Biomechanical Predictors of Performance in Ice Hockey and Speed Skating: A Systematic Review

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Summary

This systematic review investigated key biomechanical performance predictors in ice hockey and speed skating. By synthesizing findings from 35 studies, we identified critical factors such as stride mechanics, push-off dynamics, and muscle activity that influence acceleration, speed, and endurance. The results highlight the role of joint flexibility and off-ice strength training in optimizing performance. We also provide insights for athlete development, injury prevention, and tailored training programs, and identify the lack of research into gender-specific determinants.

Introduction

Performance in ice hockey and speed skating is influenced by the interplay of several biomechanical factors, including joint flexibility, muscle activity, push-off mechanics, arm swing, and stride mechanics. Ice hockey players must perform explosive bursts of speed and rapid transitions to respond to the fast-paced nature of the game [1]. In contrast, speed skaters prioritize efficiency and sustained power output to optimize performance in races of varying distances [2]. While numerous studies have examined individual performance predictors, a comprehensive review identifying the most critical factors for success in these sports remains lacking. A clearer understanding of these elements can optimize training programs and improve competitive outcomes. The purpose of this systematic review was to bridge this gap by collating research findings on biomechanical predictors of performance in ice hockey and speed skating.

Methods

This systematic review followed PRISMA guidelines. A comprehensive search of three databases—SPORTDiscus, Scopus, and the Sports Medicine and Education Index (ProQuest)—was conducted to identify relevant studies published in English or French between 1979 and 2020. The search yielded 1,422 articles (Figure 1), which were screened for relevance based on predefined inclusion criteria. Ultimately, 35 studies examining both on-ice and off-ice performance predictors were included.

Results and Discussion

Stride mechanics and push-off dynamics emerged as pivotal elements in both sports. In ice hockey, more frequent stride rate significantly influenced acceleration, with athletes who demonstrated superior joint flexibility achieving smoother transitions between push-off and gliding phases. Efficient stride transitions from gliding to push-off were equally critical in speed skating, where they enhanced power output and endurance during races.

Strength training, particularly squat jumps, strongly positively correlated with on-ice performance in ice hockey. Similarly, speed skaters benefited from off-ice training focused on strengthening the glutes and quadriceps. Arm swing mechanics were another critical factor, particularly in ice hockey, where mediolateral arm swing contributed significantly to lateral propulsion and stability.

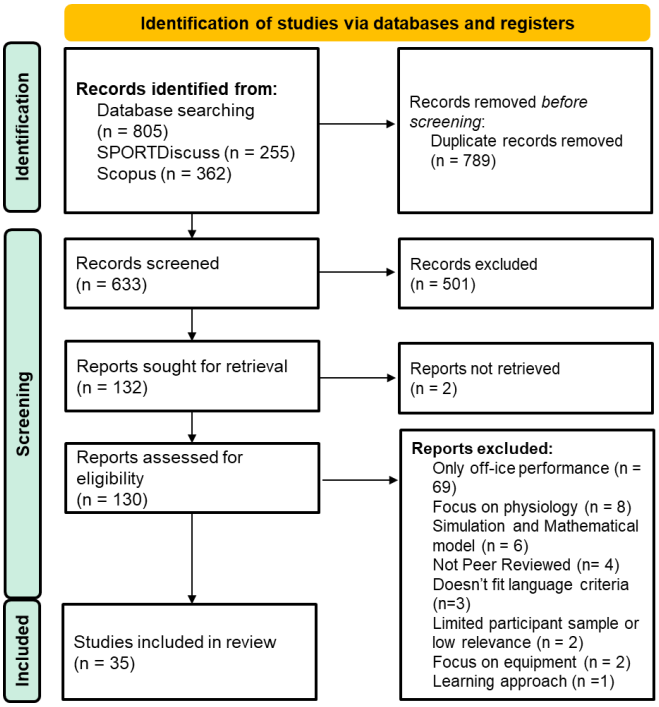

Figure 1. PRISMA flow diagram of articles screening procedure

Despite these insights, the review highlighted several challenges in biomechanical research on elite sports. Achieving random sampling remains difficult due to the specialized nature of athlete populations, often requiring familiarization with experimental tasks. Limited access to advanced data collection methods further constrains the feasibility of capturing biomechanics data on ice. Additionally, significant gaps persist, particularly in understanding gender-specific differences. These challenges underscore the need for continued methodological innovation in sports biomechanics research.

Conclusions

This comprehensive review highlights the importance of stride mechanics, push-off dynamics, and muscle activity in predicting ice hockey and speed skating performance. The findings offer insights for designing tailored training programs to enhance performance, potentially reduce risk of injury, and inform talent identification.

References

[1] Falinger CM. et al. (2007). *J. Strength Cond. Res.*, **21(4)**: 1386-96.
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