



Literature review

Prevalence and profile of musculoskeletal injuries in ballet dancers: A systematic review and meta-analysis



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ARTICLE INFO

Article history:

Received 21 July 2015

Received in revised form

13 November 2015

Accepted 25 December 2015

Keywords:

Ballet dancing

Musculoskeletal disorder

Prevalence

Risk factors

ABSTRACT

Aim: To determine the prevalence of musculoskeletal disorders and anatomical regions which are most frequently injured in ballet dancers.

Methods: Published (AMED, CINAHL, EMBASE, SPORTDiscus, psycINFO, MEDLINE, the Cochrane Library) and grey literature databases (OpenGrey, the WHO International Clinical Trials Registry Platform, Current Controlled Trials and the UK National Research Register Archive) were searched from their inception to 25th May 2015 for papers presenting data on injury prevalence in ballet dancers. Two reviewers independently identified all eligible papers, data extracted and critically appraised studies. Study appraisal was conducted using the CASP appraisal tool. Pooled prevalence data with 95% confidence intervals were estimated to determine period prevalence of musculoskeletal disorders and anatomical regions affected.

Results: Nineteen studies were eligible, reporting 7332 injuries in 2617 ballet dancers. The evidence was moderate in quality. Period prevalence of musculoskeletal injury was 280% (95% CI: 217–343%). The most prevalent musculoskeletal disorders included: hamstring strain (51%), ankle tendinopathy (19%) and generalized low back pain (14%). No papers explored musculoskeletal disorders in retired ballet dancers. **Conclusions:** Whilst we have identified which regions and what musculoskeletal disorders are commonly seen ballet dancers. The long-term injury impact of musculoskeletal disorders in retired ballet dancers remains unknown.

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1. Introduction

Ballet dancers are athletes who, due to the activities and training they partake in at the extremes of joint capabilities, are at significant risk of musculoskeletal injury. These injuries are invariably overuse in nature (American Academy of Pediatrics Committee of Sports Medicine and Fitness, 2000; Ekegren, Quedsted, & Brodrick, 2014). Professional dancers frequently begin their specialist training from an early age, frequently becoming full-time dancers from the age of 15 years and over (American Academy of Pediatrics Committee of Sports Medicine and Fitness, 2000;

Ekegren et al., 2014). Thus, when associated with adolescent growth spurts, and a developing musculoskeletal system, such dancers are at greater risk of growth-related overuse injuries which may become longer-term chronic musculoskeletal disorders injuries (American Academy of Pediatrics Committee of Sports Medicine and Fitness, 2000; Ekegren et al., 2014).

Musculoskeletal pathologies, have been cited as a potential cause of long-term disability and a reduction in quality of life for physically active people (Kirkness & Ren, 2015). Previous studies have reported an association between engagement in physically-demanding activities such as football, netball and athletics and the development of long-term musculoskeletal pain and disability (Whittaker, Woodhouse, Nettel-Aguirre, & Emery, 2015). There is limited understanding on whether such a similar association is evident in recreational, semi-professional and professional ballet dancers (Hincapie, Morton, & Cassidy, 2008). Hincapie et al. (2008) previously systematically reviewed the literature on

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musculoskeletal injuries in dancers. This provided a valuable basis, but did not aim to explore musculoskeletal injuries in retired ballet dancers and their search was last updated in 2004.

The purpose of this review was to examine the current evidence-base on the prevalence and nature of musculoskeletal disorders in ballet dancers. We aimed to answer the following questions: (1) what is the prevalence of musculoskeletal injury in ballet dancers? (2) what are the most frequent types of musculoskeletal injuries experienced by ballet dancers? (3) which are the most frequent anatomical regions affected by musculoskeletal injuries in ballet dancers? and (4) what is the prevalence of chronic musculoskeletal disorders in ballet dancers once they retire from ballet?

2. Materials and methods

2.1. Search strategy

The primary search was of the electronic databases: AMED, CINAHL, EMBASE, SPORTDiscus, psycINFO, MEDLINE and the Cochrane Library, which were searched from their inception to May 25, 2015.

The secondary search included the electronic databases of unpublished evidence: OpenGrey, the WHO International Clinical Trials Registry Platform, Current Controlled Trials and the UK National Research Register Archive were also reviewed from inception to 25th May 2015. The electronic search for the MEDLINE search is presented in [Supplementary Table 1](#). This was amended for each individual database. The reference lists of each eligible paper were assessed for any additional papers. Finally, the corresponding authors from all included citations were emailed to identify any additional papers.

2.2. Eligibility criteria

2.2.1. Participants

We included all studies of cohorts where 80% or over of the cohort were described as being 'ballet dancers' or where the data for ballet dancers were presented separately to other forms of dance. We included recreational, semi-professional and professional dancers.

2.2.2. Outcomes

We included all papers which presented data on the musculoskeletal profiles of ballet dancers. Data were sought on the incidence (assessing 'new' injury occurrence prospectively for a specific period of time) or prevalence (assessing injury presence in a cross-sectional 'snap-shot' (point prevalence) or at some time over a given period (period prevalence)) of chronic musculoskeletal disorders in ballet dancers. Musculoskeletal pain, injury and dysfunction were defined as a pathology/injury/trauma of the joint, muscle, ligament, tendon, bone or nerve. This could be physician/physiotherapist/clinician-diagnosed or self-reported in this instance. We planned to assess the prevalence of musculoskeletal disorders and injury profile of retired ballet dancers. Given their cessation of dancing at the time of assessment, the 'exposure' of dance is removed. Therefore only prevalence data could be used to provide an estimate of musculoskeletal disorder profile as 'new' musculoskeletal injuries related to dance, would not occur.

2.2.3. Study design

We included case-control and cohort study designs. Single-case study papers were excluded. No restriction was placed on the language of paper or date of publication.

2.3. Identification of papers

Based on the eligibility criteria above, two reviewers (TS, LD) independently reviewed the titles and abstracts from potentially relevant papers. The full texts of all potentially eligible papers were reviewed by each reviewer (TS, LD) independently before making a final decision on eligibility.

2.4. Data extraction

We entered data onto a pre-defined data extraction table. Data extracted included: characteristics of ballet dancers including age at cohort inception and follow-up; gender; duration and level of ballet participated at; presence (and degree) of joint hypermobility (frequently assessed using the Beighton scoring system); and subsequent findings on location of pathology. This was performed by one reviewer (TS) and was verified by a second (LD). Any disagreements in data extraction were resolved through discussion between the two reviewers.

2.5. Outcome measures

The primary outcome measurement was the incidence or period prevalence of musculoskeletal injury in ballet dancers.

Secondary outcome measurements included: the incidence or period prevalence of different musculoskeletal injuries experienced by ballet dancers; the incidence or period prevalence of specific anatomical regions affected by musculoskeletal injuries in ballet dancers; and the prevalence of chronic musculoskeletal disorders in ballet dancers once they had retired from ballet.

2.6. Critical appraisal

Each included paper was critically appraised using the CASP 'Cohort Study' tool ([CASP, 2015](#)). This tool was justified since it has been widely adopted for reviews of previous musculoskeletal studies ([Postle, Pak, & Smith, 2012](#); [Reilly, Barker, & Shamley, 2006](#); [Smith, Walker, & Russell, 2007](#)). Each included paper was reviewed by one reviewer (TS) and independently verified by a second (LD). Quality was judged as scores of 10–13 (high quality), seven to nine (moderate quality), zero to six (low) as per [Hosny, Gademsetty, Smith, and Hing \(2014\)](#) recommendations.

Any disagreements in study eligibility, data extraction or study appraisal score were discussed and resolved through a third reviewer who adjudicated (AM).

2.7. Data analysis

Study method heterogeneity was assessed visually using the data extraction tables. Through this cohort characteristics and data collection methods were evaluated for between-study consistency. If heterogeneity was evident, we performed a qualitative narrative review of the trends in results. If study method homogeneity was evident in participant characteristics, follow-up period and data collection methods, a meta-analysis was undertaken to pool incidence data (number of new cases which developed musculoskeletal injuries within a given period of time) or period prevalence (number of cases with a musculoskeletal injury event within a period) data using a random or fixed effect effects meta-analysis model dependent on statistical heterogeneity. Such heterogeneity was evaluated using the Chi-squared and I-squared statistical tests. When $p > 0.10$ and I-squared $\geq 20\%$ a random-effects model was undertaken. When $p < 0.10$ and I-squared $< 20\%$ a fixed-effects model was employed.

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