 42(12):996-1004. https://doi.org/10.1136/bjsports-2012-091277

Walden, M., Hägglund, M., Wener, J., & Ekstrand, J. (2011) The Epidemiology of anterior cruciate ligament injury in footbal (soccer): a review ot he literatura from a gender-related perspective. Knee Surgery, Sports Traumatology, Artroscopy, 19 81): 3-10. https://doi.org/10.1007/s00167-010-1172-7

Woods, C., Hawkins, R., Maltby, S., Hulse, M. Thomas, A., & Hodson, A. (2013). The Football Association Medical Research Programme: an audit of injuries in professional football—analysis of hamstring injuries. British Journal Sports Medicine 2004, 38:36-41.

Zahínos, J., González, C., & Salinero, J. (2010). Epidemiological study of the injuries, the processes of readaptation and prevention of the injury of anterior cruciate ligamento in the professional football. Journal of Sport and Health Research, 2(2): 139-150.

