

Science of floorball: a systematic review

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Background: The purpose of this study was to comprehensively review the scientific research on floorball at the competitive and recreational levels according to field of study.

Methods: Full articles containing original data on floorball that had been published in English in peer-reviewed journals were considered for inclusion.

Results: Of 75 articles screened, 19 were included in this systematic review. One article each was identified in the fields of sports management and sports psychology, and the remaining 17 articles were in the field of sports medicine. Injury epidemiology in floorball players was the most thoroughly examined topic of research. To date, no research has been performed on the incidence of floorball-related injury, or any aspect of the sport, in children and adolescents.

Conclusion: Collaborative research among sports science disciplines is needed to identify strategies to reduce the incidence of injury and enhance the performance of licensed floorball players. Despite the increasing popularity of floorball in recent years, surprisingly little research has examined this sport.

Keywords: floorball, unihockey, review

Introduction

Floorball is a relatively new indoor sport that is rapidly gaining popularity. It is played in three 20-minute periods on a 40×20 m court surrounded by a 0.5 m high rink with 1.6×1.15 m goals. Six players from each team, including the goalkeeper, participate in active play. Field players handle a 7.2 cm diameter perforated plastic ball with sticks made of carbon and composite materials; they are not allowed to touch the ball with the head or arms or to hit it while it is above knee height, except if no other player is nearby. The goalkeeper has no stick and the goal crease measures 4×5 m.

During its 30 years of official existence, floorball has developed from a spontaneous recreational activity into one of the fastest growing organized sports. The International Floorball Federation currently has 57 member associations and floorball is a recognized sport by the International Olympic Committee.¹ According to the International Floorball Federation, there were 293,088 registered/licensed players in the world in 2012.¹ Sweden has the most registered players, with approximately 118,000 members (approximately 87,000 registered male and 31,000 female floorball players),² followed by Finland with its approximately 51,000 registered players and then the Czech Republic with approximately 39,000 registered players.³

Floorball is not only played by registered players; it has been calculated that in Sweden, the country with the greatest number of registered players and 9,651,531 inhabitants in 2014,⁴ around half a million people play floorball regularly

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in schools, different associations, and workplaces, ie, roughly 5.2% of the population plays floorball at some level.²

Despite the great interest in this sport, no review of the scientific literature on floorball has been performed. Thus, the aims of this study were to systematically review the scientific research on floorball at all competitive and recreational levels and to make suggestions about directions for future research.

Methods

The methodology used for the systematic review was based on previously published guidelines.^{5,6} Full articles containing original data on floorball and published in English in peer-reviewed journals were considered for inclusion. Studies published only as abstracts and those in which the manner of data presentation prevented the distinction of data on floorball (ie, pooled data from multiple sports with no subanalysis of floorball) were excluded. Potentially eligible studies published between 1966 and October 2012 were identified through searches of the PubMed, SportDiscus, SweMed, CINAHL, Cochrane Library, Medline, Pedro, Physical Education Index, ScienceDirect, Web of Science, Wiley Online Library, PsycInfo, and Ebsco electronic databases using the keywords “floorball” and “unihockey”.

The retrieved articles were screened in three steps (title, abstract, and full text), with exclusion of duplicate publications in the first two steps and articles that did not fulfill the study criteria in all steps. The reference lists of the included articles were also examined to identify additional potentially relevant studies, which were added to the screening sample on the basis of consensus among researchers. Two independent reviewers then examined the full texts of the selected studies in detail.

Articles were categorized according to the field of study (sports management, sports psychology, or sports medicine). Sports medicine research was further classified using the following subcategories: injury rates in floorball players, injury prevention measures, sports physiology, and illness in sport.

Results

Staged screening of 75 identified studies led to the exclusion of five studies that were published only as abstracts, 40 that were not published in peer-reviewed journals, one published in German, one published in Swedish, and nine that presented pooled data from multiple sports. Thus, 19 articles, all published in international journals, were included in the systematic review. Tables 1–5 summarize the studies by theme. The studies examined 12–565 (mean 177) licensed floorball players with a

mean age of 22.2 (range 18.4–26.0) years. Sixty-four percent (range 0%–100%) of participants were female.

Floorball-related research in sports management

One study was found in the field of sports management.⁷ This research involved several analyses of the establishment of floorball in Australia based on Lai’s personal experience of playing floorball, interviews with floorball players at different levels and leaders/managers in official teams and national federations in Australia and Europe, and interviews with importers of floorball sticks. The article described the development of this sport in Australia and the important roles of international federations and sports equipment manufacturers and importers, particularly the latter bodies’ efforts to increase their markets. Although Lai highlighted the importance of exchange between residents and international visitors in the establishment of the sport, she argued that increased coordination of cultural and marketing strategies would be optimal for the establishment of the sport elsewhere (Table 1).

Floorball-related research in sports psychology

Only one floorball-related article was found in the field of sports psychology.⁸ The authors investigated whether floorball players’ effort and performance were influenced by individual motivational factors, including performance in a competitive environment. They examined the “social loafing” effect, in which people working in groups make less effort to achieve a goal than when they are working independently. The cohort consisted of 24 male students with experience in recreational floorball who participated in a floorball tournament. Participants were not aware that they were evaluated on the first day of the tournament, but were given this information before the second day. The researchers recorded players’ heart rates and

Table 1 Floorball-related research in the field of sports management and sports psychology

Author/Year	Type of study	Aim	Participants	Journal
Lai (1999) ⁷	Observation Interviews	Study floorball’s establishment in Australia		<i>Sport Manag Rev</i>
Højgaard and Ingvaldsen (2006) ⁸	Empirical study	Study social loafing during floorball tournament	Students, n=24	<i>Online Journal of Sport Psychology</i>

Abbreviation: n, floorball players.

asked them to complete several self-assessment instruments. The authors reported that players' knowledge that they were being evaluated increased their performance and perceived level of effort, reduced the perceived degree of social loafing, and had no effect on heart rate. They concluded that the provision of feedback to individual players might enhance group performance, although they noted that further investigation was necessary (Table 1).

Floorball-related research in sports medicine

Eleven articles investigated injury rates in floorball players. Three prospective observational studies examined overall injury rates in floorball players during single seasons.^{9–11} Snellman et al⁹ followed 295 licensed floorball players (199 males and 96 females) in the first through fifth divisions in Finland. During the season, 34% of players (37% of men and 28% of women) were injured; 83% of injuries were traumatic and 17% were related to overuse. The most common types of injury were sprains in men and those related to overuse in women. The most common sites of injury were the knees (22%) and ankles (20%). The overall injury rate was 1.0 per 1000 training hours for both sexes; injury rates per 1,000 match hours were 23.7 for men and 15.9 for women.

Pasanen et al¹⁰ prospectively examined injuries in 374 licensed female floorball players in the first and second divisions in Finland during a single season. Injuries were recorded using a structured questionnaire and later verified by a physician. During the season, 35% of players sustained an injury; 70% were traumatic and 30% were related to overuse. The most common injury type was joint sprain (27%) and the most common sites of injury were the knees (27%) and ankles (22%). The incidence of injury was 1.8 per 1,000 training hours and 40.3 per 1,000 match hours.

Wikstrom and Andersson¹¹ prospectively examined injuries in 457 floorball players in the Swedish elite league during a single season. Eleven percent of players were injured;

36% of injuries were classified as slight (absence from participation for up to 7 days), 29% as moderate (an absence for 8–30 days), and 35% as severe (an absence of more than 30 days). Seventy-six percent of injuries were traumatic and 24% were due to overuse. The most common injury type was ankle sprain. Most (71%) injuries occurred in male players. Incidence rates of injury per 1,000 game hours were 2.5 in female players and 2.6 in male players.

In a retrospective study, Lofgren and et al¹² investigated the incidence of floorball-related injury requiring emergency care at a university hospital during a one-year period. Nine percent of all sports injuries occurring during the observation period were related to floorball; 78% of these injuries were mild and 21% were moderate according to the Abbreviated Injury Scale.¹³ The most common injury type was sprain of the foot (30%) or knee (11%). Fourteen percent of injuries occurred in licensed players and 61% occurred during match play (Table 2).

Four articles examined eye-related injuries.^{14–17} Maxen et al¹⁴ conducted a questionnaire-based survey of 565 competitive and recreational floorball players in Sweden and Switzerland. At the end of a season, 27.7% of respondents reported an answer to a specific question within the questionnaire indicating that they had incurred trauma in or around the eye on at least one occasion. Eye injury occurred more frequently at the semiprofessional level (32.3%) than at the amateur level (23.0%). Balls were the most common cause of trauma (52.1%), followed by sticks (20.7%). Only 4.9% of players in this study reported the use of protective eyewear.

Ghosh and Bauer¹⁵ conducted a retrospective database study of eye injuries in sports using the records of patients treated at an eye clinic during a 2.5-year period. A total of 272 patients were treated after sustaining blunt trauma to the eye region, and 40% of these injuries were sustained during sports activities. Half of all sports-related injuries were related to floorball.

Table 2 Studies on injury rates in floorball players

Author/Year	Type of study	Aim	Participants	Journal
Snellman et al (2001) ⁹	Prospective observation study	Assess the incidence of floorball injuries during 12 months	5th division premier, n=295	<i>Int J Sports Med</i>
Pasanen et al (2008) ¹⁰	Prospective observation study	Study the incidence of floorball injuries during 6 months	Elite league, n=374	<i>Scand J Med Sci Sports</i>
Wikstrom and Andersson (1997) ¹¹	Prospective observation study	Study floorball injuries during 6 months	2nd – 5th division n=457	<i>Scand J Med Sci Sports</i>
Löfgren et al (1994) ¹²	Retrospective observation study	Study floorball injuries	Patients, n=206	<i>Scand J Med Sci Sports</i>

Abbreviation: n, floorball players.

Leivo et al¹⁶ prospectively examined the incidence of eye injuries treated at an emergency eye clinic in Helsinki, Finland, during a 6-month period. Of all sports-related eye injuries, 45% were related to floorball. Most (93%) of these injuries occurred in males. Balls were the most common cause of injury (close to 60%), followed by sticks (30%). The most common injury type was hyphema (bleeding in the anterior chamber of the eye).

Drolsum¹⁷ conducted a retrospective study of patient records from a hospital in Norway, finding that 13.7% of all recorded eye injuries were related to sports, 17.1% of which were related to floorball. The majority of patients seeking treatment for floorball-related eye injuries were men (Table 3).

Three articles examined the frequency of injury among professionals who played floorball during working hours to maintain physical fitness.^{18–20} De Loes and Jansson¹⁸ retrospectively examined the incidence of injury in fire fighters, reporting a rate of 2.6 injuries per 10,000 training hours; 61% of injuries occurred during floorball (32%) and soccer (29%) training. The authors conducted a similar study of Swedish police officers and obtained similar results: the risks of injury for male and female police officers were 1.6 and 2.2 per 10,000 training hours, respectively.¹⁹ Most injuries were sustained during floorball (41% for men, 28% for women) and soccer practice.

Bylund and Björnstig²⁰ investigated injury rates among 111 fire fighters and reported a rate similar to those reported by de Loes and Jansson.¹⁸ Among sports-related injuries, 26% were related to floorball (Table 3).

Studies of injury prevention measures for floorball players

Four papers examined injury prevention measures for floorball players.^{21–24} Pasanen et al²¹ conducted a randomized trial

investigating the preventative effects of a neuromuscular training program in 457 female floorball players during a single season. Participants underwent 20–30 minutes of intensive training two to three times per week at the beginning of the season and weekly as maintenance later in the season. The program consisted of running, coordination and balance exercises, plyometric training (jump training utilizing a stretch-shortening cycle), weight training, and stretching. The authors found a decreased injury rate in the intervention group compared with the control group (0.65 versus 2.08 per 1,000 match and training hours; adjusted incidence rate ratio 0.34, $P < 0.001$). The risk of leg injury in noncontact situations was 66% lower in the intervention group.

Pasanen et al²² also investigated the role of floor properties in the risk of injury among 331 female elite players during one season. They reported injury rates of 59.9 and 26.8 per 1,000 match hours on artificial and wood floors, respectively. Artificial floors significantly increased the risks of leg injury in noncontact situations and severe injury. The authors suggested that their findings were related to greater friction between players' shoes and artificial floor surfaces in comparison with wood surfaces.

In a randomized study, Pasanen et al²³ investigated the effects of a 20–30-minute neuromuscular warm-up program on injury in 222 female elite players during a single season. The program consisted of jumping, balance, and coordination exercises. The authors found that the program significantly improved players' side jump speed and static balance, thereby helping to reduce ligament injuries in the foot and knee joints.

Stacoff et al²⁴ analyzed typical ankle movements during floorball games in 12 floorball players while they were barefoot, wearing shoes with higher shaft, so-called high-cut, or wearing shoes with lower shaft, so-called low-cut, with

Table 3 Studies on injury rates in floorball players

Author/Year	Type of study	Aim	Participants	Journal
Maxen et al (2011) ¹⁴	Questionnaire and interviews	Study occurrence of eye injuries	Registered players, n=565	<i>Dental Traumatology</i>
Ghosh and Bauer (1995) ¹⁵	Retrospective study patients journals	Study sports related eye injuries	Patients, n=50	<i>Acta Ophthalmol Scand</i>
Leivo et al (2007) ¹⁶	Prospective observational study	Study sports related eye injuries	Patients, n=42	<i>Scand J Med Sci Sports</i>
Drolsum et al (1999) ¹⁷	Retrospective study patients journals	Study sports related eye injuries	Patients, n=13	<i>Scand J Med Sci Sports</i>
de Loes and Jansson (2001) ¹⁸	Retrospective study injury register	Study sports related injuries in fireman	Firemen	<i>Int J Sports Med</i>
de Loes and Jansson (2002) ¹⁹	Retrospective study injury register	Study sports related injuries in police officers	Police officers	<i>Int J Sports Med</i>
Bylund and Björnstig (1999) ²⁰	Retrospective study insurance data	Study sports related injuries in fireman	Firemen	<i>Work</i>

Abbreviation: n, floorball players.

Table 4 Studies on injury prevention measures for floorball players

Author/Year	Type of study	Aim	Participants	Journal
Pasanen et al (2008) ²¹	Randomized controlled study	Study effects of a 6 month neuromuscular program	Elite and 1st division, n=457	<i>Br J Sports Med</i>
Pasanen et al (2008) ²²	Prospective observation study	Compare injury risk in two different surfaces	Elite and 1st division, n=331	<i>Br J Sports Med</i>
Pasanen et al (2009) ²³	Randomized controlled study	Study effects of neuromuscular warm-up program	Elite, n=222	<i>Br J Sports Med</i>
Stacoff et al (1998) ²⁴	Cross-sectional study	Study ankle movements in different sports shoes	Floorball players, n=12	<i>J Biomech</i>

Abbreviation: n, floorball players.

identical shoe sole properties. They found that high-cut shoes improved lateral ankle stability, thereby reducing the risk of ankle injury (Table 4).

Floorball-related research regarding sports physiology

Rontu et al²⁵ examined maximum strength during bench press using two maximum repetition methods in 22 male floorball players, 19 of who played at the elite level. The main aim of the study was to develop a new test for evaluation of maximum strength from a submaximal lift. The floorball players bench-pressed an average of 69.9 kg (Table 5).

Floorball-related research regarding illness in sports

Leuppi et al²⁶ examined the prevalence of bronchial hyper-responsiveness and asthma in 26 elite ice hockey players and 24 elite floorball players. They found higher proportions of asthma and bronchial hyperresponsiveness in the ice hockey players. Asthma was diagnosed in 4.1% of floorball players and 19.2% of ice hockey players (Table 5).

Discussion

This review identified 19 floorball-related publications, indicating that little research has been conducted in this sport

despite its growing popularity. In addition to recreational players, about 300,000 floorball players are currently licensed worldwide.¹ A search of SportDiscus, the international scientific sports research database, using the keyword “floorball” yielded only 47 hits. By comparison, the keyword “soccer” yielded 141,481 hits in the same database. This difference is likely due to the relatively recent development of floorball. Current research on this sport reflects its manner of practice internationally.

Only two of 19 articles included in this review were unrelated to sports medicine.^{7,8} These articles were assigned to the sports management and sports psychology categories. Further research on factors other than skill and fitness that contribute to players’ performance is thus warranted.

Very few studies have investigated the physiological and anthropometric characteristics of floorball players. No article reported an examination of body composition, maximal aerobic power, speed, agility, or muscular strength and power. Furthermore, no time-motion analysis to determine players’ movement patterns has been performed. Information about floorball players’ activities during match play (eg, low-intensity [jogging and standing] versus high-intensity [sprinting, physical collision, and tackling, which place considerable demands on anaerobic energy systems] activities) would be valuable.

Injury epidemiology in floorball players was the most thoroughly investigated topic among the articles included in this review. Four studies exclusively examined floorball-related injuries.^{9–12} Injury rates per 1,000 training hours ranged from 1.0 to 2.5 in women and from 1.0 to 2.6 in men. Injury rates during matches per 1,000 training hours were 15.9–40.3 in women and 23.7 in men, which could be compared with reports of 15.6 for male ice hockey players, another sport that is popular in Northern Europe.²⁷ The most common injury type and location in floorball players were sprains of the ankle or knee. The majority of the injuries were traumatic and most occurred during matches. Short (single-season) study periods constitute a major drawback of these studies. Differences in

Table 5 Floorball-related research in the field of sports physiology and illness in sports

Author/Year	Type of study	Aim	Participants	Journal
Rontu et al (2010) ²⁵	Cross-sectional study	Compare two different maximum strength test	Floorball players, n=22	<i>J Strength Cond Res</i>
Leuppi et al (1998) ²⁶	Cross-sectional study	Compare occurrence of asthma in hockey and floorball players	Premier, n=24	<i>Eur Respir J</i>

Abbreviation: n, floorball players.

injury rates between studies could be partly explained by differences in study design and methodology, but may also be due to substantial increases in the number of floorball players and competitive matches since the 1990s (the studies were conducted between 1994 and 2008).

Three studies exclusively examined eye injuries, which are common in floorball players.^{14–16} Maxen et al¹⁴ reported that nearly 30% of floorball players had experienced an eye injury on at least one occasion, which could be compared with studies in elite ice hockey players showing 1.3% experienced eye injuries during a season.²⁸ Leivo et al¹⁶ and Ghosh and Bauer¹⁵ showed that floorball caused nearly one half of all eye-related sports injuries. All studies found that balls or sticks caused most eye injuries, that mainly young men were injured, and that very few players used protective eyewear. The differences in injury rates between the study conducted in Sweden by Drolsum¹⁷ and the study conducted in Finland by Leivo¹⁶ could be explained by different study designs (retrospective versus prospective), the differences in years when the studies were conducted (earliest 1999 and latest 2007), the differences in inhabitant rates in the places where the studies were conducted (approximately 300,000 versus 600,000), or differences in popularity of the sport and therefore exposure between the countries.

This injury epidemiology research leaves many questions unanswered with respect to the timing of injury (eg, in the second half of match, suggesting fatigue-induced skill reduction, or seasonal variation) and the relationship between injury risk and playing position (eg, forwards versus defenders) and division membership (eg, differences reflecting disparities in length of training and aerobic fitness). In addition, no study to date has examined the incidence of floorball-related injury in children and adolescents, who comprise the majority of licensed players.

Only two intervention studies have been performed to reduce the incidence of floorball-related injury.^{21,23} Both studies were conducted among female floorball players in Finland. Pasanen et al^{21,23} studied the effects of a neuromuscular training program on injury prevention and a warm-up program on balance and coordination. The neuromuscular training program effectively reduced leg injury in noncontact situations. The results of these studies are promising with regard to the ability to reduce the frequency of floorball-related injuries, but more studies are needed. For example, few elite floorball players use protective eyewear despite its demonstrated ability to reduce eye injury rates;²⁹ this situation may be due to poor dissemination of information,

interference of protective eyewear with players' performance, and/or various other factors.

Conclusion

We generally lack scientific knowledge about floorball. Collaborative research among sports science disciplines is needed to identify strategies to reduce the incidence of injury and enhance the performance of licensed floorball players. Important areas of research include: a description of players' physiological characteristics; identification of specific requirements for playing positions, such as body composition, maximal aerobic power, speed, agility, and muscular strength and power; and evaluation of the effects of these factors on performance and the incidence of injury. Time-motion analyses to determine the movement patterns of floorball players in different positions would also be useful. In addition, closer examination of the incidence, location, type, and cause of injuries sustained during matches and training would provide valuable information for the development of interventions. Combined investigation of playing position and injury timing (with respect to match and season) is also needed. Thus, studies investigating the impact of improvements in physiological capabilities, including the effects of strength and conditioning programs, on floorball players' performance and the incidence of injury are warranted.

Disclosure

The authors report no conflicts of interest in this work.

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