

REVIEW

Dance as a double-edged sword:
physiological adaptations, injury risks
and therapeutic potentialAndrea Hinojosa-Azaola,¹ Emma Renoult,² Lise Lam-Briand,² Jasmine Pochart,²
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To cite: Hinojosa-Azaola A, Renoult E, Lam-Briand L, *et al.* Dance as a double-edged sword: physiological adaptations, injury risks and therapeutic potential. *RMD Open* 2026;**12**:e006937. doi:10.1136/rmdopen-2026-006937

Received 12 March 2026

Accepted 4 June 2026



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ABSTRACT

Dance is a complex physical activity with high biomechanical and artistic demands that cause repetitive stress on the musculoskeletal, neuromuscular, metabolic and cardiorespiratory systems. Dance induces physiological adaptations in children and adults, including bone remodelling, improved muscle strength and neuromuscular control, enhanced balance and flexibility, lower limb morphological adaptations and changes in body composition. However, it is also associated with a high incidence of musculoskeletal injuries, predominantly affecting the lower limbs, owing to overuse mechanisms such as sprains, muscle injuries, fractures, stress fractures and soft tissue damage. Growth periods, cumulative training load, technical constraints (eg, pointe shoes, specific footwear, hard surfaces) and individual factors such as joint hypermobility, low energy availability and low body mass index may increase injury risk, potentially affecting performance and quality of life. Acute injuries during professional performances are often recognised as work-related, whereas those sustained during training or rehearsals and chronic conditions related to prolonged practice lack occupational recognition. Emerging observations suggest that dance therapy may offer benefits for certain chronic musculoskeletal conditions, particularly fibromyalgia, although evidence remains limited. This narrative review synthesises the physiological adaptations to dance, the spectrum of dance-related musculoskeletal injuries, associated risk factors and the available data supporting dance as a non-pharmacological intervention. The findings reported herein should be interpreted in light of several limitations, including the narrative design, heterogeneity across studies, small observational samples, inconsistent definitions, potential publication bias and regional variability in practice conditions.

INTRODUCTION

There is a profound connection between the arts and the musculoskeletal system.¹ Artists were among the first to explore and depict the intricacies of human anatomy, laying the groundwork for modern anatomical and medical understanding. Moreover, they championed early therapeutic practices

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The high artistic demands of dance cause repetitive musculoskeletal and physiological stress, leading to adaptations in bone remodelling, muscle strength, neuromuscular control, balance, flexibility and body composition.

WHAT THIS STUDY ADDS

⇒ This narrative review summarises the physiological adaptations associated with dance, the spectrum of dance-related musculoskeletal injuries and their associated risk factors, and evidence supporting dance as a non-pharmacological intervention.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Dance therapy may benefit individuals with chronic musculoskeletal conditions, but evidence is limited by heterogeneity across studies.

such as balneotherapy and thalassotherapy, from which the first rheumatology centres emerged. Conversely, artists have long drawn inspiration from the musculoskeletal system in their creative works while also using their own extraordinary physical capabilities throughout their artistic careers. Among these artists, we most commonly consider painters, sculptors, architects, writers and musicians. However, the relationship between dance and the musculoskeletal system has received far less attention in scholarly research. Dance is a recurring theme in paintings because it unites movement, emotion and the human body, allowing artists to explore styles from realism to abstraction.² Edgar Degas (1834–1917) focused on classical ballet and anatomical precision³ (figure 1a,b), showing the *extreme joint ranges of motion required in ballet*, such as full lateral splits or forced external hip rotation under axial load and forced plantar hyperflexion. For example, Henri de



Figure 1 Dance in paintings. (a) Edgar Degas, *Dancers at the Barre* (early 1880s-c. 1900). The Phillips Collection, Washington, DC, USA. Photo Andrea Hinojosa-Azaola. (b) Edgar Degas, *Dance Class at the Opera* (1872). Orsay Museum, Paris, France. Photo Alain Saraux. (c) Henri de Toulouse-Lautrec, *Bal in the Moulin Rouge* (1895). Orsay Museum, Paris, France. Photo Alain Saraux.

Toulouse-Lautrec (1864–1901) depicted cabaret dancers and bohemian nightlife (figure 1c), including Boneless Valentin, who was renowned for his extraordinary flexibility, which was attributed to Ehlers-Danlos syndrome. Pierre-Auguste Renoir (1841–1919) portrayed social dances filled with collective joy. Henri Matisse (1869–1954) transformed dance into a symbol of rhythm and pure colour. And Pablo Picasso (1881–1973) reinterpreted it through modern and Cubist perspectives.^{2,4}

Evidence of dance dates back to the Palaeolithic period, as seen in rock paintings depicting dance as a means of communication and way of life. In primitive cultures, rituals involving dance were performed at birth, marriages and death, as well as for purposes related to fertility, such as food and children. The dances of ancient civilisations began to acknowledge the aesthetic purposes of the art, questioning its meaning, what the movements represented and how they might be interpreted. India, China and Ancient Greece are among the first civilisations with recorded accounts of dance.⁵

During the Medieval Era, traditional arts such as belly dancing and folk dances became prominent and were often associated with the pursuit of spiritual purity. However, associations with death, witchcraft and the plague led some religions to reject or discourage dance. In the Renaissance period, dance was revived through folk and court dancing, accompanied by music, and was increasingly viewed as a formal art form. During the Contemporary period, new genres emerged, including contemporary and classical ballet, modern dance, tap, jazz and hip-hop.⁵

Dance combines an artistic dimension with high biomechanical demands, often repeated and sometimes extreme. Practised from childhood, sometimes intensively—particularly in classical ballet—it induces physiological adaptations whose expression varies according to age, level and style (ballet, contemporary, flamenco, Irish dance, etc). Despite some favourable adaptations (strength, coordination, balance, body awareness), musculoskeletal injuries remain prevalent. Growth

periods, training load intensity and certain individual characteristics, such as hypermobility or low body weight, contribute to the occurrence of injuries and chronic disorders.

This narrative review synthesises the physiological adaptations associated with dance, the spectrum of dance-related musculoskeletal injuries and their associated risk factors and available data supporting dance as a non-pharmacological intervention.

MEDLINE (via PubMed), Embase, Scopus, Web of Science and the Cochrane Library were systematically searched for literature published from database inception to April 2026. To enhance comprehensiveness, grey literature sources (Google Scholar) were screened, and the reference lists of the included articles were manually reviewed. The search strategy combined controlled vocabulary (eg, Medical Subject Headings terms) and free-text keywords related to four concepts: *dance and performing arts*; *dance therapy*; *musculoskeletal system and injuries*; and *occupational and work-related conditions*. No restrictions on study design were applied to ensure broad capture of evidence. Studies were considered eligible if they addressed dance as a physical or occupational activity or as a therapeutic intervention; reported on physiological adaptations, musculoskeletal outcomes or injuries; evaluated risk factors, including occupational or training-related exposures; or included participants of any age or level (recreational or professional dancers). Articles published in English or French were included. Findings were synthesised descriptively to map the extent, range and nature of available evidence.

PHYSIOLOGICAL ADAPTATIONS INDUCED BY DANCE

Dance has numerous effects on the body, leading to metabolic, morphological and neuromuscular changes. Some of these effects are observed in both children and adults. First, dance stimulates bone remodelling. Under the effect of repeated constraints, significant trabecular bone growth is observed, resulting in important

but harmonious and symmetrical bone rigidity, unlike certain so-called asymmetric sports.^{6–10} Vitamin D deficiency is frequently observed in dancers, both adults and children and is often linked to insufficient sun exposure. This deficiency can negatively affect bone health, reduce mineral density and increase the risk of injury.^{11 12}

The practice of dance also has very specific effects on the growth of children. First, in children, dance strengthens the lumbopelvic muscles. The repeated demands on the trunk and pelvis, which are necessary for maintaining postures and executing movements, promote the development of deep musculature and spinal flexibility—particularly lumbar hyperlordosis—contributing to the stability of the spine and pelvis during growth.^{13–15} Dance also contributes to the development of balance and postural control; repeated stimulation of the proprioceptive and vestibular systems improves the management of postural adjustments and static and dynamic stability. This thus contributes to the development of body awareness.^{13–15} Furthermore, dance leads to a significant increase in flexibility because of repeated stretching and the large joint ranges imposed by certain disciplines, particularly ballet, contemporary dance and Irish dance. This functional hyperlaxity can, however, be accompanied by decreased joint stability when the constraints exceed the adaptive capacity of the joint.^{16 17} In parallel, the practice of dance promotes the development of motor coordination and control of complex movements. These adaptations allow for better distribution of joint and plantar pressures and are also accompanied by compensatory mechanisms that modify physiological motor patterns, with the benefit/risk ratio of all so-called intensive activities.^{6 18} Dance leads to morphological adaptations of the lower limbs, particularly at the level of the feet. Flat and splayed feet are prevalent among dancers, possibly because of repeated weight-bearing constraints and the specific postures imposed by the practice, particularly due to progression in demi-pointe and pointe in classical ballet.^{19 20}

However, during growth, child dancers are at increased risk of injury. High joint ranges, repeated loads and skeletal immaturity contribute to micro-joint instabilities and growth plate injuries.^{6 18 19 21 22} Furthermore, generalised hypermobility and certain pathologies, such as scoliosis, can be associated with muscle weakness and altered joint stability.^{23 24} Finally, changes in body composition accompanied by a very low body mass index (BMI) can have repercussions. Some dancers experience primary or secondary amenorrhoea, with some girls experiencing their first menstruation later than average. Thus, anorexia and bone demineralisation can be observed, fitting into the framework of the female athlete triad.^{16 25–27}

In adults, regular dance practice increases muscle strength and therefore improves neuromuscular control and postural balance. The repeated execution of complex movements improves intermuscular coordination and the ability to adjust muscle contraction, contributing to more efficient movement and better joint stability.^{16 27–29} Increased co-contraction of agonist and

antagonist muscles is observed in certain dancers, particularly in disciplines such as flamenco. This adaptation influences muscle contraction strength and improves joint stiffness, contributing to precise controlled movement.^{7 30} However, this asymmetry of muscle activation, with marked functional lateralisation—sometimes of one leg and sometimes of the other—depending on whether the lower limb is used for push-off or landing, leads to an unequal distribution of mechanical constraints.^{7 16 30–33}

Furthermore, dance is an intermittent, high-intensity physical activity that significantly challenges the cardio-respiratory system. The alternating phases of intense effort and recovery promote beneficial cardiovascular adaptations, improving endurance and overall functional capacity. Prolonged dance practice also leads to anatomical adaptations of the lower limbs, including variations in knee alignment, genu recurvatum, hallux valgus and forefoot adduction. These modifications result from repeated constraints and specific postures imposed by the discipline.¹⁶ However, repeated training activities and performances can lead to functional overload when the workload exceeds the recovery capacity. This imbalance promotes chronic fatigue and decreased performance.^{34 35} Notably, dance leads to gait modifications in adults, characterised by increases in plantar load and stance duration. These adaptations reflect the influence of repeated constraints exerted on the foot and ankle during practice.³⁶

Finally, intensive dance practice is associated with changes in body composition. Although female dancers often have reduced fat mass and a low BMI, which lead to decreased energy availability, male dancers often develop strong musculature to lift their partners. Low energy availability associated with a high training load can lead to hormonal disorders and decreased bone mineral density.^{25 37 38}

MUSCULOSKELETAL INJURIES RELATED TO DANCE

Current literature has consistently revealed that dance, regardless of style or level, is associated with a high incidence of musculoskeletal injuries, predominantly affecting the lower limbs.^{13 20 21 28 39–42} A prospective cohort study involving 66 full-time preprofessional dancers from New Zealand who were followed for more than 38 weeks revealed that 86% sustained one or more injuries, with an incidence rate of 2.27 per 1000 hours of dance exposure and 3.35 per 1000 dance exposures.⁴³ According to both professional and non-professional dancers, the most frequently reported locations are the ankle, foot, knee, hip and lumbar region.^{13 20 28 39–42} The upper limbs, which are rarely affected except in dancers who lift partners in classical ballet, account for less than 5% of injuries in certain disciplines such as Irish dance.⁶ The most common injuries are sprains, muscle injuries and fractures—particularly stress fractures—and, more broadly, soft tissue damage.^{21 28 39–41 44} Dislocations and subluxations remain rare.²⁸ The style of dance also

Table 1 Musculoskeletal injuries among dancers: professional versus non-professional

Site of injury	Professional	Non-professional
Lower limbs		
Pelvis	Early signs of hip osteoarthritis ²¹ Hip instability ²⁵ Hip dysplasia ⁶⁹	Hip and groin injuries ¹⁸ Hip pain ^{13 49}
Knee	Early signs of knee osteoarthritis ^{21 70} Patellar subluxation ⁶ Retropatellar chondropathy ⁷¹ Patellofemoral pain syndrome ^{6 13 16 19 23 72} Ligamentous and meniscal injuries ^{70 73–75} ACL and MCL injuries ^{70 76 77} Patellar instability ^{6 78}	
Leg	Posterior tibial tendonitis ⁶ Tibial stress fracture ^{6 39 70} Tibial apophysitis ⁶ Osgood-Schlatter disease ⁴⁰ Medial tibial stress syndrome ^{6 40 79} Calf, quadriceps, adductor injuries ⁷⁰	Acute hamstring sprains ⁷⁶ Hamstring biceps injuries ⁸⁰
Ankle	Achilles tendon rupture ⁷⁰ Posterior ankle impingement syndrome ^{8 40 79} Sever's disease ⁶ Ankle synovitis ⁷⁶	Ankle sprains ^{6 13 28 40 41} Bilateral reduced ankle mobility ⁸ Tendinopathy ¹⁶
Foot	Plantar fasciitis ⁶ Stress fractures (sesamoid, navicular, 5th metatarsal base, IPP) ^{6 39 40 42 70} Metatarsal joint sprain ⁴⁰ Hallux sprain ⁴⁰ Turf toe ⁴⁰ Talus bone marrow oedema ⁸ Hallux longus flexor tendon injury (dancer's tendonitis) ^{39 42 76} Hallux rigidus ⁷⁸ Hallux abducto valgus ⁶⁵ Claw toes ⁶⁵ 5th toe varus ⁶⁵ Tendinopathy ^{16 80}	
Upper limbs		
	Ulnar neuropathy ⁷⁸ Thoracic outlet syndrome ⁷⁸ Hand osteoarthritis ⁷⁸	
Spine		
	Spinal stress fracture ³⁹ Scoliosis ^{16 23 25} Spondylolisthesis ¹⁶ Spondylolysis ²⁸	Low back pain, dorsal pain, cervicobrachialgia ^{13 16 28 39 41 73 78 79}

ACL, anterior cruciate ligament; MCL, medial collateral ligament; IPP, interphalangeal joint.

influences injury frequency; injuries are more common among ballet dancers than among modern dancers, likely because classical ballet imposes sustained physical demands from early childhood throughout a dancer's career.^{13 21} Table 1 summarises the most frequent musculoskeletal injuries among both professional and non-professional dancers.

A large proportion of injuries are linked to overuse mechanisms, resulting from repeated movements, jumps and impacts and the accumulation of micro-traumas.^{13 18 20 21 28 39–41} Studies report a higher proportion of chronic and overuse injuries among professional dancers than among non-professional dancers, while acute injuries, particularly sprains, are frequently observed in both populations.^{21 28 40} In professional Irish

dancers, stress fracture is the most frequently reported injury and results from overuse mechanisms linked to repeated impact and high-intensity movements.⁶ The most frequently involved mechanisms include repetitive movements, jumps and landings, as well as pirouettes, particularly among professional dancers.^{28 41}

Asymptomatic bone marrow oedema in the posterior talus detected on MRI is highly prevalent among professional ballet dancers.⁴⁵ Moreover, a study comparing qualitative MRI and quantitative T2 measurements of the tibiotalar cartilage between ballerinas and healthy controls across the anterior, middle and posterior zones revealed significantly higher T2 values in ballerinas than in controls. The posterior zones exhibited the highest T2 values along with a greater frequency of posterior soft

tissue oedema and flexor hallucis longus tenosynovitis, in the ballerina group.⁴⁶

Several risk factors have been identified: the use of pointe shoes, training on hard or slippery surfaces, inadequate warm-up, defective techniques and excessive training load.^{6 13 21 28 39–41} Specific shoes, particularly those used in ballet and Irish dance, are strongly associated with foot and ankle injuries.^{6 13 28 39 42} Injuries occur more frequently during training than during performance, highlighting the central role of cumulative load.³⁹

Age appears to be a determining factor: children and adolescents have an increased incidence of injuries, particularly during periods of rapid growth, because of immature motor coordination and high mechanical constraints on the developing musculoskeletal system.^{13 18 21 40} Adolescents are at increased risk of injury, which may affect future development.^{13 18 39} Scoliosis and hyperlordosis (with or without spondylolisthesis) are frequently observed in young dancers, particularly in girls, and may be accompanied by limitations in daily activities such as walking or climbing stairs.^{23 25}

Differences in the distribution of injuries by sex have been described, with a higher proportion of bone injuries and locations at the fifth metatarsal and ankle in female dancers.^{21 28 40 42} They also have a longer post-injury stoppage time, although the overall frequency of injuries does not always differ from that of male dancers.^{8 28} In men, certain acute injuries, such as hallux sprains, are more frequent, whereas low back pain is the more prevalent chronic condition.⁴⁰ However, the overall frequency of injuries appears comparable between men and women, except for injuries related to pointe practice.²⁸ This finding reflects sex differences observed in other orthopaedic conditions and sports-related injuries, such as adolescent idiopathic scoliosis, hallux valgus, osteoporosis, osteoarthritis, ligamentous laxity and anterior cruciate ligament tears, among others, which are more frequent in females than in males. These differences likely reflect variations in anatomy, bone and cartilage physiology and hormonal factors.⁴⁷

A recent systematic review describing dance-specific injury-prevention strategies across dance populations revealed that both the efficacy of and adherence to these strategies are understudied and that conditioning and exercise programmes are currently the most commonly used approaches for injury prevention.⁴⁸ Overall, these studies highlight that dance is an activity with high biomechanical demands, in which cumulative mechanical overload, technical characteristics specific to each style and individual factors interact to promote the occurrence of musculoskeletal injuries, which are often chronic and sometimes responsible for impairment in daily activities.^{6 8 18 20 21 23 25 28 40–42 44 49}

'PRE-EXISTING' PROFILES AND PREDISPOSING FACTORS

Hypermobility is frequently observed in dancers and often corresponds to a preexisting characteristic that may

guide certain children towards dance rather than other sports. High joint ranges constitute an obvious morphological and aesthetic advantage, facilitating body lines and turnout (external rotation of the hips allowing the feet to open outwards), elements widely valued particularly in classical ballet.^{19 44} However, hypermobility is frequently accompanied by a deficit in proprioception and an alteration in dynamic balance. An analysis of the functional implications of hypermobility revealed that the ability of joints to stabilise and provide support during complex movements is reduced, particularly under load.^{19 23 44} Decreased muscle strength, particularly in knee extensors and flexors, has also been reported in individuals with hypermobility, limiting the active stabilisation of highly mobile joints.^{23 44} Hypermobility of the first ray, resulting from instability of the first metatarsocuneiform joint, is a contributing factor to hallux valgus and may be associated with technical errors and anatomical-hereditary factors in ballet dancers.⁵⁰ Furthermore, joint hypermobility is associated with decreased proprioception and frequent pain. Different clinical and functional profiles have been analysed in dancers, and musculoskeletal pain, particularly patellofemoral pain, is very common throughout a professional season. Moreover, low back pain can appear early and is associated with a risk of chronic symptoms. Thus, hypermobility does not systematically increase the overall injury rate, but certain preexisting biomechanical characteristics can constitute predisposing factors.^{16 23 34 44 51} Orthopaedic characteristics such as genu recurvatum (hyperextension of the knee) and flat feet are frequently observed in dancers. These particularities reflect structural hyperlaxity, often identified from childhood. However, this can be accompanied by reduced joint stability, requiring increased muscular control to preserve alignment and function during repeated movements.¹⁹ There is no consensus on whether flatfoot is a pathology, an anatomical condition, or merely a phenotypic feature or on the best indications for its treatment or whether it requires treatment at all.⁵² The BoneLess Valentin (Valentin Le Désossé in French) (1844–1907) was a French dancer who has been suggested to have had Ehlers-Danlos syndrome and to have built his artistic identity around his hypermobility. His early career reveals the ambivalence of this characteristic: a predisposing factor for uniqueness and performance but also a potentially fragile condition, likely to be reinforced by practice.⁵³ Thus, hypermobility appears to be a predisposing factor for practice, whose functional and painful consequences can be revealed and reinforced by the specific demands of dance.

Low body weight constitutes another profile frequently associated with dance and can also play a role in early orientation towards this discipline. The thin body ideal is deeply rooted in choreographic culture and tends to attract or retain children naturally presenting a slender morphology.^{37 38} This ideal, initially aesthetic, has gradually been associated with performance, as thinness is perceived as facilitating lightness, elevation and

endurance. These representations can precede intensive engagement in practice and then be reinforced by the normative environment of dance.^{37 38} A low BMI is also associated with certain pathologies, notably scoliosis, delayed menarche and specific injury locations, particularly in the toes.^{20 23} Dietary restrictions are also frequently reported in dancers and increase the risk of eating disorders, particularly anorexia nervosa.³⁷ Thinness thus appears to be a predisposing morphological and behavioural factor, often present before the individual enters dance, whose clinical expression and consequences can be amplified and perpetuated by practice and its environment.

Ballet dancers closely monitor their bodies as they grow older, fearing injuries as imminent threats to their careers that may eventually force them to retire from active dancing as early as their 20s or 30s. Dancers therefore must cope dynamically with the ageing process and adapt their style as their bodies change. An example is the Russian virtuoso Mikhail Baryshnikov, who transitioned from classical ballet to modern dance.⁵⁴

WORK-RELATED MUSCULOSKELETAL DISORDERS AND THEIR PROGNOSIS IN PROFESSIONAL DANCERS

The practice of professional dance may give rise to a range of rheumatological and traumatic injuries, as discussed above. Acute traumas sustained during performances are typically classified as work-related accidents. However, when a professional dancer develops conditions such as low back pain, an ankle sprain or an Achilles tendon rupture during training or rehearsals, recognition as a work-related accident may be more difficult to obtain in some social protection systems. In the context of sports-related Achilles tendon rupture, approximately 50% of patients return to sports within 1 year, and there is currently no standardised treatment or rehabilitation protocol.⁵⁵ However, these too may be considered work-related injuries depending on the applicable legal framework, as they occur because of the demands of this profession and would likely not have happened if these individuals had pursued a different career. In terms of musculoskeletal disorders or chronic injuries, many biomechanical constraints can explain their occurrence in classical ballet, flamenco, hip-hop and contemporary dance.³⁸ Additionally, professional dancers face psychological stressors, including organisational and social pressures, which are risk factors for these conditions.⁵⁶ These psychological factors compound biomechanical constraints, often making musculoskeletal disorders in dancers multifactorial. The most well-known psychological risk factor in this profession is undoubtedly performance anxiety (stage fright), where the fear of critics' and audiences' judgements induces psychological tension alongside physical strain.⁵⁷ In this regard, the more a performance is rehearsed and repeated, the more it can be mastered, thereby reducing the anxiety of performing in public. Unfortunately, repeated rehearsals

often increase biomechanical stress on the joints, thereby increasing the risk of musculoskeletal disorders.

In terms of chronic conditions resulting from prolonged dance practice, similar to many musculoskeletal diseases (MSDs) that can occur in physically demanding professions, some healthcare systems allow these conditions to be recognised as occupational diseases. Recognition as an occupational disease leads to compensation in cases where a clause related to this practice provides for this possibility. This recognition and specific compensation for the occupational cause of these MSDs provide financial support that compensates for the temporary interruption of dancing (this interruption indeed results in the inability to earn income from paid dance performances). Unfortunately, in cases of highly disabling MSDs, this interruption of dancing can become permanent, and dancers may then describe medical and professional prognoses very similar to those of professional athletes (assuming dance is considered distinct from sports). In this sense, the careers of professional athletes are often short because physical abilities tend to decline between the ages of 30 and 40 years, making these athletes potentially less high-performing, and their earning potential is consequently reduced.⁵⁸ Injuries, traumas and disabling MSDs are, moreover, major contributors to even earlier career endings, given that this practice relies heavily on the dancer's (and professional athlete's) physical condition. Steven McRae, a principal dancer, recounts his immense difficulty returning to his profession after an Achilles tendon rupture that occurred mid-performance at the age of 36. A film was even dedicated to his resilience following this injury.

The permanent cessation of dancing due to a musculoskeletal disorder, beyond the psychological trauma it may represent, necessitates professional reorientation. Many dancers choose to remain in the performing arts world by becoming choreographers, dance teachers, artistic directors or ballet directors, much like Mikhail Baryshnikov or Maurice Béjart. The Anglo-Saxon approach can be perceived as more protective, as a young talent may train exclusively in dance but is often also encouraged to learn an instrument, singing or acting. Temporarily unable to dance, they can then focus on another artistic practice. Two examples illustrate this artistic versatility: Madonna and Beyoncé Knowles, both exceptional dancers and hardworking performers, have each suffered from prolonged knee injuries that temporarily or permanently prevented them from performing but fortunately allowed them to continue singing.

DANCE THERAPY: INTEREST AND LIMITATIONS OF THE DATA

Dance offers a promising, safe, cost-effective and accessible approach to promote healthy, active ageing.⁵⁹ It is a complex motor skill that requires coordination, rhythm, memory, balance, physical expression and social interaction.⁵⁹ Dance therapy is a non-pharmacological intervention used in the management of chronic musculoskeletal

conditions that combines physical activity, sensorimotor stimulation and psychosocial engagement, with the objectives of improving pain, function and quality of life. A recent narrative review reported generally favourable effects of dance therapy on pain, physical function and quality of life, particularly in patients with fibromyalgia, with notable psychosocial benefits. Compared with strictly structured forms, creative and expressive forms of dance appear to be associated with more consistent results, although the heterogeneity of protocols and variable methodological quality limit the scope of the conclusions.⁶⁰ Moreover, a recent systematic review and meta-analysis of 59 studies, encompassing 3256 patients, aimed to determine which modality of therapeutic exercise is most effective in reducing the impact of fibromyalgia in women. It was found that dance and mixed exercise ranked highest in the long term, with moderate certainty of evidence, which was limited mainly by imprecision and heterogeneity.⁶¹

Preliminary interventional data suggest a reduction in pain perception and an improvement in body awareness after therapeutic dance programmes in women with fibromyalgia, despite a low level of evidence due to the absence of a control group and small sample sizes.⁶² Additionally, greater changes in the nonlinear dynamics of heart rate variability were observed in female dancers with cardiovascular risk factors than in women who performed conventional treadmill exercise,⁶³ and positive effects of free dancing on depressive symptoms, anxiety and stress were also reported in women after breast cancer surgery.⁶⁴

A randomised controlled trial involving older adults revealed that structured dance significantly improved balance and mobility, suggesting an interest in musculoskeletal function.⁶⁵ These results are consistent with those of systematic reviews indicating that the majority of studies report an improvement in pain or pain experience through dance interventions while emphasising the need for better standardised protocols.^{5 66 67} Moreover, dance training may improve bone density and support skeletal health through its mechanical loading characteristics. It may also act as a mechanical stimulus influencing bone metabolism via the activation of relevant cellular signalling pathways; however, current evidence is limited and heterogeneous, and its impact on bone loss remains unclear.⁶⁸

Aspecific tool, the DanSES-60+, aims to assess dance self-efficacy in older adults, enabling participant screening and stratification, programme evaluation, progress monitoring and investigation of psychological mechanisms underlying dance programme effectiveness.⁶³

This narrative review is limited by its methodological design, which prioritises comprehensive coverage over critical appraisal, precluding formal assessment of study quality and limiting causal inferences. The marked heterogeneity in populations, dance modalities and outcome measures restricts comparability and prevents quantitative synthesis. Additionally, most of the included studies

were observational with small sample sizes, increasing the susceptibility to bias. Variability in the definitions of injury and exposure, as well as potential publication bias and the choice to perform a narrative review including grey literature rather than a systematic review (explaining the lack of review reporting elements such as flow charts, the number of included studies and study selection details) further constrain the robustness and generalisability of the findings. Moreover, variability in practice conditions across different regions (eg, low- and middle-income countries) may further influence injury risk and access to therapeutic dance programmes. Most available evidence derives from small observational studies and heterogeneous interventions; therefore, conclusions should be interpreted cautiously until higher-quality randomised studies become available.

CONCLUSIONS

The practice of dance induces substantial physiological adaptations in the musculoskeletal, neuromuscular and metabolic systems in both children and adults. These changes represent a specific bodily response to repeated, and at times extreme, mechanical demands, comparable to adaptations observed in certain high-level sports.

Nevertheless, the literature consistently reports a high incidence of musculoskeletal injuries, predominantly affecting the lower limbs and largely related to overuse mechanisms. Periods of growth, cumulative training load and individual characteristics such as joint hypermobility and low energy availability emerge as key vulnerability factors. Together, these findings highlight the dual nature of dance, which can foster beneficial functional adaptations while also posing pathological risks when practised intensively and over prolonged periods. Injury prevention strategies are needed.

Current evidence suggests that appropriately adapted and supervised dance therapy may offer some benefit as a non-pharmacological intervention for selected chronic musculoskeletal conditions, with possible improvements in pain, function and quality of life. However, substantial heterogeneity in intervention protocols and variability in methodological quality limit the strength and consistency of these findings, emphasising the need for more rigorous and standardised research.

Contributors AS had full access to all the data in the study and takes responsibility for the integrity; he is the guarantor. All authors participated in the redaction of the manuscript, revised the successive versions for important intellectual content, read and approved the final submitted version. I use AI only for English polishing.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

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