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Performance optimization and injury prevention in floorball: a systematic literature review of biomechanical, physiological, and technological evidence

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ABSTRACT

Floorball is a fast, multidirectional indoor team sport in which performance and injury risk emerge from interacting tactical, biomechanical, neuromuscular, physiological, and monitoring factors. This systematic review synthesised evidence from 2005–2026 across three linked domains: performance determinants, injury risk and prevention, and technologies for monitoring and prediction. PRISMA 2020 guided the review, and Scopus was used as the primary information source because it spans sport science, biomechanics, and engineering literature. The search identified 63 records; 30 full texts were assessed and 10 empirical studies were included: five prospective/longitudinal, three cross-sectional, one observational match-analysis, and one intervention-plus-modelling study. Thematic synthesis identified three evidence clusters. Performance was associated with tactical decision-making, shooting coordination, reactive lower-limb strength, directional-speed symmetry, and load-sensitive psychophysiological state. Injury evidence centred on ACL-related landing and neuromuscular-control factors, but no single screen consistently predicted future injury. Emerging technologies included wearables, velocity-based training, machine learning, and automated tracking, with modest individual-level predictive validity. The review therefore proposes a hypothesis-generating monitoring-informed framework that links performance and injury domains while requiring larger prospective cohorts, external validation, stronger female- and youth-specific evidence, and replication across databases.

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Introduction

Team ball sports sit at the centre of contemporary physical culture, and for good reason. They combine cardiovascular conditioning, motor-skill development, and social participation across the whole lifespan (Castagna et al., 2020). Floorball, a fast indoor stick-and-ball invasion game, has expanded rapidly from a Nordic recreational pastime into an internationally governed competitive sport with structured leagues, national teams, and a growing scientific literature (Krejzová et al., 2026). Its movement profile is distinctive. Players work in a crouched posture, handle a light stick, and constantly accelerate, decelerate, and change direction. That profile simultaneously drives performance and exposes players to injury. As participation spreads across youth, adult, and older populations, the need for a consolidated, evidence-informed understanding of how floorball performance is produced, monitored, and protected becomes increasingly urgent.

Floorball's competitive demands surface in a few recognisable actions: shooting, passing, sprinting along curved paths, and rapid change of direction. Each depends on specific neuromuscular and biomechanical capacities (Gómez et al., 2013; Vecbērza et al., 2026). Effective ball possession is not just about individual technique. It also hinges on tactical variables such as court zone, possession duration, and defensive pressure, all of which interact with the quality of the opposition (Gómez et al., 2013). At the level of a single action, the determinants become sharper. Shooting accuracy appears to rest on finely coordinated segmental control (Farana et al., 2025), while high-intensity locomotor performance is constrained by inter-limb asymmetries and reactive strength qualities (Vecbērza & Plakane, 2025). Principled training design depends on understanding all of these determinants first.

The musculoskeletal cost of those demands has been examined in a large and methodologically rigorous body of work, with the knee receiving particular attention. Prospective cohort studies have used three-dimensional motion analysis to investigate the biomechanical antecedents of anterior cruciate ligament (ACL) injury in young players (Leppänen et al., 2017b; Pasanen et al., 2025). Screening tools, including frontal-plane knee control tests, have been evaluated as predictors of lower-extremity injury (Räisänen et al., 2018; Raïsänen et al., 2016). Parallel research has looked at the economic burden of injury (Forssblad et al., 2005) and the behavioural barriers that keep youth players and coaches from embracing preventive exercise (Åkerlund et al., 2024). Taken together, these studies have established floorball as a high-risk sport for knee trauma.

Methodological and technological advances are now reshaping how floorball is studied and coached. Wearable and sensor-based instruments make it possible to estimate energy expenditure and mechanical output in the field (Gilgen-Ammann et al., 2019; Rontu et al., 2010). Velocity-based training frameworks tie neuromuscular monitoring to individualised load prescription (Achermann et al., 2025), and machine-learning approaches have been applied to injury-risk detection in team-sport athletes (Jauhiainen et al., 2021). Computer-vision systems for multi-object tracking (Mu et al., 2025) and digital-twin and simulation environments (Gutmann et al., 2023; Hilmi et al., 2024) reinforce the same shift toward data-intensive analytics. The promise is a move from descriptive observation toward prediction and decision support.

Despite this momentum, the floorball evidence base remains fragmented. Performance analysis, injury epidemiology, physiological conditioning, and technological innovation have largely developed as parallel silos, each carrying its own designs, samples, and outcome measures. A recent scoping review of competitive floorball highlighted how dispersed the literature is and noted the absence of an integrative synthesis linking performance determinants to injury mechanisms and to the tools used to monitor both (Krejzová et al., 2026). The practical result is that practitioners lack a consolidated account of which capacities to develop, which risks to mitigate, and which technologies meaningfully inform those decisions.

The second gap is methodological. Many performance and biomechanical studies rest on small, cross-sectional samples, which limits statistical power and generalisability (Farana et al., 2025; Van Der Does et al., 2015). Even well-powered prospective cohorts report modest predictive accuracy for future injury (Jauhiainen et al., 2021; Pasanen et al., 2025). Predictive modelling has often prioritised discrimination over interpretability, and female-specific evidence remains comparatively sparse despite the disproportionate ACL burden carried by female players (Leppänen et al., 2017b; Levin et al., 2025). These limitations constrain the translation of research findings into coaching and clinical practice.

Addressing these gaps now is timely. Biomechanical methods have matured, wearable ecosystems continue to expand, and machine-learning tools are increasingly accessible. Their convergence makes an integrated review feasible, but the synthesis must remain explicit about its boundaries: this is a systematic review, not a scoping review; the search covers 2005–2026; Scopus is the primary database; and the evidence base includes observational, prospective, cross-sectional, and intervention-plus-modelling designs. The review therefore aims to integrate findings without assuming that heterogeneous outcomes are directly comparable. A thematic synthesis is used to connect performance, injury, and technology while preserving the design-specific limitations of each evidence stream.

Accordingly, this review is guided by three research questions. The first addresses the foundations of performance and contributes an integrated account of the trainable capacities that distinguish effective floorball play.

RQ1: What biomechanical, neuromuscular, and tactical factors determine performance in floorball?

The second question turns to health protection. It contributes a consolidated synthesis of modifiable injury-risk factors and the evidence on preventive strategies across the developmental spectrum.

RQ2: What risk factors and prevention strategies for sport injury have been identified in floorball populations?

The third question examines the analytical frontier, and this is where the novelty of the review lies. To the authors' knowledge, it is the first synthesis to position emerging sensor and machine-learning technologies as the connective tissue between performance optimisation and injury prevention in floorball.

RQ3: How are wearable sensors, velocity-based training, machine learning, and tracking technologies being used to monitor performance and predict injury in floorball?

Method

Research Design and Framework

A systematic literature review design was chosen so that evidence on performance, injury, and monitoring technology could be identified, appraised, and synthesised transparently and reproducibly (Tranfield et al., 2003). Reporting followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) statement (Page et al., 2021). The protocol defined the three research questions, the 2005–2026 search window, eligibility criteria, information source, extraction fields, and thematic synthesis strategy before the final synthesis was written. Because the included studies used heterogeneous designs, populations, constructs, and outcomes, the review was intentionally narrative and thematic rather than meta-analytic.

Search Strategy

The search was designed as a high-sensitivity three-domain strategy covering the sport identifier, performance/injury constructs, and technology/monitoring concepts. The Scopus TITLE-ABS-KEY field was used, with truncation to capture lexical variants. No language, date, or document-type limiter was imposed during retrieval; the 2005–2026 period and English full-text requirements were applied during eligibility screening. The executed Scopus query was:

TITLE-ABS-KEY ("floorball" OR "floor ball" OR "unihockey") AND ("performance" OR "biomechanic" OR "kinematic*" OR "injur*" OR "training" OR "wearable*" OR "machine learning" OR "sensor*"))*

This strategy was deliberately broad because the review integrates three evidence domains that are often indexed under different terminology. The absence of a database-specific limiter was intended to preserve retrieval sensitivity. However, a single-database search remains a limitation; a sensitivity search in Web of Science and PubMed is recommended before final resubmission, using equivalent sport, performance/injury, and technology blocks.

Database and Information Sources

Scopus was used as the single primary information source because its coverage spans sport science, biomechanics, engineering, and applied performance research, while its structured metadata export supports reproducible record management. The retrieved corpus contained 63 records published between 2005 and 2026. This choice was made for reproducibility and interdisciplinary coverage, not because Scopus is assumed to be exhaustive. Consequently, database coverage bias is treated as a major limitation, and the revised submission should include a sensitivity search in at least one additional bibliographic database (preferably Web of Science and/or PubMed) or explicitly report that those searches yielded no additional eligible studies.

Eligibility Criteria

Inclusion and exclusion followed the predefined criteria in Table 1. Peer-reviewed journal articles and reviews were favoured, but only when they directly addressed floorball performance, injury, or supporting technology and reported extractable outcomes.

Table 1. Inclusion and exclusion criteria applied during screening.

Criterion	Inclusion	Exclusion
Language	Records with English-language metadata and retrievable full text	Records without accessible English full text
Document type	Journal article; review	Conference paper, book chapter, editorial, conference review
Period	2005–2026	Before 2005
Subject focus	Floorball performance, biomechanics, injury, or monitoring technology	Unrelated sports or non-floorball focus with only tangential mention
Outcome data	Reports extractable performance, injury, or technological outcomes	Insufficient outcome data; abstract only
Relevance	Directly addresses a review research question	Tangential or non-empirical treatment

Study Selection Process

Study selection followed PRISMA 2020 in three stages: duplicate checking, title/abstract screening, and full-text eligibility assessment. A standardised decision form was used and exclusion reasons were recorded. The present source file does not preserve reviewer-level screening decisions, so Cohen's kappa cannot be reconstructed retrospectively without inventing data. For the resubmission, title/abstract and full-text screening should be repeated independently by two reviewers and Cohen's kappa reported for each stage; percent agreement may be reported as a supplementary statistic. Any disagreement should be resolved by consensus or a third reviewer.

Quality Assessment, FICO Framework

The original manuscript used the FICO framework (Focus, Information, Context, Outcome) as a descriptive appraisal of reporting quality. Because FICO is not a validated risk-of-bias instrument, it should not be interpreted as equivalent to a formal methodological appraisal. For the revised submission, the ten included studies should be reassessed with design-specific JBI Critical Appraisal Tools (for example, the appropriate cohort, analytical cross-sectional, or quasi-experimental checklist), with item-level judgements reported in a supplementary table. The current source file does not contain the full-text appraisal records required to generate defensible JBI scores, so no JBI score is fabricated here. This distinction is important because the current evidence base includes heterogeneous designs and cannot be reduced to a single generic risk-of-bias scale.

Data Extraction Procedure

A standardised extraction template captured author(s), year, national context, study design, sample characteristics, performance/injury/technology construct, measurement methods, principal outcomes, and key findings. For included studies, extraction should be performed from the full-text report rather than from metadata alone; metadata are used only to verify bibliographic information. Study-level decisions should never be inferred when a required field is not reported. The extracted variables were then mapped to the three research questions and to design-specific methodological limitations.

Network and Bibliometric Analysis

Descriptive bibliometric indicators were computed from the full set of retrieved records to characterise the broader corpus. These covered the annual distribution of publications, the journals that contributed the most, and how often author-supplied keywords appeared. Keyword frequencies were tabulated to approximate the field's thematic structure and visualised as a co-occurrence map. The purpose of these analyses is to place the included studies in the wider publication landscape, not to serve as the primary synthesis.

Data Analysis and Synthesis

Included studies were combined using thematic synthesis (Thomas & Harden, 2008). Findings were coded inductively, grouped into descriptive codes, and then organised deductively under the three research questions. The synthesis explicitly compared convergent and contradictory findings and retained study-design differences rather than pooling unlike outcomes. No effect-size meta-analysis was attempted because the ten studies differed substantially in population, exposure, outcome definition, measurement protocol, and statistical approach. The synthesis therefore supports patterns and hypotheses, not pooled causal estimates.

Reporting and Documentation

Documentation followed the PRISMA 2020 checklist. The flow of records through identification, screening, eligibility, and inclusion is laid out in the flow diagram (Figure 1) (Page et al., 2021). Every quantitative flow value shown there is consistent with the abstract, the methods, and the results.

The review is presented as a systematic review throughout the manuscript. It should not be described as a scoping review in reviewer correspondence or supplementary material. The PRISMA flow counts are reported consistently: 63 records identified, 63 screened, 30 full texts assessed, and 10 studies included. The principal reproducibility gaps that remain are independent dual screening with Cohen's kappa and independent design-specific risk-of-bias appraisal.

PRISMA 2020 Flow Diagram

Figure 1 traces the flow of records through the review. Scopus returned 63 records, and none of them were duplicates. All 63 records were screened at title and abstract, and 33 were excluded as not relevant to floorball performance, injury, or technology. That left 30 reports for full-text assessment, and 20 of those were excluded: 9 for ineligible document type, 8 for not being focused on floorball performance, injury, or technology, and 3 for insufficient outcome data or unavailable full texts. Ten studies remained for synthesis.

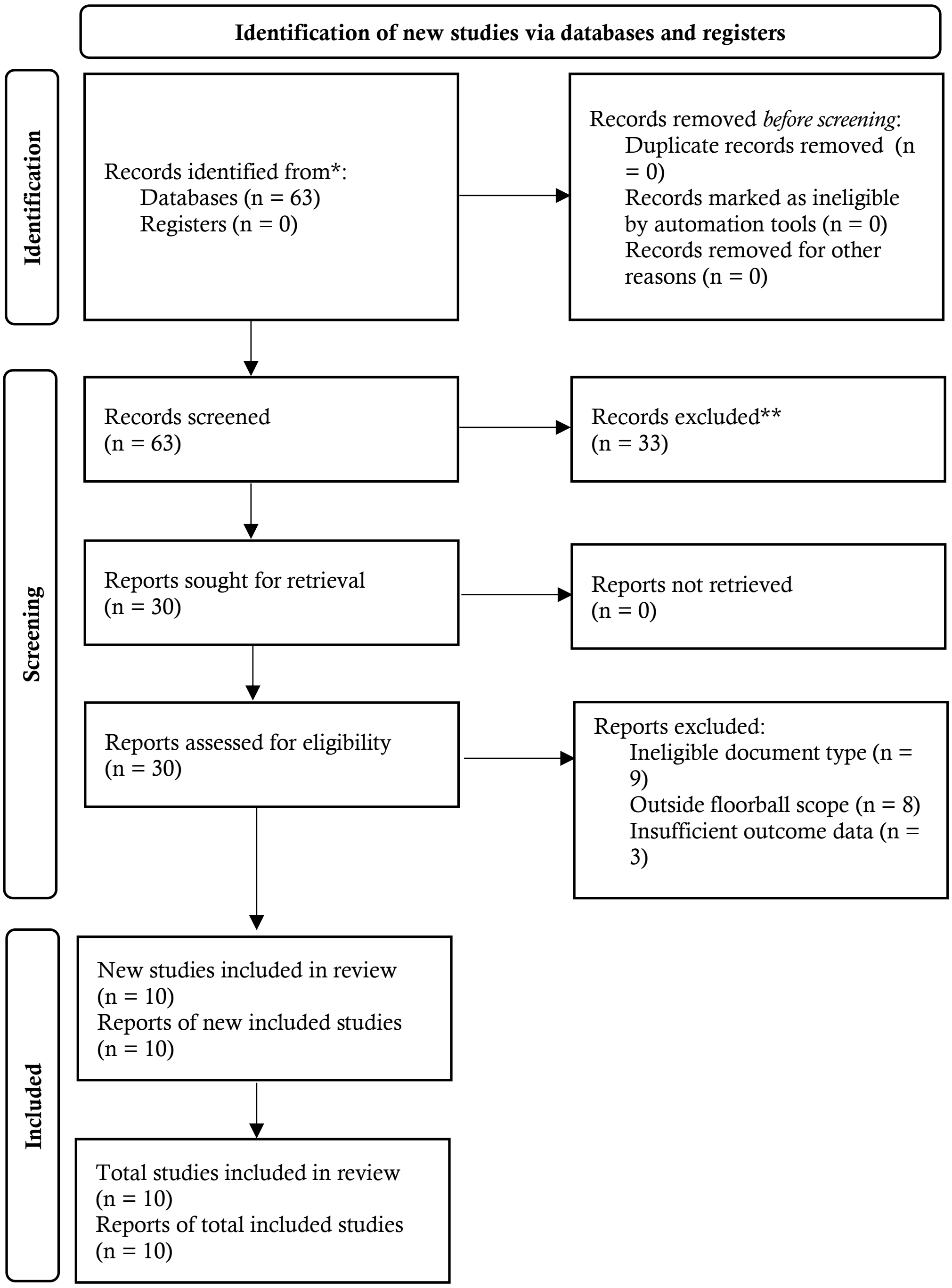

Figure 1. PRISMA 2020 flow diagram of study identification, screening, eligibility, and inclusion.

Results and Discussions

Study Selection Results

The systematic search turned up 63 Scopus records, all published between 2005 and 2026. No duplicates were found. Title and abstract screening removed 33 of those records. Their focus mostly sat outside floorball performance, injury, or supporting technology, and they tended to be general physical education, cardiovascular health, or unrelated field hockey and management studies. That left 30 reports for full text assessment. Twenty were excluded at this stage. Nine were ineligible by document type, covering conference papers, book chapters, an editorial, and a conference review. Eight did not centre on floorball performance, injury, or technology. The other three had too little extractable outcome data or no accessible full text. In the end, ten empirical studies met every criterion and were carried forward to synthesis, which matches Figure 1 numerically.

Table 2 summarises the 10 included studies. The design distribution was heterogeneous: five studies used prospective or longitudinal designs, three used cross-sectional performance testing, one used observational match analysis, and one combined intervention with predictive modelling. Injury studies were concentrated in young and female populations, whereas performance studies also included male youth and mixed competitive settings. Sample sizes ranged from small biomechanical cohorts to prospective samples exceeding 300 athletes. These differences constrain direct comparison and are important when interpreting generalisability.

The corpus itself expanded sharply over the review period. Most records appeared from 2020 onward, and 2025 saw the single biggest peak (Figure 2). That points to a fast growing research interest in floorball science. Journals in sport medicine, sport science, and applied research all carried these publications, though the Scandinavian Journal of Medicine and Science in Sports led the way (Figure 4), a reminder of floorball's strong Nordic roots. Author supplied keywords (Figure 5) reinforce the field's three part structure. High frequency terms cluster around the sport itself and team sports, around biomechanics and knee injuries, and around measurement constructs such as accelerometry and performance analysis. Thematically, the corpus falls into four broad areas: health, physical education and pedagogy; performance and biomechanics; injury prevention and risk; and technology, analytics, and management (Figure 3).

Table 2 summarises the 10 included studies. These range from cross sectional performance testing to prospective injury cohorts, biomechanical motion analysis, monitoring designs, and predictive modelling studies. Most were conducted in European settings, with Finnish, Latvian, Swiss, Swedish, and Dutch contributions all represented. Sample sizes varied notably, from small biomechanical cohorts up to prospective samples with more than 300 athletes.

Table 2. Summary of included studies (n = 10).

Author(s) & year	Country	Design	Sample	Key findings
Gómez et al. (2013)	Spain / Portugal	Observational match analysis	1,500 possessions; 14 elite games	Tactical variables (court zone, possession duration, shooting technique, defensive pressure) predicted ball-possession effectiveness, moderated by quality of opposition.
Van Der Does et al. (2015)	Netherlands	Prospective monitoring (6 months)	10 female players	Psychosocial stress and recovery affected interval-running performance, and physical stress influenced agility up to six weeks before testing, supporting integrated monitoring.
Leppänen et al. (2017b)	Finland	Prospective cohort (VDJ, 3D motion)	171 female players; 15 ACL injuries	Lower peak knee-flexion angle and higher peak vertical ground-reaction force (stiff landings) were associated with increased ACL-injury risk.
Jauhiainen et al. (2021)	Finland	Prospective + machine learning	314 young athletes; 57 injuries	Logistic-regression and random-forest models identified consistent knee/ankle injury predictors (e.g., BMI, hamstring flexibility, knee laxity, medial knee displacement, valgus) with modest accuracy (AUC 0.63–0.65).

Author(s) & year	Country	Design	Sample	Key findings
Achermann et al. (2025)	Switzerland	Intervention + predictive modelling	17 female players; 6-week VBT	Velocity-based training improved estimated 1RM and concentric velocity; regression models explained 54–79% of strength gains, illustrating a monitoring-to-prediction workflow.
Farana et al. (2025)	Czechia	Biomechanical (3D vector coding)	10 youth players	Successful shooting involved coupled head–trunk action dominated by the head, underscoring segmental coordination in shot accuracy.
Vecbērza & Plakane (2025)	Latvia	Cross-sectional performance testing	76 male players (U17/U20/20+)	Reactive strength index and relative ankle plantar-flexor strength differed by age and competitive level but not by playing position; strength benchmarks were proposed.
Pasanen et al. (2025)	Finland	Prospective cohort (2.5-year)	65 female players; 10 ACL injuries	No baseline differences in 90-degree cutting knee biomechanics between injured and uninjured players; single-task cutting kinematics did not predict future ACL injury.
Levin et al. (2025)	Sweden	Prospective, latent profile analysis	222 youth players	Three psychological–physical profiles emerged; a high-physical-performance/moderate-mental-health profile showed higher injury occurrence, highlighting combined risk.
Vecbērza et al. (2026)	Latvia	Cross-sectional performance testing	48 male players	Curvilinear- and change-of-direction-sprint deficits revealed inter-limb asymmetries; deficit metrics offer a practical tool for assessing directional speed.

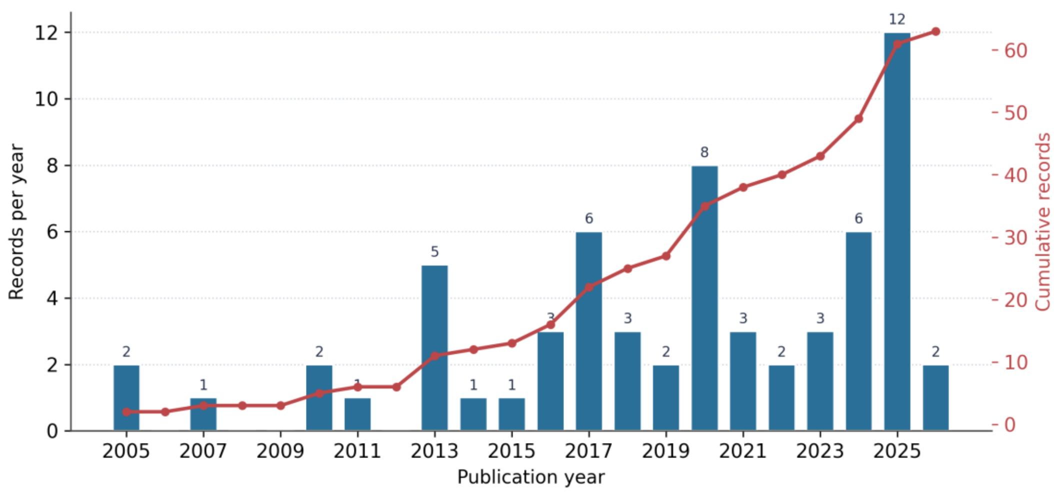

Figure 2. Annual and cumulative distribution of retrieved records (Scopus, 2005–2026).

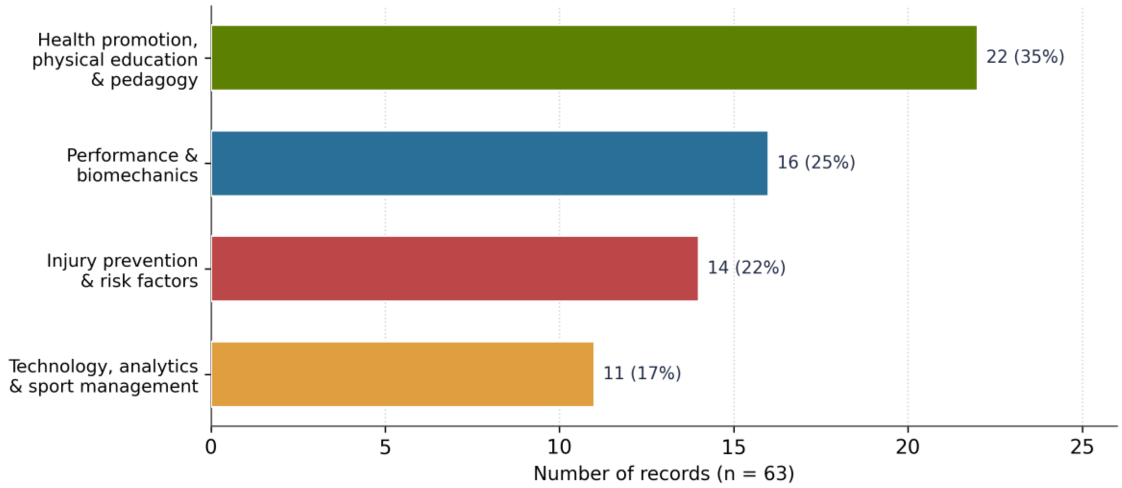

Figure 3. Distribution of the retrieved corpus across four thematic domains (n = 63).

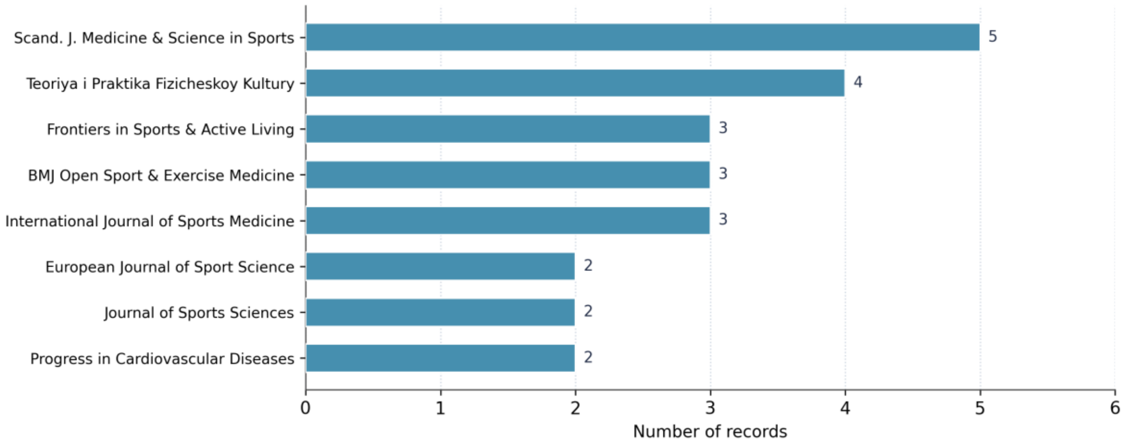

Figure 4. Leading source journals contributing to the retrieved corpus.

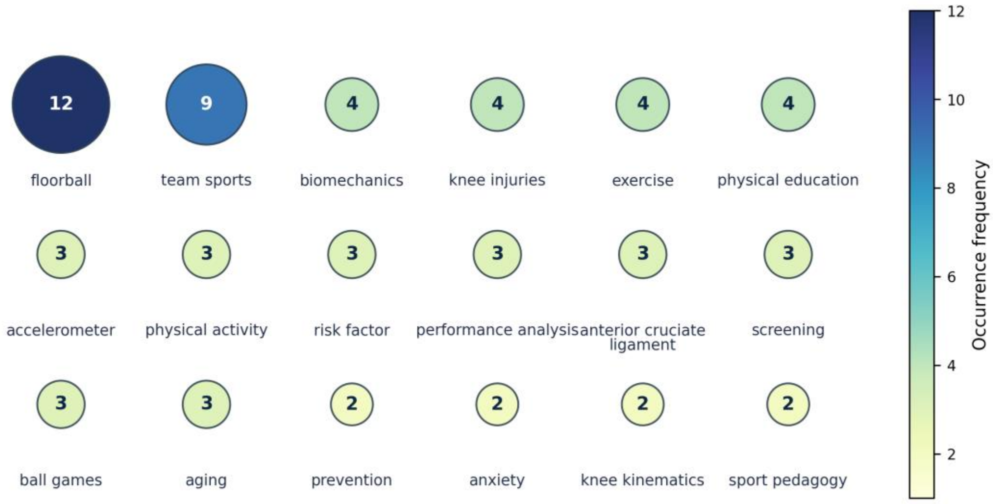

Figure 5. Author-keyword occurrence map for the retrieved corpus.

Across the ten included studies, the evidence base therefore favoured prospective/longitudinal and observational designs over controlled intervention trials. This distribution supports identification of associations and monitoring signals but provides limited evidence for causal effects of monitoring-informed interventions.

Table 3. Classification of included studies by theme, method, and technology.

Author(s) & year	Year	Research design	Primary theme / focus	Technology or method
Gómez et al.	2013	Observational / logistic regression	Performance — tactical analysis	Notational match analysis
Van Der Does et al.	2015	Prospective multilevel modelling	Performance — psychophysiological monitoring	Training logs; RESTQ-Sport; field tests
Leppänen et al.	2017	Prospective cohort	Injury — ACL biomechanics	3D motion analysis (drop jump)
Jauhiainen et al.	2021	Prospective + ML	Technology — injury prediction	Logistic regression; random forest
Achermann et al.	2025	Intervention + modelling	Performance — strength/power	Velocity-based training; regression
Farana et al.	2025	Biomechanical (cross-sectional)	Performance — shooting coordination	3D motion capture; vector coding
Vecbērza & Plakane	2025	Cross-sectional testing	Performance — ankle strength	Reactive strength index; dynamometry
Pasanen et al.	2025	Prospective cohort	Injury — cutting biomechanics	3D motion analysis; force plates
Levin et al.	2025	Prospective; latent profiles	Injury — psychological–physical risk	Latent profile analysis
Vecbērza et al.	2026	Cross-sectional testing	Performance — sprint / COD	Timed curvilinear & COD tests

Thematic Synthesis

RQ1, Determinants of floorball performance

Taken as a whole, the evidence points to a multifactorial picture of floorball performance. Tactical decision-making matters, and so do discrete neuromuscular and biomechanical capacities. In elite men's floorball, effective ball possession depends on which court zone the ball is in, how long a team holds it, shooting technique, and defensive pressure. Those relationships shift with the quality of the opponent (Gómez et al., 2013). That pattern matches what broader invasion-game analyses have found, where contextual and positional indicators separate successful teams from unsuccessful ones (Vinson & Peters, 2016). It also fits recent accounts that treat perception and decision-making as core trainable skills in game sports (Magnaguagno & Beck, 2025). Position-specific demands extend to goalkeepers too; observational studies have quantified their in-game movement patterns to guide role-specific preparation (Tengman et al., 2025).

Move down to the individual skill level, and biomechanics locate performance in how body segments coordinate. In young players, successful shooting involves a coupled action of the head and trunk that is driven mainly by the head. That points to segmental coordination as the immediate determinant of shot accuracy, rather than isolated limb strength (Farana et al., 2025). Locomotor performance is also directional. Curvilinear sprinting and changes of direction expose inter-limb asymmetries that a straight sprint test would never pick up (Vecbērza et al., 2026). Underneath those abilities sits reactive ankle plantar-flexor strength, which separates athletes by age and competitive level and supplies benchmarks for readiness and progression (Vecbērza & Plakane, 2025).

One theme comes up again and again: performance is dynamic and state-dependent, not fixed. In a longitudinal study of female players, psychosocial stress and recovery influenced interval-running performance, while accumulated physical load shaped agility even six weeks before testing (Van Der Does et al., 2015). Strength and power behave the same way. They are trainable, and more importantly, they are predictable. A velocity-based training block boosted neuromuscular outputs, and simple regression models captured most of the gains (Achermann et al., 2025). Other training studies show that floorball-based interventions can improve coordinative abilities in broader populations (Kopeykina et al., 2025), while autonomic markers like heart-rate variability track conditioning (Martusevich et al., 2021). Altogether, floorball performance comes across as coordinated, sensitive to load, and coachable, spanning tactical, biomechanical, and physiological levels.

RQ2, Injury risk factors and prevention

Most of the injury research focuses on the knee, and specifically the ACL, in young players who are mostly female. Landing mechanics sit at the center of that work. Stiff vertical-drop-jump landings, with reduced peak knee-flexion angle and elevated peak vertical ground-reaction force, were prospectively linked to higher ACL-injury risk (Leppänen et al., 2017b). The predictive picture is not uniform, though. One 2.5-year prospective cohort found that baseline knee biomechanics during a floorball-specific 90-degree cutting task did not separate players who later suffered an ACL injury from those who did not (Pasanen et al., 2025). That apparent contradiction makes a useful point: a single, discrete screening task may simply be too narrow to capture the multifactorial, situational reality of how injuries happen.

Screening studies reinforce that nuance. Frontal-plane knee-control assessments and single-leg squat tasks have been proposed as practical field screens (Räisänen et al., 2018; Raïsänen et al., 2016), and knee control itself has been tied to lower-extremity injury and jump-landing technique in young team-sport athletes (Leppänen et al., 2016; Leppänen et al., 2017a). Yet not all prospective work agrees. One study found no relationship between lower-extremity alignment during drop jumps and later knee or ankle injury (Räisänen et al., 2020), and altered hip control has also been implicated as a contributor (Leppänen et al., 2020). On balance, the evidence supports modifiable neuromuscular-control targets, but it warns against leaning too heavily on any single biomechanical marker.

Beyond mechanics, one person-centred study combined psychological and physical factors to build risk profiles. Combinations, not isolated variables, characterised vulnerability best. A profile of high physical performance and moderate mental health showed elevated injury occurrence (Levin et al., 2025). Prevention, then, is not just a biomechanics problem. It is a matter of holistic athlete management. Implementation is the practical sticking point. Qualitative data show that youth players and coaches weigh the perceived costs and benefits of knee-control programmes, and adherence depends on framing prevention as something that enables performance, not just something that avoids injury (Åkerlund et al., 2024). Across female team-sport athletes, structured neuromuscular training remains the best-supported preventive strategy (Caldemeyer et al., 2020). Surveillance data from comparable stick sports also help contextualise floorball's risk profile (West et al., 2025).

RQ3, Technology and analytics for monitoring and prediction

Across both the included and contextual evidence, the movement is clear: from measurement to prediction. Wearables and sensors lay the data foundation. Multisensory devices estimate energy expenditure across different activities (Gilgen-Ammann et al., 2019), and accelerometer-based methods gauge mechanical outputs such as one-repetition-maximum performance (Rontu et al., 2010). Velocity-based training builds on those inputs, turning real-time neuromuscular monitoring into individualised prescription and, crucially, into short-horizon predictions of how someone will respond to training (Achermann et al., 2025). Psychophysiological monitoring does something similar, converting routine stress-and-recovery data into signals that matter for performance (Van Der Does et al., 2015).

Machine learning applied to injury risk is the clearest analytical step forward. When linear and non-linear models were run on three-dimensional motion and physical data from young basketball and floorball players, logistic regression and random forests both settled on a consistent subset of knee- and ankle-injury predictors. Their cross-validated discrimination, however, was only modest (Jauhiainen et al., 2021). That dual outcome, reproducible feature identification alongside limited predictive accuracy, echoes the biomechanical findings and underscores how hard injury is to foresee from baseline data alone. Other computational tools are broadening the toolkit too. There is automated multi-object tracking for match analysis (Mu et al., 2025), digital-twin approaches for equipment and process optimisation (Gutmann et al., 2023), and game-simulation environments designed for engagement and learning (Hilmi et al., 2024).

Read together, the findings support a hypothesis-generating model rather than a settled unified theory: performance and injury may share interacting neuromuscular, biomechanical, and load-related determinants, but the present evidence is too heterogeneous to conclude that they constitute one fully validated monitoring problem. The strongest common levers are landing control, cutting capacity, reactive strength, shooting coordination, tactical decision-making, and state-dependent load management. These should therefore be treated as linked domains for future testing rather than as a single causal pathway.

Comparative and Critical Analysis

Methodologically, the included studies fall into three families. First, cross-sectional performance and biomechanical testing (Farana et al., 2025; Vecbērza & Plakane, 2025; Vecbērza et al., 2026). Second, prospective injury cohorts that include motion analysis (Leppänen et al., 2017b; Pasanen et al., 2025). Third, monitoring or modelling designs that pair data collection with prediction (Van Der Does et al., 2015; Achermann et al., 2025; Jauhiainen et al., 2021; Levin et al., 2025). What dominates, in other words, is observational and prospective work. Experimental intervention trials are comparatively rare, and the sole training study here is small (Achermann et al., 2025). There is also a clear evolution over time, running from descriptive notational and postural analyses toward instrumented, model-based approaches. That progression mirrors the accelerating publication trend shown in Figure 2. Sample size remains a persistent limitation in biomechanical work, while injury cohorts carry more statistical power but still deliver modest prediction. The field's methodological ceiling, it seems, is set by the complexity of the outcomes as much as by sample size.

Three research gaps follow from the synthesis. First, the field needs adequately powered, multicentre prospective cohorts that harmonise injury definitions, biomechanical protocols, and follow-up periods. Second, female- and youth-specific designs remain underrepresented relative to the injury burden observed in these populations. Third, machine-learning models require transparent feature definitions, calibration, external validation, and clinically meaningful decision thresholds before they can support individual decisions. The review itself has several limitations. Scopus was the only database, so records unique to Web of Science, PubMed, regional indexes, or grey literature may have been missed. The eligibility framework restricted the evidence to English-accessible reports, creating possible language and availability bias. The ten included studies were heterogeneous in age, sex, skill level, design, and measurement protocol, preventing meta-analysis and limiting transportability across populations. The injury evidence is weighted toward young and female cohorts, whereas some performance evidence comes from male or youth samples; conclusions should therefore be restricted to the populations represented in the relevant studies. The technology evidence is similarly heterogeneous and should not be interpreted as demonstrating interchangeability of sensors, screening tests, or predictive models. Finally, the present source file does not retain independent reviewer-level screening and risk-of-bias records, so inter-rater reliability and validated appraisal scores cannot be reported retrospectively without introducing unsupported data.

Generalizability and internal validity

The evidence is most directly applicable to competitive floorball populations represented in the included studies: predominantly young athletes, with injury evidence especially concentrated in females, and performance evidence spanning elite, developmental, and university settings. The conclusions should not be extrapolated automatically to recreational players, older adults, goalkeepers, or other invasion sports. Internal validity is also domain-specific: prospective injury cohorts provide stronger temporal evidence than cross-sectional performance studies, whereas the technology literature is more exploratory and model-dependent. These boundaries are essential when translating the synthesis to coaching, rehabilitation, or clinical decision-making.

This systematic review synthesised ten empirical studies published within a 2005–2026 search window and organised them across performance determinants, injury risk and prevention, and emerging monitoring technologies. The evidence indicates that floorball performance is multifactorial, involving tactical decision-making, segmental shooting coordination, directional-speed symmetry, reactive lower-limb strength, and load-sensitive psychophysiological state. Injury evidence most consistently implicates modifiable landing and neuromuscular-control characteristics, particularly in young and female cohorts, but no single biomechanical screen provides sufficiently stable prediction across studies. Wearables, velocity-based training, and machine learning show promise for monitoring and decision support, yet current individual-level predictive validity and interpretability remain limited. The central contribution is therefore a hypothesis-generating monitoring-informed framework that connects performance and injury domains without claiming causal unity. Its practical value will depend on replication across databases, independent dual-review screening, validated risk-of-bias appraisal, larger prospective cohorts, external model validation, and better representation of female, youth, recreational, and older populations.

Read together, the findings suggest that performance and injury in floorball are two sides of one neuromuscular system. The capacities that make rapid play possible, landing, cutting, and reactive strength, are the same places where injury risk concentrates. That reframes optimisation and prevention. Instead of competing priorities, they become a single, integrated training problem, one that can be addressed with shared biomechanical and monitoring levers.

On the theoretical side, the review supports a monitoring-informed model. Tactical, biomechanical, and physiological determinants would be measured and interpreted continuously, guiding performance development and risk mitigation at the same time. That model extends existing performance-analysis and injury-prevention frameworks by making analytics the connective tissue between them (Jauhiainen et al., 2021; Achermann et al., 2025). On the practical side, the evidence hands coaches a concrete set of priorities. Work on head-led shooting coordination (Farana et al., 2025). Correct inter-limb speed asymmetries (Vecbērza et al., 2026). Build reactive lower-limb strength against age- and level-referenced benchmarks (Vecbērza & Plakane, 2025). Coach soft, flexed landings (Leppänen et al., 2017b). And frame preventive programmes as performance-enhancing if adherence is the goal (Åkerlund et al., 2024). Delivery itself depends on coaches' pedagogical and leadership skills (Kwon et al., 2010), and on the participation and health benefits that keep people engaged across the lifespan (Pedersen & Bangsbo, 2025; Vorup et al., 2017; Castagna et al., 2020; Toivo et al., 2023; Morales-Belando et al., 2018).

Compared with earlier scoping work that mapped the spread of floorball research (Krejzová et al., 2026), this review pushes the synthesis further by tying performance determinants to injury mechanisms and to the technologies that track both. It also surfaces a central contradiction. Stiff-landing mechanics predicted ACL injury in one prospective cohort (Leppänen et al., 2017b). Cutting-task kinematics did not in another (Pasanen et al., 2025). And drop-jump alignment showed no association with injury in a third (Räisänen et al., 2020). The most plausible reading is that injury grows out of context-dependent combinations of factors (Levin et al., 2025; Jauhiainen et al., 2021), not out of any single variable measured in isolation.

Three research gaps follow from all of this. First, the field needs prospective, adequately powered cohorts, ideally multicentre, to move beyond modest predictive accuracy. Second, female-specific and youth-specific designs are underrepresented relative to the injury burden, which skews toward exactly those groups. Third, predictive models have to be transparent and externally validated before analytics can be trusted for individual decisions. This review also has its own limitations. It relied on a single database and that database's metadata export, so relevant records indexed elsewhere may have been missed. The included set was deliberately focused, with broader contextual literature shaping the introduction and discussion. And a formal meta-analysis was impossible given how heterogeneous the designs and outcomes were. The agenda ahead, then, is clear: large prospective cohorts with harmonised outcome definitions, interpretable and validated machine-learning pipelines, and pragmatic studies of how preventive training works in real coaching environments.

Answering the research questions directly, RQ1: floorball performance is determined by trainable tactical decision-making, head-led shooting coordination, directional-speed symmetry, and reactive lower-limb strength, all of which respond to accumulated load (Gómez et al., 2013; Farana et al., 2025; Vecbērza et al., 2026; Van Der Does et al., 2015). RQ2: injury risk centres on modifiable landing and neuromuscular-control mechanics and on combined psychological and physical profiles, with structured neuromuscular training remaining the best-supported preventive strategy, even though no single screen reliably predicts injury (Leppänen et al., 2017b; Pasanen et al., 2025; Levin et al., 2025; Caldemeyer et al., 2020). RQ3: wearables, velocity-based training, and machine learning are moving floorball from descriptive monitoring toward prediction and integrated decision support, though current accuracy and interpretability remain modest (Jauhiainen et al., 2021; Achermann et al., 2025; Mu et al., 2025).

Conclusions

Drawing on ten empirical studies and guided by the PRISMA 2020 framework, this systematic review synthesised the evidence on performance, injury, and technology in floorball. On the first research question, floorball performance comes across as a coordinated, coachable construct. Tactical decision-making, head-led shooting coordination, symmetrical directional speed, and reactive lower-limb strength all interact, and each responds to training load. The second question concerned injury risk. It concentrates in the knee and hits young female players disproportionately hard. The risk reflects modifiable landing and neuromuscular-control mechanics, plus a combination of psychological and physical profiles. Structured neuromuscular training remains the most defensible preventive approach, yet no single biomechanical screen reliably forecasts who will get injured. On the third question, the picture is shifting. Wearable sensors, velocity-based training, and machine-learning models are pushing the field from description toward prediction and integrated decision support. Accuracy and interpretability are still modest, and that limits how far these tools can go. The central contribution of this review is to reframe performance optimisation and injury prevention as a single, monitoring-informed problem, addressed through shared biomechanical and analytical levers. For practitioners, that means testing and training the same capacities that enable performance and mitigate risk, and treating prevention as something that enables performance. The review has clear limits. It drew on only one database, and the included designs were heterogeneous enough to rule out meta-analysis. Future research should prioritise large, prospective, sex- and age-specific cohorts, plus transparent and externally validated predictive models, so that emerging technologies can be translated safely into floorball coaching and clinical practice.

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