

Hip and Groin Injuries in Dancers: A Systematic Review

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Context: Injury data on hip and groin injuries vary, and these injuries are often misrepresented or overlooked for more commonly seen injuries, such as those to the foot and ankle.

Objective: To provide a systematic review of the injury rates of hip and groin pathology in dancers and look to establish a better understanding of the occurrence of hip and groin injuries in the dancer population.

Data Sources: A literature search was performed using PubMed and CINAHL databases for articles published between 2000 and 2016.

Study Selection: Inclusion criteria consisted of (1) documentation of the number of hip and/or groin injuries, (2) study population consisting of dancers whose training included some level of ballet, and (3) studies of levels 1 through 3 evidence.

Study Design: Systematic review.

Level of Evidence: Level 3.

Data Extraction: A single reviewer identified studies that met the inclusion criteria. The number of overall injuries, hip/groin injuries, study participants, injured participants, training hours per week, mean age of study group, injury definition, injury reporting method, and study time frame were extracted.

Results: Thirteen unique studies were included in the descriptive analysis. Of the 2001 dancers included in this study, 3527 musculoskeletal injuries were seen in 1553 dancers. Of these, 345 injuries were localized to the hip and groin region (overall rate, 17.2%). An incidence rate of 0.09 hip and groin injuries per 1000 dance-hours was seen in the selected cohort studies. Of 462 professional dancers, 128 hip/groin injuries were recorded, for an injury rate of 27.7%. Of the 1539 student dancers, 217 hip/groin injuries were recorded, for an injury rate of 14.1% ($P < 0.01$).

Conclusion: Data on hip and groin injuries have many limitations. However, these injuries represent an important health issue for dancers of all skill levels, encompassing 17.2% of musculoskeletal injuries seen in dancers. An increasing rate of hip/groin injuries is seen in professional dancers compared with students.

Keywords: hip; groin; ballet; dance; injuries

Dancers move various body segments in repetitive rhythmic fashion to demonstrate their artistic expression and athletic prowess while placing significant physical demands on their bodies. This often requires extreme ranges of motion, particularly of the hip, as well as controlled displays of strength to obtain optimal form.

Dance medicine has sought to define injury rates in dancers over recent years in hopes of identifying risk factors and devising improved prevention techniques for the unique injury patterns seen. Hip and groin injuries in dancers tend to occur at a lower frequency relative to injuries at the more distal lower extremities, such as the foot and ankle.^{5,8,10-13,18,23,25,28,29} As young

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Table 1. Inclusion and exclusion criteria

Inclusion Criteria	Exclusion Criteria
Number of hip/groin injuries or pain reported	No report of hip/groin injuries
Student or professional dancer whose training includes ballet	Reviews, case reports, abstracts, or presentations
Levels 1 through 3 evidence	Animal, cadaver, or in vitro studies
English language	

adult hip pathology becomes better understood and less invasive treatment options increase, focus on hip and groin injuries in athletes and dancers grows.

METHODS

Literature Search and Criteria

A literature search was performed in August 2016 using OVID/MEDLINE (PubMed) and CINAHL (Cumulative Index to Nursing and Allied Health Literature) databases, with a date range from January 2000 to August 2016. A keyword search was performed by application of a combination of the following words: *hip, groin, injury, ballet, dance, strain, sprain, femoroacetabular impingement, FAI, snapping hip, bursitis, and labral tear*. Language was limited to English, and all subjects were human. Duplicate patient populations appearing in separate distinct publications were analyzed only once. The titles of articles were initially reviewed to assess for relevance to the topic, with further review of the abstract and manuscript as required. Cross-referencing of the bibliographies of relevant articles was performed for completeness.

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were followed in preparation of this review.²⁰ The inclusion and exclusion criteria are detailed in Table 1. Diagnostic and prognostic studies reporting incidence or prevalence of hip and groin injuries in dancers were included.

Outcome Measures

The primary outcome measure of interest was number of hip/groin injuries. The number of overall dancers, number of injured dancers, number of injuries, and mean training hours were used to establish injury rates.

Data Extraction

The data on outcomes measures were identified from each study and recorded in Microsoft Excel (Microsoft, Inc). To systematically review all included studies, country of origin, year of publication, journal of publication, author list, training level, definition of injury, age, sex, number of participants, number of injured participants, number of injuries, number of hip injuries, nature of study, and study time frame were recorded.

Data Analysis

The included patient cohorts were pooled, where possible, and rate of hip/groin injuries was calculated with regard to the overall dancer population studied. Incidence rates of injury for hip and groin injuries were calculated for cohort studies reporting hours per week of training. Fischer exact analysis with a significance level of 0.05 was employed to compare the number of hip injuries based on level of dance expertise (dancing students vs professionals).

RESULTS

Thirteen unique studies were included in our systematic review of the literature (Table 2).

A total of 2001 dancers were included in the systematic review: 462 professional dancers and 1539 student dancers (1436 women and 565 men). The mean age of the combined study group was 17.9 years. Nine studies characterized training hours, with a mean 27.1 training hours per week. The majority (69%) of studies focused only on ballet dancers, while the remaining studies included ballet as well as other dance forms.

A total of 3527 musculoskeletal injuries were seen in 1553 dancers, with 9.8% ($n = 345$) of these being related to the hip or groin (Table 3). With a study population of 2001 dancers, a hip/groin injury rate of 17.2% was found. Studies were inconsistent on reporting training hours, but using the cohort studies reporting exposure time, an incidence rate of 0.09 hip groin injuries per 1000 dance-hours was found, ranging from 0.05 to 0.38 across the individual studies (Table 4).

Of 462 professional dancers, 128 hip/groin injuries were recorded, for an injury rate of 27.7%. Of the 1539 student dancers, 217 hip/groin injuries were recorded, for an injury rate of 14.1% ($P < 0.01$) (Table 5).

Only 3 studies sought to differentiate between overuse and traumatic hip/groin injuries.^{18,21,22} Of the 82 hip/groin injuries among these 3 studies, 85% were overuse injuries.

Only 2 studies distributed hip/groin injuries by age.^{18,28} One study found no hip/groin injuries in those younger than 10 years, 20 injuries in those aged 11 to 14 years, and 26 injuries in those aged 15 to 21 years.¹⁸ A second study found 1 injury in dancers younger than 12 years and 24 injuries in those older than 12 years.²⁸ Because there were only 2 studies reviewed, no comparisons were able to be performed.

Table 2. Summary of study demographics

Study	Year	Country	Training Level	Mean Age, y	Sex	Training, h/wk	Dance Type
Nilsson et al ²²	2001	Sweden	103 professionals	28.3	52F/51M	48	Ballet
Byhring and Bo ⁴	2002	Norway	41 professionals	26.7	27F/14M	35	Ballet
Luke et al ¹⁹	2002	USA	39 students	15.8	34F/5M	22.4	Mixed
Kish et al ¹⁵	2003	USA	173 students	15.2	167F/6M	15.2	Mixed
Negus et al ²¹	2005	Australia	29 students	18	24F/5M	NR	Ballet
Gamboa et al ¹¹	2008	USA	204 students	14.7	163F/41M	20	Ballet
Leanderson et al ¹⁸	2011	Sweden	476 students	14.5	297F/179M	11.75	Ballet
Duthon et al ⁷	2013	Switzerland	20 professionals	26	20F	>12	Ballet
Ekegren et al ⁸	2013	UK	266 students	17.2	154F/112M	30.3	Ballet
Sobrinho et al ²⁵	2015	Spain	145 professionals	25.8	75F/70M	NR	Ballet
Stracciolini et al ²⁸	2015	USA	171 students	14.7	171F	NR	Mixed
Ramkumar et al ²³	2016	USA	153 professionals	27	81F/72M	27.5	Ballet
Yin et al ²⁹	2016	USA	181 students	14.8	171F/10M	NR	Mixed
Total			2001	17.9	1436F/565M	27.1	

F, female; M, male; NR, not recorded.

DISCUSSION

While lower extremity injuries are very common among dancers, injuries to the hip and groin are rarely discussed in detail and may be overlooked in favor of more common injuries.^{3,5,9,12,13,17,19,22,26} A single sports medicine practice has reported that 50% of dancers presenting to their clinic within a 3-year period for assessment and treatment presented with hip complaints.¹⁶ A spectrum of hip and groin injuries is experienced in both male and female dancers as the hips pass through high repetitions of extreme ranges of motion during practice and performance. The hip and groin are also susceptible to injury through high-impact jumps and landings.

Epidemiology

Hip and groin injuries accounted for 9.8% of all injuries reported in dancers. In an attempt to compare injury rates across studies, the available evidence was pooled and the injury rate per dancer was measured. A review of the literature found a 17.7% hip/groin injury rate among all dancers studied, with individual studies ranging from 9.7% to 80%. This assumes each injury reported occurred in a single dancer and no bilateral injuries were reported. If considering the risk “per hip” as opposed to “per dancer,” the injury rate per hip is 8.6% in the 4002 hips studied.

Prior studies show a 40% to 55% rate of musculoskeletal injury in professional ballet companies and 85% rate of musculoskeletal injury in dance students.^{3,9,13,24} In looking at hip/groin injuries, 5 studies focused on professional dancers and 8 studies on student dancers at various levels. In this review, a 27.6% hip/groin injury rate was seen in the professional population versus a 14.1% hip/groin injury rate seen in the student population ($P < 0.01$). In looking at dance students at private studios versus elite training schools, similar numbers of training hours and injury patterns have been seen, and both were categorized as “students” in this review.¹⁵

Compared with previously reported rates of generalized musculoskeletal injury in professional versus student dancers, this review found a reversal of the trend when looking specifically at hip and groin injuries. While professional dancers were more prone to hip/groin injuries than their student counterparts, the etiology is unclear: It may be secondary to higher levels of training or skill, increased exposure time, or older age. As a group, professional dancers tend to be older, with hip injuries in dancers occurring with increasing age.^{18,27,28}

Dance injuries can be classified as either traumatic or overuse, a factor considered in 3 studies presented. Not surprisingly, given the repetitive nature and extreme ranges of motion required in dance, overuse injuries of the hip are more common than acute traumatic injuries among dancers.^{2,4,18,21,22} Of those

Table 3. Summary of injury characteristics

Study	Dancers	Injured Dancers	Total Injuries	Hip/Groin Injuries	Injury Diagnosis	Study	Study Time Frame
Nilsson et al ²²	103	98	390	15	Medical	R/P	5 y
Byhring and Bo ⁴	41	31	64	10	Self-report	P	19 wk
Luke et al ¹⁹	39	35	112	9	Self-report	P	9 mo
Kish et al ¹⁵	173	134	226	15	Self-report	R	Indefinite
Negus et al ²¹	29	29 (24F/5M)	82	21	Self-report	R	2 y
Gamboa et al ¹¹	204	151	378	43	Medical	R	5 y
Leanderson et al ¹⁸	476	210	438	46	Medical	R	7 y
Duthon et al ⁷	20	12 (12F)	16	16	Self-report	R	1 d
Ekegren et al ⁸	266	203 (117F/86M)	378	29	Medical	P	1 y
Sobrino et al ²⁵	145	145 (75F/70M)	486	56	Medical	R	5 y
Stracciolini et al ²⁸	171	171 (171F)	171	25	Medical	R	10 y
Ramkumar et al ²³	153	153 (81F/72M)	574	31	Medical	R	10 y
Yin et al ²⁹	181	181 (171F/10M)	222	29	Medical	R	10 y
Total	2001	1553	3527	345			

F, female; M, male; P, prospective; R, retrospective.

Table 4. Incidence rate of hip/groin injuries

Study	Dancers	Injured Dancers	Total Injuries	Hip/Groin Injuries	Total Hours	Hip/Groin Injury Incidence (per 1000 Dancer-Hours)
Nilsson et al ²²	103	98	390	15	69,032	0.22
Byhring and Bo ⁴	41	31	64	10	190,855	0.05
Luke et al ¹⁹	39	35	112	9	23,779	0.38
Gamboa et al ¹¹	204	151	378	43	257,143	0.17
Leanderson et al ¹⁸	476	210	438	46	555,318	0.08
Ekegren et al ⁸	266	203	378	29	274,089	0.11
Ramkumar et al ²³	153	153 (81F/72M)	574	31	630,769	0.05
Total	1282	881	2334	183	2,000,985	0.09

F, female; M, male.

Table 5. Injury characteristics between professional and student dancers

Study	Dancers	Mean Age, y	Injured Dancers	Total Injuries	Hip/Groin Injuries	Training, h/wk
Professional dancers						
Nilsson et al ²²	103	28.3	98	390	15	48
Byhring and Bo ⁴	41	26.7	31	64	10	35
Duthon et al ⁷	20	26	12 (12F)	16	16	>12
Sobrinho et al ²⁵	145	25.8	145 (75F/70M)	486	56	NR
Ramkumar et al ²³	153	27	153 (81F/72M)	574	31	27.5
Total	462	26.8	439	1530	128	34.2
Student dancers						
Luke et al ¹⁹	39	15.8	35	112	9	22.4
Kish et al ¹⁵	173	15.2	134	226	15	15.2
Negus et al ²¹	29	18	29 (24F/5M)	82	21	NR
Gamboa et al ¹¹	204	14.7	151	378	43	20
Leanderson et al ¹⁸	476	14.5	210	438	46	11.75
Ekegren et al ⁸	266	17.2	203 (117F/86M)	378	29	30.3
Stracciolini et al ²⁸	171	14.7	171 (171F)	171	25	NR
Yin et al ²⁹	181	14.8	181 (171F/10M)	222	29	NR
Total	1539	15.2	1114	2007	217	18.3

F, female; M, male; NR, not recorded.

studies, 85% of hip injuries were overuse in nature, with the majority of diagnoses being tendinitis. Overuse injuries in dancers ranged from 47% to 93%.^{2,6,14,21}

Within these large epidemiological studies, the various types of hip and groin injuries were not defined; instead, they were grouped by anatomic location. The breakdown of specific injuries such as snapping hip, labral tears, and muscle strains was not possible in this study.

Limitations

This systematic review is limited by the number and types of primary resources available in the literature. It is difficult to establish an accurate injury rate when combining studies because of differences in study periods and the lack of consistent exposure time data. Additionally, the variation in injury rates may be explained by different study populations, use of retrospective or prospective designs, different data collection methods or varying definitions of injury.

The design of the studies may affect the determination of injury rates, with 9 studies using retrospective data collection, 3 utilizing a

prospective design, and 1 having a mixed design. Studies that used a retrospective design may experience recall bias when questionnaires are utilized for data collection. Even when medical records are reviewed, the definition of injury has been predetermined and/or data may be missing. Several studies relied on self-report, which depends on the dancers' opinions of their injury and, when done retrospectively, on their memory. Other studies utilized a diagnosis by medical professionals, which requires dancers to seek medical attention for their injuries. However, dancers may have avoided medical treatment to keep performing and decided to work through chronic or minor injuries.¹² Physicians have been viewed by dancers as third-line providers for dance-related injuries, behind dance instructors and physical therapists.¹ This may be due to mistrust of the medical profession or fear of job loss. There is also a tendency for severe injuries to be reported while minor injuries are ignored or overlooked.¹⁹ However, these minor injuries may be part of an overuse injury that may culminate in a larger, more severe injury in the future.

Various definitions of injury were employed by different studies. The most common definition involved seeking care and

treatment from a health care provider or therapist, but only 4 required associated modification or loss of training.^{4,8,21,23} One study did not clearly define “injury,” and another defined “pain during dance” as a reported injury.^{7,15} Lack of consistency on injury definition among the studies makes comparisons across populations less efficient and reliable.

In generalized epidemiological injury studies, hip injuries are poorly defined or more often grouped with other injury sites (pelvic/spine/other), resulting in underreporting of these types of injuries. Without a standard methodology for injury surveillance among dancers, pooling data and meaningful comparison to guide injury prevention efforts remains challenging.

CONCLUSION

Hip and groin injuries are an important health issue for dancers of all skill levels, presenting with an injury rate of 17.7% in this systematic review. This risk of injury is especially concerning for dancers as they grow older and increase their skill levels. Despite inherent study limitations, the risk of hip and groin injuries in dance medicine appears to be a larger issue than previously thought. Improved methodology for injury surveillance will help better characterize the true rate of injury and hip pain in this population.

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