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Review Article

Physiotherapy Section

Distribution of Groin Injury Subtypes in Football Players: A Narrative Review

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ABSTRACT

Groin injury accounts for 3-31% of all sport related injuries, frequently affecting field athletes and football players, where repetitive kicking, side-to-side movement, and twisting impose high mechanical demands such as in soccer and American football. This review aimed to determine the distribution of different subtypes of groin injury in football players using the standardised terminology and anatomical classification systems. A comprehensive search was conducted across PubMed, British Journal of Sports Medicine (BJSM), Sage Journals, ResearchGate, and Google Scholar, following, covering studies published up to December 2024. The search included studies focusing on distribution of groin injury subtypes among football players. Eligible studies included football players novices to experts, sex and age group, articles investigating the distribution of different subtypes of groin injury using standardised terminology and anatomical classification systems, and were published in English. Two independent reviewers screened and extracted data. Of 1,245 studies identified, 11 met the inclusion criteria, encompassing 4,226 groin injuries. 2,476 (58.58%) were adductor-related injuries, which were most prevalent, subsequent to iliopsoas-related injuries, n=635 (15.02%). The remaining injuries n=1176 (27.82%) were attributed to other anatomical regions, including inguinal, pubic, and hip-related injuries, often underreported (Total injury location exceed total number of injuries due to multiple location injuries per player). Common risk factors included high training loads, insufficient recovery, previous groin injuries, and muscular imbalances. Based on current findings adductor-related injuries dominate groin pathology in football, followed by iliopsoas but other categories remain underreported. These results emphasise the need for standardised diagnostic criteria to improve injury classification and reporting. Broader adoption of standardised terminology and improved preventive interventions are essential for advancing clinical management and reducing injury burden. Future research should aim at refining diagnostic criteria and developing targeted preventive interventions.

Keywords: Athletic injury, Soccer, Sports, Epidemiology

INTRODUCTION

Groin pain is a significant clinical concern for athletes in various disciplines, especially those involving dynamic movements like repetitive kicking, side-to-side motion, and twisting, such as in soccer and American football [1]. Injuries to the groin area are considered for 3-31% of all sports-related injuries [2]. In professional football, the impact is particularly pronounced, with players averaging two time-loss injuries per season [3]. The groin is the region where the abdomen connects to the thighs and also involves the perineal structures. The groin area includes the inguinal region, symphysis pubis, lower rectus abdominis musculature, upper portions of the adductor muscles of the thigh, and the genitalia (including the scrotum in males) [4]. Majority of groin injuries involve soft tissues, typically including muscle strains, tendinitis, and contusions [5].

These injuries typically occur through the following mechanisms [6]:

- Blunt trauma: Direct contact with opponents or the ground can cause contusions and muscle damage.
- Forceful action: Sudden changes in direction, forceful kicking, and tackling manoeuvres can place significant strain on the muscles.
- Overuse: Repetitive high-intensity training and competition can lead to microtrauma and subsequent inflammation.

Until recently, inconsistent terminology made it difficult to synthesise evidence across studies. To simplify the understanding of terminology and classification of groin pain in sports persons, the Doha agreement was introduced (2015) [7]. This consensus classifies groin-related pain into three primary categories:

1. Defined clinical entities of pain in groin area**:** This category includes:
    - Adductor-related groin pain: Identified by tenderness over the adductor muscles.
    - Iliopsoas-related groin pain: Involves tenderness over the iliopsoas muscle.
    - Inguinal-related groin pain: Pain and tenderness in the inguinal canal.
    - Pubic-related groin pain: Tenderness is specifically noted over the pubic symphysis and adjacent bone.
2. Groin pain in relation to hip.
3. Additional causes of painful groin in sports person (nerve entrapment, referred affliction).

This framework enables clearer reporting and greater comparability across studies. The Doha Agreement systematically examines the distribution of groin injury subtypes in football players. This review endeavours to determine the distribution of different subtypes of groin injury in football players using the standardised terminology and anatomical classification system.

MATERIALS AND METHODS

In the present narrative review, a literature search was conducted between January 2025 to March 2025 across major databases. The search was limited to studies aired up to December 2024. The time period for the final search for each database was as follows: PubMed (last searched on December 2024), British Journal of Sports Medicine (BJSM) (last searched on December 2024), Sage

Journals (last searched on December 2024), ResearchGate (last searched on December 2024), and Google Scholar (last searched on December 2024).

The search strategy used a combination of MeSH (Medical Subject Headings) and Boolean operators. The primary search terms were ("groin pain" OR "groin injury in football players" OR "groin pain in football players" OR "occurrence of groin harm in football players") AND ("Epidemiology" OR "Distribution" OR "Patterns" OR "Subtypes"). Articles which were in English-language were filtered.

Inclusion criteria:

- Studies involving soccer at all skill levels of play, sex, and age groups.
- Studies investigating the distribution of subtypes of groin pain.
- Studies using groin pain standardised terminology and recognised anatomical classification systems.
- Studies published in English.

Exclusion criteria:

- Articles focussing on non-football-related groin traumas.
- Case reports and expert opinions.
- Studies lacking a clear distribution of subtype data.

Study selection: After removing duplicates, two reviewers independently screened titles and abstracts for relevance. Subsequently, to full-text articles of eligible studies were retrieved and assessed against the inclusion criteria.

Study Procedure

Data extraction: Data on authors, year of study, study design, sample size, duration, player level, diagnostic method, total injury number and subgroup distribution were extracted by two independent reviewers from included studies.

Data items: The primary outcomes sought were the distribution of groin injury subtypes in total number of injuries and their distribution according to subtypes in numbers and percentage among football players using standardised terminologies. Additional variables extracted included players' skill level, study duration, and diagnostic method. Assumptions were made regarding "multiple entities" where studies reported total diagnosis counts exceeding the total number of injuries; these were mentioned as such.

Study risk of bias assessment: Quality assessment was performed using tools appropriate for each study design. For the cohort study Newcastle-Ottawa Scale (NOS) was used. For Cross-sectional study, a Modified Newcastle-Ottawa Scale (Modified-NOS) (adapted for cross-sectional studies) was used [8,9].

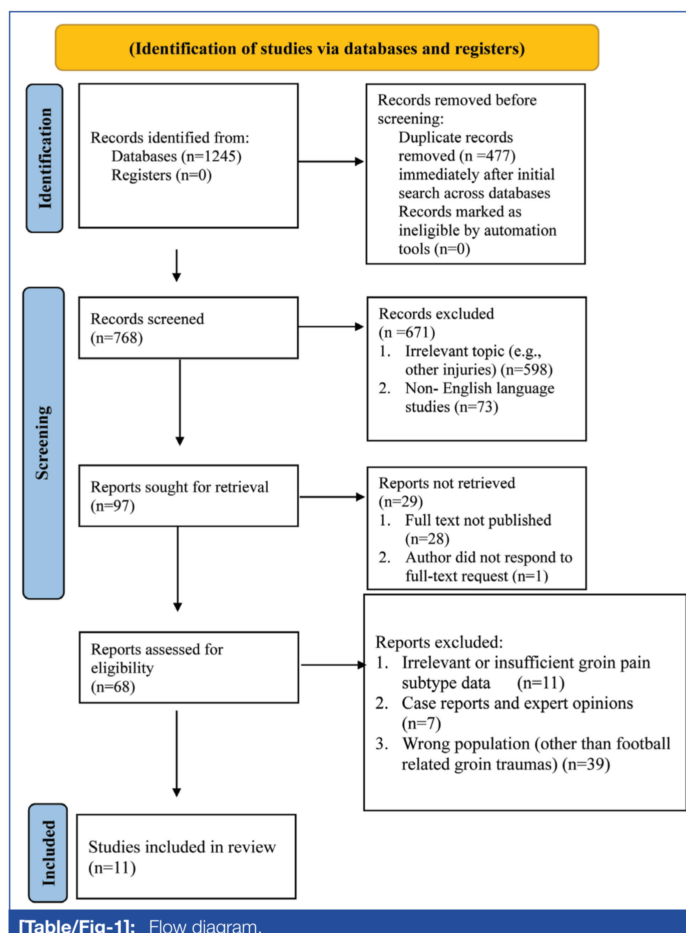
Due to heterogeneity in study designs and outcome reporting, a formal meta-analysis was not feasible. Therefore, a narrative synthesis was performed, and results were presented in a structured table [Table/Fig-1].

RESULTS

Study selection: An initial search identified 1,245 studies. After removing 477 duplicate records, 768 studies remained for title and abstract screening. Following screening, 97 full-text articles were looked up for eligibility. Eleven studies met the final inclusion criteria and were included for further evaluation. A flow diagram adapted from PRISMA principles was utilised to visually depict the article selection process for transparency [Table/Fig-1].

Study characteristics: The included studies comprised nine cohort studies, two cross-sectional studies. Most of the reports focused on professional male footballers, while a few studies examined female, amateur and youth athletes.

Distribution of groin injury subtypes: Across the 11 studies, a total of 4,226 groin injuries were reported.



[Table/Fig-1]: Flow diagram.

- Groin injuries related to the adductor were the most prevalent clinical entity, accounting for 2,476 (58.58%) of all cases.
- Iliopsoas-related injuries were the second most common representing 635 cases (15.02%).
- The remaining 1,176 cases (27.82%) were attributed to other causes, including inguinal, pubic, and hip-related injuries, are often underreported.
- Total locations of injury (4287) exceeds total number of injuries (4226) due to multiple clinical findings per player.
- Results of all distinct studies are given in [Table/Fig-2] [3,10-19].

Risk factors: Several studies identified common risk factors contributing to groin injuries, including:

- High-intensity training loads.
- Insufficient recovery periods.
- A history of previous groin injury history.
- Weakness or imbalance in hip and adductor musculature.
- Sudden directional changes, repetitive kicking, and explosive movements.

DISCUSSION

The present review synthesised data from 11 studies encompassing 4226 players to determine distribution of groin injury subtypes. The results highlight that groin pain related to adductors is the most common subtype of groin injury among footballers, accounting for 58.58% of all groin injuries followed by iliopsoas-related groin pain across professional, collegiate and sub elite skill level. While these injuries have been well-documented, there remains a lack of research into other subtypes of groin pain, including hip, inguinal, and pubic-related conditions. Furthermore, multiple clinical entities can be present from a single traumatic event.

The present findings are consistent with earlier epidemiological studies on groin pain in football players, identified that adductor related injuries remain the single most prevalent groin injury subtype

Author/Year	Study design	Sample size	Duration	Player level	Diagnostic method	Total injury numbers and subgroup distribution	Quality score
Thorarinsdottir S et al., (2024) [10]	Prospective cohort	294 football players (11 teams)	2 Seasons (63 weeks) 2020-2021	Professional	Clinical examination and MRI	Total (N): 67 Adductor: 37 (55%) Iliopsoas: 10 (15%) Rectus femoris: 8 (12%) Pubic: 5 (7%) Hip: 4 (6%) Inguinal: 2 (3%) Other cause: 1 (1%)	8/9 (NOS)
DeLang MD et al., (2021) [11]	Cross-sectional study	101 players	N.A. (Mid-season screening- one time point)	Academy soccer player	Clinical examination	Total (N): 22 Adductor-related: 14 (63.6%) Iliopsoas-related: 3 (13.6%) Pubic-related: 2 (9.1%) Multiple locations: 3 (13.6%)	5/9 (Modified NOS)
Ralston B et al., (2020) [12]	Retrospective cohort	Taken from NCAA Database	10 Years (2004-2014)	Collegiate women soccer	Athletic trainer diagnosis	Total (N): 439 Adductor injury: 164 (37%) Iliopsoas/sartorius: 135 (31%) Hip contusion: 54 (12%) Others: 86 (20%)	6/9 (NOS)
Werner J et al., (2019) [3]	Retrospective cohort	3,055 players (47 teams)	15 Seasons (2001-2016)	Professional	Clinical examination	Total (N): 1,812 Adductor-related: 1,139 (63%) Iliopsoas-related: 146 (8%) Pubic-related: 57 (3%) Inguinal-related: 66 (4%) Hip-related: 73 (4%) Other: 331 (18%)	7/9 (NOS)
Tummala SV et al., (2018) [13]	Retrospective cohort	Taken from NCAA database	10 Years (2004-2014)	Collegiate men soccer	Athletic trainer diagnosis	Total (N): 600 Adductor Strains: 279 (46.5%) Hip Flexor Strains: 164 (27.3%) Hip Contusions: 65 (10.8%) Other: 92 (15.4%)	6/9 (NOS)
Mosler AB et al., (2018) [14]	Prospective cohort	438 players	2 seasons (2013-2015)	Professional	Clinical examination (Using Doha Classification)	Total (N): 113 Adductor-related: 85 (75%) Iliopsoas-related: 15 (13%) Pubic-related: 14 (12%) Inguinal-related: 8 (7%) Hip-related: 1 (1%) (Percentages exceed 100% because multiple injury locations were recorded per player)	8/9 (NOS)
Mosler AB et al., (2018) [15]	Prospective cohort	606 players (17 clubs)	2 Seasons (2013-2015)	Professional	Clinical examination (Using Doha Classification)	Total (N): 240 Adductor-related: 162 (67.5%) Iliopsoas-related: 29 (12.08%) Pubic-related: 22 (9.17%) Inguinal-related: 19 (7.92%) Hip-related: 2 (0.83%) Other cause: 6 (2.5%)	8/9 (NOS)
Serner A et al., (2015) [16]	Cross-sectional study	110 athletes (76% Football players)	20 months (2012-2014)	Professional	Clinical examination and MRI, ultrasound	Total (N): 110 Adductor: 73 (66%) Iliopsoas: 28 (25%) Rectus Femoris: 25 (23%) Abdominal: 11 (10%) Rectus Femoris: 25 (23%) Sartorius: 7 (6%) (Percentages exceed 100% because multiple injury locations were recorded per player)	7/9 (Modified NOS)
Hölmich P (2014) [17]	Prospective cohort	998 players (44 clubs)	1 season (10 months)	Sub-elite	Clinical examination	Total (N): 58 Adductor-related: 30 (51%) Iliopsoas-related: 18 (30%) Abdominal-related: 11 (19%) Others: 16 (27%) (Percentages exceed 100% because multiple injury locations were recorded per player)	7/9 (NOS)
Werner J et al., (2009) [18]	Prospective cohort	465 players across 23 clubs	7 Seasons (2001-2008)	Professional	Clinical examination and MRI, US	Total (N): 628 Adductor injury: 399 (64%) Hip flexor/iliopsoas: 52 (8%) Rectus abdominis: 14 (2%) Hip joint injuries: 34 (5%) Hernia/Sportsman's hernia: 22 (4%) Others: 107 (17%)	7/9 (NOS)
Hölmich P (2007) [19]	Prospective cohort	207 athletes (137 football players)	N.A (consecutive series)	Recreational & professional athletes	Clinical examination	Total (N): 137 Adductor-related: 94 (68.6%) Iliopsoas-related: 35 (25.5%) Others: 8 (5.8%)	5/9 (NOS)

[Table/Fig-2]: Study characteristics [3,10-19].

in football accounting for 58.58% of all cases across professional, collegiate and sub elite skill level and iliopsoas related groin injuries being the second most common injuries accounting for 15.02%. This was similar to previous study done by Thorarinsdottir S et al., in 2024 who found adductor related injuries to be most common clinical entity (55%) of all cases followed by iliopsoas related injuries (15%) and Werner J et al., in 2019 who also found adductor related groin injuries to be most common clinical entity accounting for 63% of all cases followed by iliopsoas related accounting for 8% [3,10].

The present review also validates the necessity of using Doha agreement taxonomy as we found that studies failing to use these

definitions like Tummala SV et al., Ralston B et al., reported broad, nonspecific diagnosis like hip flexor strains [12,13]. In contrast, studies utilising Doha agreement taxonomy like Mosler AB et al., quantitively ranks the distribution of groin injuries subtypes as adductor (67.5%) being the primary clinical entity followed by iliopsoas (12.08%) as the close second and pubic related injuries (9.17%) as tertiary clinical entity [15].

Sources of Heterogeneity

A notable source of heterogeneity across the included studies lies in the diagnostic methodology and classification systems employed. Studies utilising the Doha agreement taxonomy, such as Mosler AB et al., (2018) and Thorarinsdottir S et al., provided quantifiable data on specific clinical entities, distinguishing clearly between iliopsoas, inguinal, pubic, and adductor-related pain [10,14]. In contrast, retrospective studies which used the NCAA (National Collegiate Athletic Association) database, such as Tummala SV et al., (2018) and Ralston B et al., relied on broad anatomical labels like hip flexor strain, internal rotator strain [12,13]. Even among these studies utilising Doha agreement taxonomy heterogeneity arises from how the classification was applied. Mosler AB et al., (2018) utilised the taxonomy prospectively, resulting in the identification of pubic-related (9.17%) and inguinal-related (7.92%) groin pain as substantial burdens [15]. In contrast, Werner J et al., (2019) applied the Doha codes retrospectively over 15 years which significantly lower rates of pubic (3%) and inguinal (4%) injuries compared to Mosler AB et al., (2018) [3,15].

Biomechanics

This distribution of groin injury subtypes deviation towards adductor and iliopsoas related pathology is likely due to repetitive kicking, side-to-side movements, and twisting demands seen in football [1,20]. The primary function of the adductor muscle group is hip adduction during open-chain movements and stabilisation of the lower extremity and pelvis during the stance phase of closed-chain movements [21]. These muscles are crucial for stabilising and decelerating the body and pelvis during activities requiring changes of direction and fast near-isometric and eccentric contractions during musculotendinous lengthening, as seen in skating, sprinting, and kicking [6]. This constant demand for rapid stabilisation creates a mechanical environment where tissue tolerance is frequently exceeded, explaining why the adductor longus is the most frequent point of failure.

As the primary hip flexor, the iliopsoas is heavily recruited during kicking (specially the swing phase which involves the transition from hip extension to explosive flexion of hip) and during high-speed sprinting. This repetitive, high-velocity loading places the muscle-tendon unit under significant eccentric stress, explaining its rank as the second most common injury subtype [16]. This burden is disproportionately higher as seen in specific studies like Holmich P in 2014 who found iliopsoas pain to be accountable for 30% of injuries in sub-elite players, likely due to reduced pelvic stability, while another study by Ralston B et al., in 2020 observed increased rates of iliopsoas injury in female players, potentially linked to wider pelvic area which alter the angle of muscle pull [12,17].

The review highlights the strong role of training load and recovery management in groin injury risk. Players exposed to high-intensity or congested match schedules without sufficient rest were more likely to develop groin pain. This finding supports the importance of structured load monitoring and individualised training programs as generic (core stability) programs are likely insufficient given the specific subtype distribution. Additionally, preventive measures targeting muscle imbalance- such as adductor strengthening, hip flexibility training, and neuromuscular control exercises-may help reduce the incidence of groin injuries. As there were cases where player suffered with multiple clinical entities, after finding a positive adductor injury there should be mandatory screening of adjacent structures (iliopsoas, pubic, inguinal).

Limitation(s)

Several limitations were identified within the existing body of evidence. Few studies explicitly adopted the Doha terminology, leading to challenges in consistency and interpretation. Only a minority of studies utilised strict adherence to the Doha agreement taxonomy, allowing for precise categorisation. The majority of large-scale data sources, including the NCAA studies by Tummala SV et al., and Ralston B et al., relied on broad anatomical labels like hip flexor strain [12,13].

Diagnostic criteria also varied considerably across studies, reducing reliability of pooled estimates. As seen in studies like Tummala SV et al., relying on athletic trainers produced the least specific data, utilising broad anatomical labels like hip flexor strains without physician confirmation [13]. Moreover, there is an underrepresentation of female athletes and youth players. As only two studies Thorarinsdottir S et al., and Ralston B et al., addressed female athletes and only one study by DeLang MD et al., investigated youth players, limiting the generalisability of results [10-12]. This review was also restricted to English language publications, which may have excluded relevant epidemiological data from high-participation countries which does not use English as primary language.

CONCLUSION(S)

Groin pain remains a prevalent issue in football. Based on the current reporting, adductor related injuries appear to be most frequently reported groin injury subtypes. While iliopsoas related injuries represent a secondary burden, other subtypes of groin injuries such as hip, inguinal and pubic-related pain are less frequently reported but it may reflect diagnostic limitations rather than true prevalence. Standardised classification, improved diagnostic accuracy, and evidence-based prevention programs are essential to address these complex injuries and reduce the injury burden in football. Future research should focus on studies that use standardised diagnostic models to ensure comparability and consistency. In addition, female athletes' participation, youth populations, and amateur players must be included in future studies to improve applicability. Hip-related, inguinal-related, and pubic-related injuries need further investigation as they are under-researched. Lastly, assessing the efficacy of targeted preventive measures could yield important insights toward minimising the burden of groin injury within sport.

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