



# Karolinska Institutet

**Institutionen för neurobiologi, vårdvetenskap och samhälle  
Centrum för Allmänmedicin (CeFAM)**

## Musculoskeletal injuries and generalized joint laxity in ballet dancers

**AKADEMISK AVHANDLING**

som för avläggande av medicine doktorsexamen vid Karolinska  
Institutet offentligen försvaras i Föreläsningssal 221/ Centrum för  
Allmänmedicin, CeFAM, Alfred Nobels allé 12, Huddinge

**Fredagen den 5 oktober, 2012, kl 09.00**

av

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**Stockholm 2012**

## ABSTRACT

**Aims** To examine the incidence and type of musculoskeletal injuries in classical ballet dancers, to analyse these injuries in relation to absence from performance, and to identify dancers at risk of frequent injuries in a Swedish professional ballet company (*study I*). To analyse spinal sagittal mobility and joint laxity in young Swedish ballet dancers in comparison with controls (*study II*). To assess the incidence of musculoskeletal injuries, the site and type of injury, and the most common injury diagnoses in young ballet dancers at the Royal Swedish Ballet School in Stockholm, Sweden (*study III*). To investigate age- and gender-specific associations between joint hypermobility, generalized joint laxity and musculoskeletal injuries in young Swedish ballet dancers (*study IV*).

**Methods** In *study I*, 98 professional ballet dancers (48 men, 50 women, average age 28.3, range 17–47) at the Royal Swedish Ballet in Stockholm were studied in a combined retro-prospective way. All injuries for which the dancers sought medical care during Aug 1988–Jun 1993 at the in-house outpatient clinic were registered. Injury incidence rates per 1,000 activity hours were calculated and  $\chi^2$  test and unpaired t-test were used for statistical analyses. In *study II*, 23 dance students (11 boys, 12 girls) in 4th grade at the Royal Swedish Ballet School in Stockholm, and 36 controls at a public Swedish school were examined regarding spinal configuration in standing. The spinal sagittal mobility was measured by use of De Brunner's kyphometer and Myrin's inclinometer. Joint mobility was measured and registered by employing a modified form of the Contompasis method. For comparison between dancers and the controls, the student's t-test was used. In *Study III*, 476 students (297 girls and 179 boys) aged 10–21 at the Royal Swedish Ballet School in Stockholm made up the study group. A 7 year (August 1988 to June 1995) retrospective analysis of medical records in the school orthopaedic outpatient clinic was undertaken. Data on diagnosis, site of injury and type of injury were collected, and the injuries were classified as traumatic or due to overuse. Injury incidence rates per 1,000 activity hours were calculated. Statistical differences for the total injury incidence rates between genders, age groups, and for type of injury were calculated and t-test was used to test statistically significant differences between proportions. In *study IV*, 216 (130 girls, 86 boys) ballet students in 4th grade were examined while entering the Royal Swedish Ballet School between Aug 1988 and Jun 1995. Joint mobility was measured applying the modified Contompasis method and the results were subdivided into three groups based on the score obtained. Medical records were analysed and all injuries for the period were registered. Injury incidence rates per 1,000 activity hours were calculated. For statistics a conditional risk set model using Cox regression was employed.

**Results** In *study I*, 95% of the 98 dancers suffered an injury when employed for one year or more. The dancers incurred 390 injuries over the 5-year study period i.e., 0.6 inj/1,000 activity hours. Most injuries were due to overuse and located in the foot and ankle region. The injury profile differed significantly between the genders and between younger and older dancers. Female dancers more frequently suffered overuse injuries while male dancers more frequently suffered knee injuries. Ankle sprain was the most common diagnosis, mostly occurring among dancers <26 years. In *study II*, the ballet dancers were found to have a less prominent thoracic kyphosis, lumbar lordosis, and showed a higher incidence of joint mobility. In *Study III*, the injury incidence was 0.8/1,000 hours of activity and the injury incidence tended to increase with increasing age. The injury panorama in the younger dancers resembled those in professional adult dancers in study I. Most injuries occurred due to overuse, ankle sprain was the most common traumatic injury and tendinitis pedis the most common overuse injury. *Study IV* showed that more female dancers (32.3%) than male dancers (15.1%) had a manifest generalized joint laxity (GJL). A significantly increased injury risk was found among students with GJL (hazard ratio=1.62, 95% CI=1.09–2.39) Higher age implied an increased injury risk and interaction tests revealed a particularly increased injury risk among those >10 years with manifest GJL.

**Conclusions** Musculoskeletal injuries are common in both young and adult ballet dancers. The association between GJL and injury risk in young ballet dancers implies that there is a need for screening programmes regarding GJL and appliance of primary prevention in order to prevent musculoskeletal injuries in young ballet dancers.