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Injuries in Ballet: Risk Factors, Treatment and Preventative Techniques

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Abstract. Ballet is both an athletic and artistic discipline, with dancers often facing a high risk of injury due to the physical demands of long hours of training and performance. Despite this, there is limited research on the specific causes of ballet injuries and effective prevention strategies. This paper aims to review the existing literature to better understand the types of injuries commonly experienced by ballet dancers and the factors contributing to them. It is found that the majority of ballet injuries are concentrated in the lower extremities, with overuse and inadequate muscle strength being the primary causes. Other risk factors include improper technique, fatigue, and the physical demands of repetitive movements. To effectively prevent these injuries, it is crucial for dancers to build adequate muscle strength, maintain proper technique, and receive consistent support from a medical team. This review provides valuable insights into injury prevention, emphasizing the importance of strength training and teamwork in ensuring dancers' long-term health and performance.

Keywords: Ballet injuries, Injury prevention, Muscle strength, Overuse injuries, Dancer health.

1. Introduction

Ballet is a classical form of dance that is categorized as a performing art. During a performance season, a ballet dancer may perform in an approximately 145 shows, with 30 to 40 hours of dance training and rehearsals per week [1]. Depending on their position in the company, dancers may have significant differences in their workload due to varying roles in performances, resulting in different amount of time spent on stage and in rehearsals. Without proper alignment and technique, dancers are at a higher risk of injury. Over-turnout, improper landing from jumps and extreme stretching are common causes of knee and ankle injuries in ballet. Additionally, the differences in the technique between male and female dancers can lead to varying risks of injury. According to Garrick J. G. et al., shoulder injuries account for 4.0% of all injuries in male dancers, but only 1.2% in female dancers, likely due to the lifting techniques predominantly performed by males [2]. It has been documented that ballet dancers are at high risk of injury, with 3960 cases founded in a 17-year period [2]. On average, a single ballet dancer experiences approximately 6.8 injuries per year [3]. However, significant gaps remain in the understanding, treatment and prevention of ballet injuries. Therefore, the purpose of this review is to consolidate information on ballet injuries and provide strategies to help dancers prevent them.

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2. Common injuries

The high physical demands of ballet, including turnout, extreme stretching, and sustained pointe work, place considerable stress on dancers' bodies, increasing the risk of injury. For instance, performing on pointe subjects the ankle to significant pressure, requiring strong stabilizing muscles to prevent injuries such as sprains. Despite adequate strength and conditioning, overuse injuries remain a concern, particularly after extended periods of intense training. Therefore, understanding the causes and risk factors associated with these injuries is crucial for developing effective prevention and treatment strategies.

2.1. Upper limb injuries

Upper limb injuries are relatively uncommon among ballet dancers, accounting for a smaller proportion of overall injuries [3, 4]. According to Milan et al., approximately 10% of all ballet injuries involve the upper limbs, with the majority affecting the wrist and hand (5%). Shoulder injuries account for 2.4%, while elbow and upper arm injuries each contribute 1.2% [4]. In a study by Ekegren et al., upper limb injuries comprised only 3% of all injuries, with 64% of these being shoulder-related [5].

2.2. Back injuries

Ballet dancers are at a particularly high risk of developing back injuries, especially due to the demands of partner lifting and extreme spinal extensions [6]. Over a one-year period, back injuries represented 23% of all injuries among female dancers and 22% among male dancers [3]. Significant stress is placed on the spine through repeated lifting, hyperextension, and incorrect technique [7]. Improper execution of port de bras or partner lifts can lead to lower back pain. The arabesque position, which requires the extended leg to be raised beyond 90°, can also contribute to lower back pain, as the body compensates to maintain alignment of the pelvis and spine [7].

2.3. Lower limb injuries

Lower limb injuries are the most prevalent among ballet dancers, affecting the hip, knee, lower leg, ankle, and foot. Injuries to the knee and ankle are particularly common, with prevalence rates ranging from 14-20% and 15-22%, respectively. Foot injuries occur at an incidence rate of approximately 13-15%, while lower leg injuries account for 5-8% [4]. A survey of 239 dancers revealed that 86.6% of participants had experienced lower extremity injuries within a two-year period, equating to 207 dancers [8].

3. Risk factors

Ballet injuries can arise from various risk factors, which can be broadly categorized into intrinsic and extrinsic factors.

3.1. Intrinsic factors

Intrinsic factors are those related to the dancer’s physical characteristics and biomechanics. According to Allen et al., the risk of injury from intrinsic factors is higher in both male and female dancers, with injury rates of 2.65 and 3.12 per 1,000 hours of training, respectively [3]. Modifiable intrinsic factors include hypermobility, fatigue, overuse, turnout, muscle weakness, and discrepancies in range of motion [8].

Dancers, compared to non-dancers, exhibit higher scores on functional capacity measures, yet they also experience a greater degree of fatigue (mean score of 47 for dancers compared to 26 for non-dancers) [9]. Dancers are also more likely to have generalized joint hypermobility (GJH), with 66% of dancers affected compared to 29% of non-dancers [9]. This hypermobility can lead to injuries such as tendinopathy, joint degeneration, and hip instability [9-11].

Hyperextension of the knee is another common issue in ballet, largely due to generalized joint laxity, and is often associated with anterior cruciate ligament (ACL) injuries [9]. Hyperextended knees (Figure 1) can cause instability in the lower limbs, forward tilting of the pelvis, and difficulty maintaining

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balance [7]. The resulting overload on the leg adds stress, leading to pain and discomfort due to backward weight distribution [7].

Figure 1. Hyperextended knees.

Forced turnout is another major contributor to injuries, particularly in the knees, pelvis, hips, and lower back [7, 12]. To achieve the ideal 180° turnout, dancers may tilt their pelvis forward, placing excessive pressure on the vertebrae. Over time, this can result in muscle overload, imbalance, and joint inflammation [7]. In such a tilted position, external rotators are unable to function properly, leading to high muscle tension and shortening [7]. Although normal knee rotation is not possible when extended, hyperextension may allow passive rotation, increasing the risk of patellar cartilage strain or dislocation [7]. Shortening of the lateral hamstring and iliotibial band can cause a persistent turnout in the lower legs, affecting even everyday movements [7]. Forced turnout in a demi-plié can lead to excessive pronation of the ankle compared to a controlled turnout (Figure 2) [13].

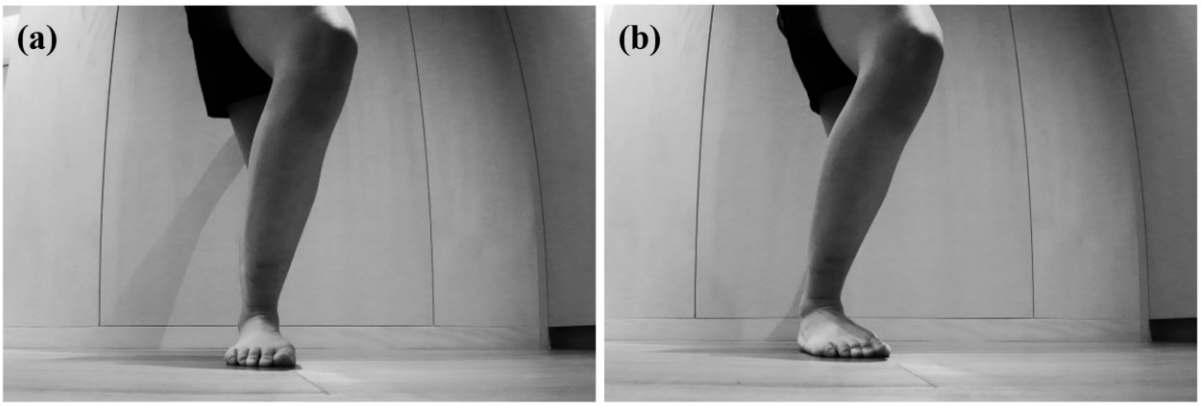

Figure 2. (a) demi-plie in 1st position with forced turnout; (b) demi-plie in 1st position with controllable turnout.

Overuse is the most common cause of injury in ballet. During a performance season, dancers often have 20 weeks of performances and 26 weeks of rehearsals, with an average of 31.5 hours per week

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during rehearsals and 35.5 hours per week during performances [3]. The workload varies depending on the size of the production and whether new choreography is involved, which often requires more rehearsal time [14]. Overuse injuries account for 64% of injuries in female dancers and 50% in male dancers, as reported by Smith et al. [15]. This can be attributed to high training volumes and insufficient rest [16]. Research by Costa et al. has shown that techniques such as pointe work, demi-pointe, and en dehors movements can cause overload and microtraumas in the knees and ankles [17]. Improper technique or inadequate rest can lead to chronic conditions such as splayfoot, hallux valgus, Achilles tendinitis, ankle impingement, and stress fractures [7]. Proper landing technique from jumps is essential to avoid ankle injuries, as improper landings increase the risk of ligament damage. Early treatment is crucial to restore ligament function and retrain balance [7].

3.2. Extrinsic factors

Extrinsic factors contributing to ballet injuries include floor surface, training methods, and shoe condition [18, 19]. While many dancers report that sprung floors in studios and stages are beneficial, some believe these floors contribute to shin splints and ankle injuries [18]. Younger dancers may not always be aware of the difference between hard and sprung floors [18]. The competitive nature of ballet, where dancers vie for company selection or specific roles, often leads to long hours of training, sometimes even continuing through injury [18]. Although flexibility is a crucial element in ballet, excessive flexibility can reduce muscle strength, negatively impacting performance and increasing injury risk [19, 20]. Participating in strength training programs, however, has been shown to benefit dancers by preventing injuries [19].

Footwear is another key extrinsic factor. Ballet shoes, particularly pointe shoes, play a crucial role in injury prevention. Pointe shoes, worn by female dancers during classes, rehearsals, and performances, can become "dead" when they no longer provide adequate support, increasing the risk of injury [21]. Worn-out pointe shoes place significantly more stress on the forefoot compared to new shoes [22]. Proper fitting of pointe shoes is essential to ensure that dancers have adequate control and support, minimizing the risk of injury.

4. Treatment and preventative techniques

Injury can be highly frustrating for dancers, often requiring long recovery times and potentially affecting the longevity of their performing careers. Therefore, it is crucial for dancers to learn how to prevent injuries and, when they do occur, to receive appropriate treatment.

The most common treatment approach for ballet injuries involves conservative care, such as physical therapy and athletic training [23]. However, psychological factors—such as fear of reduced income, loss of a desired role, or career setbacks—can also significantly impact recovery, potentially prolonging the healing process [23]. This highlights the importance of a multidisciplinary team approach in both treatment and prevention. The importance of teamwork is emphasized by dancers and staff alike, who stress the necessity of trusting the medical team and maintaining open communication throughout the recovery process [23, 24].

It is equally important to educate young dancers about injury prevention from an early stage. As ballet techniques continue to evolve, pre-professional dancers must establish a strong foundation in basic movements before progressing to more advanced techniques [25]. Foundational movements, such as plié, are essential for preparing the body for more complex skills like pirouettes and jumps, and are crucial for safe landings, helping to absorb the impact on the ankle.

Strength training plays a vital role in injury prevention. Research conducted by Vera et al. found that dancers who participated in an injury prevention program—a routine consisting of exercises performed three times a week—were 82% less likely to experience injuries compared to those who did not participate [26]. Many of these exercises focus on core strength (such as side and standard planks) and leg strength and stability (such as side steps with resistance bands and single-leg stances) [26]. This underscores the importance of strengthening both the core and lower limbs in injury prevention [25, 26].

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5. Conclusion

Ballet injuries are often the result of a variety of factors, with the majority occurring in the lower extremities. Given the relatively short career span of professional dancers, a severe injury can have a significant impact on their performance longevity. Therefore, understanding the risk factors and applying effective prevention techniques is crucial.

Dancers should actively work to minimize extrinsic risk factors. For instance, they should ensure they are wearing appropriate footwear that provides adequate support and replace pointe shoes once they become "dead" or worn out. While competition among dancers is common, it is essential to balance training with sufficient rest to avoid overtraining. Incorporating strengthening exercises into a dancer's routine not only aids in injury prevention but can also enhance overall performance.

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