Hip and Groin Injuries in Dancers: A Systematic Review

Natasha Trentacosta, MD,*†‡§ Dai Sugimoto, PhD, ATC, CSCS,†‡§ and Lyle J. Micheli, MD†‡§

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.\(^{5,8,10,13,14,22,25,28,29}\) As young...
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. 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.

| 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                                        |                                         |

**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. Of the 82 hip/groin injuries among these 3 studies, 85% were overuse injuries. Only 2 studies distributed hip/groin injuries by age. 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. A second study found 1 injury in dancers younger than 12 years and 24 injuries in those older than 12 years. Because there were only 2 studies reviewed, no comparisons were able to be performed.
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. 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. 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. 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. 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.

Prior studies show a 40% to 55% rate of musculoskeletal injury in professional ballet companies and 85% rate of musculoskeletal injury in dance students. 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. This 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. 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.
Table 3. Summary of injury characteristics

| Study               | Dancers | Injured Dancers | Total Injuries | Hip/Groin Injuries | Injury Diagnosis | Study | Study Time Frame |
|---------------------|---------|-----------------|----------------|--------------------|-----------------|-------|------------------|
| Nilsson et al22     | 103     | 98              | 390            | 15                 | Medical         | R/P   | 5 y              |
| Byhring and Bo4     | 41      | 31              | 64             | 10                 | Self-report     | P     | 19 wk            |
| Luke et al19        | 39      | 35              | 112            | 9                  | Self-report     | P     | 9 mo             |
| Kish et al15        | 173     | 134             | 226            | 15                 | Self-report     | R     | Indefinite       |
| Negus et al21       | 29      | 29 (24F/5M)     | 82             | 21                 | Self-report     | R     | 2 y              |
| Gamboa et al11      | 204     | 151             | 378            | 43                 | Medical         | R     | 5 y              |
| Leanderson et al18  | 476     | 210             | 438            | 46                 | Medical         | R     | 7 y              |
| Duthon et al7       | 20      | 12 (12F)        | 16             | 16                 | Self-report     | R     | 1 d              |
| Ekegren et al8      | 266     | 203 (117F/86M)  | 378            | 29                 | Medical         | P     | 1 y              |
| Sobrino et al25     | 145     | 145 (75F/70M)   | 486            | 56                 | Medical         | R     | 5 y              |
| Stracciolini et al28| 171     | 171 (171F)      | 171            | 25                 | Medical         | R     | 10 y             |
| Ramkumar et al23    | 153     | 153 (81F/72M)   | 574            | 31                 | Medical         | R     | 10 y             |
| Yin et al29         | 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 al22     | 103     | 98              | 390            | 15                 | 69,032      | 0.22                                              |
| Byhring and Bo4     | 41      | 31              | 64             | 10                 | 190,855     | 0.05                                              |
| Luke et al19        | 39      | 35              | 112            | 9                  | 23,779      | 0.38                                              |
| Gamboa et al11      | 204     | 151             | 378            | 43                 | 257,143     | 0.17                                              |
| Leanderson et al18  | 476     | 210             | 438            | 46                 | 555,318     | 0.08                                              |
| Ekegren et al8      | 266     | 203             | 378            | 29                 | 274,089     | 0.11                                              |
| Ramkumar et al23    | 153     | 153 (81F/72M)   | 574            | 31                 | 630,769     | 0.05                                              |
| Total               | 1282    | 881             | 2334           | 183                | 2,000,985   | 0.09                                              |

F, female; M, male.
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%.

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.

Physicians have been viewed by dancers as third-line providers for dance-related injuries, behind dance instructors and physical therapists. 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. This may be due to the medical profession or fear of job loss. 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

---

**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 al12              | 103     | 28.3        | 98              | 390            | 15                 | 48            |
| Byhring and Bo4              | 41      | 26.7        | 31              | 64             | 10                 | 35            |
| Duthon et al17               | 20      | 26          | 12 (12F)        | 16             | 16                 | >12           |
| Sobrino et al25              | 145     | 25.8        | 145 (75F/70M)   | 486            | 56                 | NR            |
| Ramkumar et al23             | 153     | 27          | 153 (81F/72M)   | 574            | 31                 | 27.5          |
| **Total**                    | 462     | 26.8        | 439             | 1530           | 128                | 34.2          |
| **Student dancers**          |         |             |                 |                |                    |               |
| Luke et al19                 | 39      | 15.8        | 35              | 112            | 9                  | 22.4          |
| Kish et al15                 | 173     | 15.2        | 134             | 226            | 15                 | 15.2          |
| Negus et al21                | 29      | 18          | 29 (24F/5M)     | 82             | 21                 | NR            |
| Gamboa et al11               | 204     | 14.7        | 151             | 378            | 43                 | 20            |
| Leanderson et al18           | 476     | 14.5        | 210             | 438            | 46                 | 11.75         |
| Ekegren et al8               | 266     | 17.2        | 203 (117F/86M)  | 378            | 29                 | 30.3          |
| Stracciolini et al28         | 171     | 14.7        | 171 (171F)      | 171            | 25                 | NR            |
| Yin et al29                  | 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.
treatment from a health care provider or therapist, but only 4 required associated modification or loss of training.10,21,22 One study did not clearly define “injury,” and another defined “pain during dance” as a reported injury.23,24 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.

**REFERENCES**

1. Air ME, Grierson MJ, Davenport KL, Krabak BJ. Dissecting the doctor-dancer relationship: health care decision making among American collegiate dancers. *PM R*. 2014;6:241-249.
2. Allen N, Neill AM, Brooks JH, Koutalakis Y, Wyon MA. The effect of a comprehensive injury audit program on injury incidence in ballet: a 5-year prospective study. *Clin J Sport Med*. 2013;23:575-578.
3. Bronner S, Brownstein B. Profile of dance injuries in a Broadway show: a discussion of issues in dance medicine epidemiology. *J Orthop Sports Phys Ther*. 1997;26:87-94.
4. Byhring S, Bo K. Musculoskeletal injuries in the Norwegian National Ballet: a prospective cohort study. *Scand J Med Sci Sports*. 2002;12:565-570.
5. Caine D, Goodwin BJ, Caine CG, Bergeron G. Epidemiological review of injury in pre-professional ballet dancers. *J Dance Med Sci*. 2015;19:140-148.
6. Coplan JA. Ballet dancer’s turnout and its relationship to self-reported injury. *J Orthop Sports Phys Ther*. 2002;32:579-584.
7. Duthion VB, Charbonnier C, Kolo FC, et al. Correlation of clinical and magnetic resonance imaging findings in hips of elite female ballet dancers. *Arthroscopy*. 2015;30:411-419.
8. Eleegreen CL, Quested R, Broderick A. Injuries in pre-professional ballet dancers: incidence, characteristics and consequences. *J Sci Med Sport*. 2014;17:271-275.
9. Evans RW, Evans RI, Carvajal S, Perry S. A survey of injuries among Broadway performers. *Am J Public Health*. 1996;86:77-80.
10. Fulton J, Burgi C, Canizares RC, Sheets C, Butler RJ. Injuries presenting to a walk-in clinic at a summer dance intensive program: a three-year retrospective data analysis. *J Dance Med Sci*. 2014;18:151-155.
11. Gamboua JM, Roberts LA, Maring J, Fergus A. Injury patterns in elite preprofessional ballet dancers and the utility of screening programs to identify risk characteristics. *J Orthop Sports Phys Ther*. 2008;38:126-130.
12. Garrison JC. Early identification of musculoskeletal complaints and injuries among female ballet students. *J Dance Med Sci*. 1999;3:80-83.
13. Garrison JC, Roquai RK. Ballet injuries. An analysis of epidemiology and financial outcome. *Am J Sports Med*. 1999;27:586-590.
14. Hamilton WG, Hamilton LH, Marshall P, Molnar M. A profile of the musculoskeletal characteristics of elite professional ballet dancers. *Am J Sports Med*. 1992;20:267-273.
15. Kish RL, Plastino JG, Martyn-Stevens B. A young dancer survey. *Med Probl Perform Artists*. 2003;18:101-105.
16. Kocher MS, Solomon R, Lee BM. Arthroscopic debridement of labral tears in dancers. *J Dance Med Sci*. 2006;10:99-105.
17. Krasnow D, Mainwaring L, Kerr G. Injury, stress, and perfectionism in young dancers and gymnasts. *J Dance Med Sci*. 1999;3:51-58.
18. Leanderson C, Leanderson J, Wylkman A, Strender LE, Johansson SE. Sundquist K. Musculoskeletal injuries in young ballet dancers. *Knee Surg Sports Traumatol Arthrosoc*. 2011;19:1553-1555.
19. Luke AG, Kenney SA, DHenemour PA, Baum J, Owen M, Micheli LJ. Determinants of injuries in young dancers. *Med Probl Perform Artists*. 2002;17:105-112.
20. Moher D, Liberati A, Tetzlaff J, Altman DG, Group P. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *BMJ*. 2009;339:b2535.
21. Negus V, Hopper D, Beffa NK. Associations between turnout and lower extremity injuries in classical ballet dancers. *J Orthop Sports Phys Ther*. 2005;35:307-318.
22. Nilsson C, Leanderson J, Wylkman A, Strender LE. The injury panorama in a Swedish professional ballet company: Knee Surg Sports Traumatol Arthrosoc. 2001;9:242-246.
23. Ramkumar PN, Farber J, Amoud J, Varner KE, McCulloch PC. Injuries in a professional ballet dance company: a 10-year retrospective study. *J Dance Med Sci*. 2016;20:50-57.
24. Rovere GD, Webb LX, Gostima AG, Vogel JM. Musculoskeletal injuries in theatrical dance students. *Am J Sports Med*. 1983;11:195-198.
25. Sobrino FJ, de la Cuadra C, Guillen P. Overuse injuries in professional ballet: injury-based differences among ballet disciplines. *Orthop J Sports Med*. 2015;3:252558715590114.
26. Solomon R, Micheli LJ, Solomon J. The “cost” of injuries in a professional ballet company: anatomy of a season. *Med Probl Perform Artists*. 1995;10:3-10.
27. Steinberg N, Aujla I, Zeev A, Redding E. Injuries among talented young dancers: findings from the U.K. Centres for Advanced Training. *Int J Sports Med*. 2014;35:238-244.
28. Straccioli A, Yin AX, Sugimoto D. Etiology and body area of injuries in young ballet dancers: findings from the U.K. Centres for Advanced Training. *Int J Sports Med*. 2014;35:238-244.
29. Yin AX, Sugimoto D, Martin DJ. Straccioli A. Pediatric dance injuries: a cross-sectional epidemiological study. *PM R*. 2016;8:548-555.

For reprints and permission queries, please visit SAGE’s Web site at http://www.sagepub.com/journalsPermissions.nav.