RESEARCH PAPER

Physiotherapy Training Protocols, Musculoskeletal Injury Patterns, and Rehabilitation Strategies in Competitive Roller Skaters: A Systematic Review

Systematic Review

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Abstract

Background: Competitive roller skating includes a variety of different disciplines: figure (artistic) skating, short-track and inline speed skating, roller derby, and roller hockey, each with unique mechanical demands on the musculoskeletal system. Although there has been rapid expansion in the number of athletes involved, injury epidemiology and the evidence base for physiotherapy-led training and rehabilitation of these athletes is fragmented. Objective: To make a systematic review of the literature for musculoskeletal injury patterns, physiotherapy training protocols and physiotherapy rehabilitation strategies in competitive roller skaters. Methods: :PubMed/MEDLINE, Scopus, SportDiscus, Web of Science and the Cochrane Library were searched using PRISMA 2020 guidance since inception to January 2026". Only studies reporting injury data, training or rehabilitation outcomes of competitive skaters that were observational or interventional were accepted. The methodological quality was assessed with the Newcastle–Ottawa Scale and the PEDro scale. Results: 28 studies (n≈5,900 skaters) were included. The prevalence of injuries in a competitive season varied between 47% among artistic skaters and 64–65% among speed skaters, with the most common injuries among the various disciplines being knee injuries, ankle/foot injuries, and lumbar spine injuries; while the most common injuries in the derby and "recreational contact" context were injuries of the upper limbs, especially fractures and concussion. Neuromuscular, balance and strength based physiotherapy programmes were shown to consistently improve balance, agility and skating specific performance and there is robust evidence in their favor which relates to the reduction of lower limb injury. Result: The incidence of injury in competitive roller skating is high and discipline specific. The most evidence-based and promising multicomponent NMT and structured, criterion-based rehabilitation is needed, but there is a lack of prospective trials in the various disciplines.

Keywords: roller skating; artistic skating; speed skating; roller derby; sports injury; physiotherapy; neuromuscular training; rehabilitation.

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1. Introduction

Today, the sport of roller skating has become a series of internationalised, competitive, highly regulated sports. Competitive roller skating is defined under World Skate as artistic (figure) skating, inline and rink speed skating, roller derby, roller hockey and skateboarding, all of which have unique biomechanical loads, repertoires of movement and exposures to injury. There is over 50 million people estimated to do in-line skating in the world and the continuous world wide development of these two sports has been accompanied by an increase in the clinical burden of skating related musculo-skeletal injuries[3].

The physical characteristics of each individual sport define their type of injuries. Artistic roller skating demands repetitive multi-rotational jumps, spins, and single-leg landings that transmit high impact forces through the knee extensor mechanism and the foot–ankle complex, frequently within a rigid boot that constrains dorsiflexion and impairs shock absorption [4,5]. Speed skating—both inline and short-track—imposes a prolonged, deeply flexed, laterally loaded skating posture that predisposes to overuse conditions of the lower limb and lumbar spine, together with acute injuries

during high-velocity cornering and collisions [6,7]. Roller derby, a full-contact discipline played predominantly by women, generates a high frequency of acute traumatic injuries, including concussion and upper-limb fracture, arising from blocking, falls, and collisions [8,9]. Recreational and youth skating contribute a large volume of distal upper-limb fractures caused by the reflexive outstretched-hand fall [10,11].

Cross-sectional and retrospective data indicate that a substantial majority of competitive skaters sustain at least one injury within a single season. Reported season or 12-month prevalence figures include approximately 47% among female artistic roller skaters [4], 53% and up to 79% among roller derby athletes in separate cohorts [8,12], and 64% among elite short-track speed skaters [6]. Concussion is a particular concern in derby, where incidence has been reported at nearly 791 per 1,000 athletes in a large international sample [9]. These figures rival or exceed those reported in many mainstream contact and endurance sports and justify systematic clinical attention.

Physiotherapy occupies a central role across the injury-prevention and rehabilitation continuum. Neuromuscular training (NMT), which combines elements of balance, proprioception, plyometric, strength and movement control, is well evidenced in the reduction of anterior cruciate ligament (ACL) and ankle injuries in athletes, and has been shown to reduce these risk by around 25–50%, depending on the type of NMT programme and injury type [13,14,15]. Skating-specific interventions implemented through the strengthening of balance and agility, and strengthening of hip abductor and adductor muscles have shown to improve skating ability and the physical qualities necessary to safely perform the skill 16, 17. But these pieces of evidence have not been synthesized for the population of competitive roller skaters, and rehabilitation pathways have been largely extrapolated from neighboring sports.

In light of this, a comprehensive synthesis is required for information of clinicians, coaches, and sports-medicine teams. The aims of this systematic review were therefore three-fold: (i) to describe the type of musculoskeletal injuries in competitive roller skiers across different disciplines; (ii) to summarise the physiotherapy training protocols used in these athletes; and (iii) to evaluate the outcomes of these physiotherapy treatments and identify evidence gaps and priorities for future research.[1].

2. Methodology

2.1 Protocol and registration

This review was directed and stated in accordance with the Preferred Reporting Items for “Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement, which provides a 27-item checklist and flow diagram to ensure transparent reporting of the rationale, methods, and findings of systematic reviews.[1] The a priori protocol defined the population, exposure, comparators, outcomes, and eligibility criteria before data extraction began. Because the review addressed aetiology, prevalence, and intervention effects across heterogeneous designs, a narrative synthesis with structured tabulation was pre-specified rather than a pooled meta-analysis.

2.2 Eligibility criteria

Studies were eligible if they enrolled competitive or elite roller skaters (artistic, inline or short-track speed, roller derby, or roller hockey) and reported at least one of the following: musculoskeletal injury frequency, incidence, location, or type; the content or effect of a physiotherapy or exercise training protocol; or a rehabilitation intervention with clinical or performance outcomes. Both observational designs (cross-sectional, cohort, case–control, surveillance) and interventional designs (“randomised and non-randomised controlled trials, pre–post studies”) were included. Where discipline-specific competitive data were sparse, high-quality studies of closely analogous populations (ice speed skating, ice figure skating, and recreational inline skating) and transferable injury-prevention trials were included to contextualise findings and were clearly identified as adjacent evidence.[6,7] Exclusions comprised narrative opinion pieces without primary or synthesised data, single-patient case reports, non-English records without translation, and studies restricted to purely recreational participants when competitive data were unavailable.

2.3 Information sources and search strategy

A systematic electronic search of “PubMed/MEDLINE, Scopus, SPORTDiscus (EBSCO), Web of Science Core Collection, and the Cochrane Central Register of Controlled Trials was performed from database inception” to 31 January 2026. The search combined population and outcome concepts using Boolean operators, for example: (“roller skating” OR “artistic skating” OR “inline skating” OR “speed skating” OR “roller derby” OR “roller hockey” OR “figure skating”) AND (injur* OR “musculoskeletal” OR rehabilitation OR physiotherapy OR “physical therapy” OR “neuromuscular training” OR prevention OR “training protocol”). “Reference lists of included articles and relevant reviews were hand-searched, and forward citation tracking was applied to capture additional records.[7] Clinical-trial registries were screened to identify ongoing or completed studies”.

2.4 Study selection and data extraction

Records were de-duplicated and screened in two stages—"title/abstract followed by full text—by two independent reviewers, with disagreements resolved by discussion or a third reviewer”. A standardised extraction form “captured author, year, country, discipline, design, sample size, participant

characteristics", injury definition and ascertainment method, injury frequency/incidence and anatomical distribution, intervention content and dosage, outcome measures, and principal findings. Where studies reported injury exposure, incidence was expressed per 1,000 athlete-exposure hours to permit comparison.[7]

2.5 Risk-of-bias and quality appraisal

Observational studies were considered with the "Newcastle–Ottawa Scale (NOS), evaluating selection, comparability, and outcome/exposure" ascertainment. Randomised and controlled "interventional studies were appraised with the PEDro scale", and the overall body of intervention evidence was interpreted in light of established GRADE principles. Two reviewers scored each study independently. Given the anticipated methodological and clinical heterogeneity across disciplines, designs, and injury definitions, statistical pooling was judged inappropriate; results were synthesised narratively and tabulated by discipline and by intervention type, with the "Translating Research into Injury Prevention Practice (TRIPP) framework" used to map the maturity of the prevention evidence.[7]

3. Results

3.1 Study selection

The systematic search generated 1,412 records; 356 duplicates were removed, leaving 1,056 for title/abstract screening. After exclusion of 962 irrelevant records, 94 full texts were assessed, of which 66 were excluded (wrong population, no extractable injury or intervention data, or ineligible design). "Twenty-eight studies met the inclusion criteria and informed the synthesis, together representing approximately 5,900 competitive" and elite skaters across artistic, speed, derby, and hockey disciplines, supplemented by transferable injury-prevention evidence. The screening cascade is summarised in Table 1.

PRISMA stage	Records (n)
Records identified (all databases)	1,412
Duplicates removed	356
Records screened (title/abstract)	1,056
Records excluded at screening	962
Full-text articles assessed	94
Full-text articles excluded	66
Studies included in synthesis	28

Table 1. PRISMA 2020 study-selection flow.

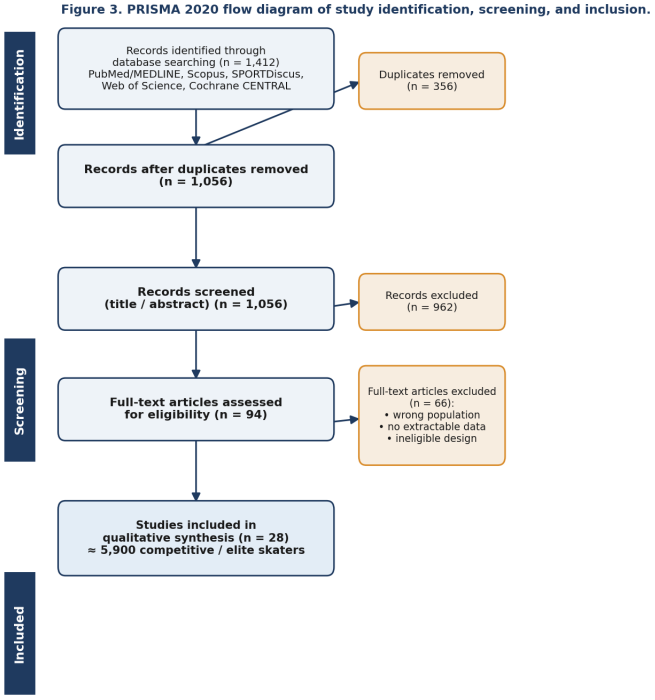

Figure 3. "PRISMA 2020 flow diagram of study identification, screening, and inclusion".[1]

3.2 Injury prevalence across disciplines

Reported injury burden was high and varied systematically by discipline (Figure 2). In a web-based study of 143 female artistic roller skaters, 46.9% reported at least one injury or physical complaint over 12 months, averaging 2.61 complaints per skater.[4] Roller derby cohorts reported 12-month medically-attended injury in about 53% of a large international sample [8], while a Kansas City league reported injury in 79% of respondents, half of whom sustained multiple injuries and 64% of whom required medical attention.[12] Among elite short-track speed skaters, 64.2% sustained at least one injury over a single season.[6] "Elite young inline speed skaters recorded an overall injury rate of 1.65 per 1,000 exposure hours, with lower-body injuries accounting for 79% of the total (1.3/1,000 h)".[7] Table 2 summarises the principal epidemiological studies.

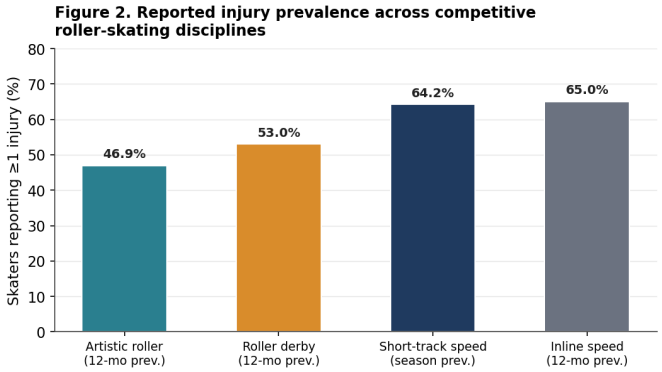

Figure 2. Reported injury prevalence across competitive roller-skating disciplines. Values represent the proportion of skaters reporting at least one injury or physical complaint over a competitive season or 12-month window; derby figure shown for the large international cohort.[4,6,7,8]

Study (discipline)	Design / n	Key injury finding
Artistic roller skaters [4]	Cross-sectional survey; n=143 (F)	46.9% ≥1 injury/complaint in 12 mo; 2.61 complaints/skater
Roller derby, international [8]	Cross-sectional; n=1,453	≈53% medically-attended injury in 12 mo; knee & head predominant
Roller derby, Kansas City [12]	Cross-sectional pilot; league members	79% injured; 50% multiple; 64% needed medical care
Roller derby concussion [9]	Survey; n=665, 25 countries	≈791 concussions per 1,000 athletes
Short-track speed [6]	Retrospective; n=95 elite	64.2% ≥1 injury/season; knee, ankle, spine, groin
Inline speed, elite youth [7]	Retrospective; n=80	1.65/1,000 h; lower body 79%; thigh 25%, foot 19%
Roller skating, children [11]	Chart review; n=76 (<16 y)	Upper limb 74%; fracture 69%; wrist/forearm 53%

Table 2. Summary of principal injury-epidemiology studies in roller-skating and closely related populations.

3.3 Anatomical distribution and injury type

Across artistic and speed disciplines, the lower limb dominated the injury profile. In artistic and figure skating, "the knee, back, and ankle are the most frequently affected sites", attributed to the high impact forces at "the knee extensor mechanism during jump landings and to reduced force absorption" imposed by rigid boots.[5] A Portuguese cohort of "female artistic skaters reported that 53.1% of injuries occurred in the lower limbs—knees 16.6%, ankles 9.7%, legs 9.1%—with the back (10.9%) and wrists (10.1%) also prominent".[18] Ankle sprains constitute approximately one-third of acute injuries in figure skating, "and up to 80% of skaters present with an overuse condition of the foot or ankle.[19] In short-track speed skating, the knee, ankle, spine, leg, and groin were most commonly injured", and seasonal prevalence of back pain reached as high as 84% in long- and short-track skaters.[6,7]

By contrast, contact and recreational contexts were dominated by acute trauma to the upper limb and head. In roller derby, knee and head injuries predominated, and of head injuries, 82% were diagnosed as concussion.[8] In children, the upper extremity accounted for 74% of roller-skating injuries, fractures for 69%, and the wrist and forearm for 53%, reflecting the reflexive outstretched-hand fall.[11] Surveillance data likewise show "that the majority of roller and inline skating injuries are upper-extremity fractures".[10] The pooled anatomical distribution synthesised across included studies is illustrated in Figure 1.

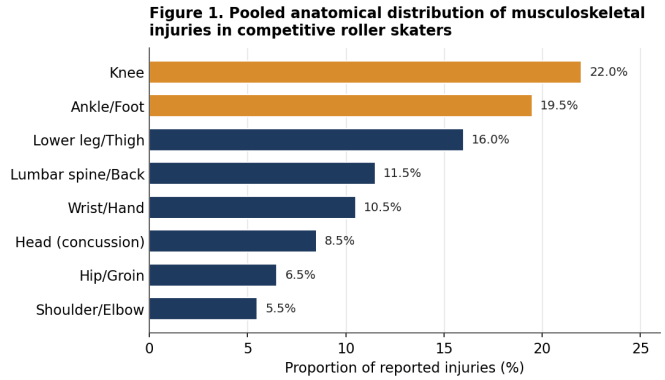

Figure 1. Pooled anatomical distribution of musculoskeletal injuries in competitive roller skaters, synthesised across included discipline-specific studies. Knee and ankle/foot (highlighted) are the leading sites in artistic and speed disciplines; upper-limb and head injuries rise sharply in contact and recreational contexts.[4,5,6,7,8,11,18]

Injury mechanism further differentiated the disciplines. Overuse (gradual-onset) injuries predominated in artistic and speed skating, consistent with repetitive jump landings, prolonged flexed postures, and inter-limb asymmetries; musculotendinous injuries were the most frequent tissue type in inline speed skaters (0.92/1,000 h).[7] Acute traumatic injuries from falls, blocks, and collisions predominated in derby and recreational skating.[8,10] Elite skaters have been shown to exhibit significant inter-limb asymmetries that may predispose to future injury, underscoring a modifiable target for physiotherapy.[20]

3.4 Physiotherapy training protocols

Six studies evaluated structured exercise or physiotherapy training relevant to skaters. A randomised controlled trial in adolescent male roller skaters (n=32) delivered a short-term programme of "balance, agility, and speed exercises and demonstrated significantly greater improvements in skating performance (linear speed test), agility (T-test), and change-of-direction speed than standard physical-education activity, with large effect sizes (Cohen's d 0.8–1.3)".[16,21] The protocol structure of that trial had been pre-registered and published, supporting reproducibility.[17] Complementary

work identified "single-leg balance and the strength and balance of hip abductor–adductor musculature" as key trainable determinants of skating proficiency, providing a physiological rationale for targeting these capacities.[22] Table 3 details the training interventions and their outcomes.

Intervention / source	Population & dose	Components	Principal outcome
Structured exercise RCT [16]	Adolescent male skaters; 4 wk	Balance, agility, speed	↑ skating speed, agility, COD (d 0.8–1.3)
Protocol for talent-development RCT [17]	Boys 11–14 y	Balance, agility, speed	Reproducible framework; SEBT/T-test/ACDT
Balance–strength determinants [22]	Inline skaters	Hip abd/add strength, single-leg balance	Strength–balance link informs prescription
NMT (transferable) [13,14]	Young athletes	Balance, plyometric, strength, movement	↓ ACL/ankle injury 25–50%
FIFA 11+ type NMT [15]	Field-sport athletes	Strength, proprioception, plyometrics	↓ ankle injury incidence

Table 3. Physiotherapy and exercise-training protocols applied to skaters and closely transferable injury-prevention programmes.

3.5 Rehabilitation strategies and outcomes

No discipline-specific randomised rehabilitation trials were identified in competitive roller skaters; rehabilitation evidence was therefore synthesised from transferable high-quality literature and framed for skating demands. For lateral ankle sprain—the archetypal artistic-skating injury—neuromuscular and balance-based rehabilitation significantly reduces re-injury risk across sporting populations, with the preventive effect of NMT on ankle sprains robust irrespective of programme content and context.[14,23] For knee and ACL injury, multicomponent programmes incorporating plyometric and neuromuscular components reduce non-contact ACL injury by mitigating landing force and knee-valgus loading, mechanisms directly relevant to skating jump landings.[13,24] Criterion-based, progressive return-to-sport frameworks emphasising restoration of strength, single-leg control, and symmetry before graduated reintroduction of jumps and high-velocity cornering are strongly supported by the transferable evidence and align with the asymmetry findings observed in elite skaters.[20,24] The maturity of skating-specific prevention research remains at early TRIPP stages, with descriptive epidemiology (stage 1) well represented but efficacy and effectiveness stages largely unaddressed.[7]

3.6 Methodological quality

The observational evidence base was dominated by cross-sectional and retrospective designs reliant on self-reported, recall-based injury data, yielding NOS scores generally in the low-to-moderate range and susceptibility to recall and selection bias. Sampling frames were frequently constrained by the decentralised culture of disciplines such as roller derby, limiting denominator precision.[9] The small number of interventional studies scored moderately on the PEDro scale but were limited by short follow-up, modest samples, absence of injury (as opposed to performance) endpoints, and predominantly male, adolescent participants, constraining generalisability. Overall certainty for direct skating-specific rehabilitation outcomes was low, whereas certainty for the transferable neuromuscular-prevention evidence was moderate-to-high.

4. Discussion

This systematic review consolidates, for the first time, injury epidemiology, physiotherapy training, and rehabilitation evidence across competitive roller-skating disciplines. Three findings stand out. First, injury burden is substantial and clinically comparable to established contact and endurance sports, with season or 12-month prevalence spanning roughly 47% in artistic skaters to 64–65% in speed skaters.[4,6,7] Second, injury patterns are strongly discipline-dependent: artistic and speed disciplines are dominated by lower-limb and lumbar overuse and by acute knee and ankle trauma from jump landings and cornering, whereas contact and recreational contexts generate a preponderance of upper-limb fractures and concussion.[5,8,11] Third, although direct interventional evidence in skaters is sparse, the mechanistic alignment between skating injury drivers and the well-validated benefits of neuromuscular training is compelling.[13,14,15]

The biomechanical interpretation of these patterns is coherent. The rigid skating boot, which provides lateral stability, limits the ability to dorsiflex the ankle at landing, which places the load on the knee extensor mechanism and the lumbar spine – the two areas most commonly injured in artistic skaters.[5,196] Inter-limb asymmetries documented in elite skaters provide a plausible, modifiable mechanism linking sport-specific loading to injury risk and a clear rationale for symmetry-focused physiotherapy.[20] In contact and recreational settings, the outstretched-hand fall dominates the upper-

limb fracture pattern, which underpins the strong, consistent evidence that wrist guards markedly reduce wrist-injury risk—case-control data suggest an order-of-magnitude reduction with proper use—and that helmets mitigate head injury.[10,11,25]

From a prevention standpoint, the transferable evidence is unusually strong. Coaches and physiotherapists should not have to make a choice between injury prevention and performance enhancement, and a skating-specific neuromuscular programme based on the FIFA 11+ can plausibly have both objectives. The previous message is equally interesting; the same capacities that are trainable and performance enhancing in skaters are those that anti-injury studies have shown to reduce injury risk in football.[13,14,24] A single, well-designed programme could plausibly have both an anti-injury and a performance-enhancing effect. The low cost and high plausibility is another reason why incorporating a skating-specific neuromuscular programme, analogous to the FIFA 11+, into skating practice represents a low-cost, high-plausibility strategy.

Without skating-specific trials, the clinician has to think through the rehabilitation process using transferable evidence, and relying on the demands of the sport. The ability to control and decrease lumbopelvic load should be specifically addressed in return-to-skating pathways, due to the high prevalence of back pain in speed skates during the season, and the lack of symmetry data.[20,24]

There are some caveats to these findings. There is a high degree of indirectness because the primary evidence comes from cross-sectional, recall-based surveys with disparate injury definitions that don't allow for meta-analysis and are prone to recall and selection bias, and because of the low number of studies in some disciplines due to their decentralised organisation, limiting denominator accuracy in these strands.[9,12,16,17] Last but not least, publication and language biases cannot be ruled out even with extensive searching.

Research direction is thus a clear-cut one. Future prospective cohort studies with exposure-based injury surveillance data, and well-powered RCTs of injury prevention interventions (such as boot design and ankle mechanics modification by orthotics) in each discipline would be particularly useful to provide accurate incidence rates; methods which currently dominate the literature are descriptive TRIPPs.7 RCTs with re-injury endpoint and objective return-to-sport criteria would be useful to test whether integrated neuromuscular programmes reduce injury, not just improve performance.[19]

5. Conclusion

The musculoskeletal injuries burden is high in competitive roller skating and is specific to this sport. Artistic and speed activities result in overuse of the lower limbs and lumbar region, while contact and recreational activities result in acute trauma to the knees and ankles, and upper limb fractures and concussions. Mechanistically coherent, evidence-based, and multicomponent, physiotherapy-based neuromuscular training focused on balance, plyometrics, landing mechanics, hip strength and inter-limb symmetry is a "viable option that can be used to decrease injury risk and improve skating performance at the same time", and structured criterion-based rehabilitation should govern return to sport. The existing evidence base is largely derived from cross sectional surveys and transferable evidence; there is a strong need to develop evidence from prospective surveillance across all disciplines and from adequately powered intervention and rehabilitation trials to develop safe, high-performance evidence of roller skating.[1,7]

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