Neuromuscular training and the risk of leg injuries in female floorball players: cluster randomised controlled study

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ABSTRACT
Objective To investigate whether a neuromuscular training programme is effective in preventing non-contact leg injuries in female floorball players.

Design Cluster randomised controlled study.

Setting 28 top level female floorball teams in Finland.

Participants 457 players (mean age 24 years)—256 (14 teams) in the intervention group and 201 (14 teams) in the control group—followed up for one league season (six months).

Intervention A neuromuscular training programme to enhance players’ motor skills and body control, as well as to activate and prepare their neuromuscular system for sports specific manoeuvres.

Main outcome measure Acute non-contact injuries of the legs.

Results During the season, 72 acute non-contact leg injuries occurred, 20 in the intervention group and 52 in the control group. The injury incidence per 1000 hours playing and practise in the intervention group was 0.65 (95% confidence interval 0.37 to 1.13) and in the control group was 2.08 (1.58 to 2.72). The risk of non-contact leg injury was 66% lower (adjusted incidence rate ratio 0.34, 95% confidence interval 0.20 to 0.57) in the intervention group.

Conclusion A neuromuscular training programme was effective in preventing acute non-contact injuries of the legs in female floorball players. Neuromuscular training can be recommended in the weekly training of these athletes.

Trial registration Current Controlled Trials ISRCTN26550281.

INTRODUCTION

Studies have shown a reduced risk of ankle and knee injuries among athletes using a neuromuscular training programme, whereas some intervention studies have found no such reduction. The methodological quality of the interventions has, however, been heterogeneous.

Floorball, a hockey type sport played indoors, has become popular in Europe. The sport results in many injuries, with the knee and ankle joints most commonly affected. 59% of acute ankle injuries and 46% of acute knee injuries occur through non-contact situations. We investigated whether a neuromuscular training programme could reduce the risk of acute non-contact leg injuries in female floorball players.

METHODS

Of 477 players from 28 floorball teams that agreed to participate, 457 were eligible for the study. Using the team as the unit of randomisation we carried out stratified cluster randomisation to the intervention and control groups at league level. The statistician (MP) who carried out the computer generated randomisation was not involved in the intervention.

We informed the teams allocated to the intervention group about the training programme. Teams in the control group were asked to continue with usual training.

The neuromuscular training programme took place over six months. At the start of the intervention period we educated one or two team members from each intervention group on use of the programme. Each intervention team was provided with an instruction booklet, equipment (see bmj.com), and exercise diary. During the intervention period the instructors kept a diary of the content and duration of each session and number of participants.

The programme was designed to enhance players’ motor skills and body control and to prepare the neuromuscular system for sports specific manoeuvres. The programme consisted of running techniques, balance and body control, plyometrics, and strengthening exercises (see bmj.com). The main point of each exercise was to focus on proper techniques. The aim of the training was to improve control of the back, knees, and ankles during sports specific manoeuvres.

The training sessions, lasting 20-30 minutes, were carried out just before the floorball exercises. During the floorball season training was divided into two intensive training periods (neuromuscular training twice or three times weekly) and two maintenance training periods with one training session (weekly). Intensive training took place at the start of the season and during the break from games in December. Over the competitive season the exercises were followed through with maintenance training.

The primary outcome was an acute leg injury that occurred in non-contact circumstances. A secondary outcome was any injury to the legs. We defined an injury as acute if it occurred during a scheduled game or practice, preventing the player from practising for 24 hours. The severity of injuries was defined as minor (absence from practice for 1-7 days), moderate (absence for 8-28 days), and major (absence for >28 days).
Data collection
At baseline, players completed a questionnaire on background information. During follow-up coaches recorded the players’ scheduled practice and game hours in a diary and noted injured players. Injuries were recorded by players using a structured questionnaire, including the time, place, cause, type, location, and severity of the injury. After each follow-up month the coaches mailed the diaries and questionnaires to the study doctor (TM). She contacted players after each new injury and checked the accuracy of the data but was not involved in the intervention.

Statistical analysis
We expressed the incidence (95% confidence interval) of injury as the number of injuries per 1000 hours of floorball practice and play. One way analysis of variance was used to estimate the intraclass correlation coefficients of incidence rates for injury. The unadjusted and adjusted incidence rate ratio between the two groups (intervention v control) was obtained from two level Poisson regression models. We considered a P value <0.05 to be significant. In the data analysis by multilevel modelling we took the cluster randomisation into account. Adjustments were done at individual and team levels. We did analyses according to the intention to treat principle. In addition to the intention to treat analyses, we carried out efficacy analyses to evaluate the potential benefits of high compliance (training at least three times a week during the first intensive period, at least twice a week during the second intensive period, and at least once a week during the maintenance periods) and adherence to training.

RESULTS
See bmj.com for the flow of participants through the study. The consent rate was high (86% of players from 28 teams) and the dropout rate low (5%). Twenty one players dropped out during the study period because of severe injury: nine from the intervention group (eight knee ligament ruptures and one rotator cuff rupture of the shoulder) and 12 from the control group (six knee ligament ruptures, four ankle ligament ruptures, and one lumbar disc prolapse). Data from these players were included in the analyses for the time they participated.

Players in both groups were similar for age, body mass index, experience of floorball, and hours spent in training and play (see bmj.com). No significant differences were found between the groups in number of previous injuries, operations, or preseason training volume. Five teams (36%) in the intervention group used the training programme according to schedule, six (43%) had some irregularities, and three (21%) interrupted training. A mean 74% of the intended training sessions was carried out as planned.

Participation in the intervention during the first intensive and maintenance periods was more active than during the second periods (see bmj.com).

Injury incidence
Overall, 32,327 scheduled hours of training and play and 87 leg injuries were reported for the intervention group compared with 25,019 hours of training and play and 102 leg injuries in the control group.

Significantly fewer non-contact leg injuries (adjusted incidence rate ratio 0.34, 95% confidence interval 0.20 to 0.57, P<0.001; table) occurred in the intervention group than in the control group. The overall risk of leg injury was significantly different between the groups, favouring the intervention (adjusted incidence rate ratio 0.70, 0.52 to 0.93, P=0.016). This difference was due to a reduction in non-contact leg injuries. The intervention group experienced six ruptures of the anterior cruciate ligament (three non-contact injuries) compared with four in the control group (three non-contact injuries).

In efficacy analysis, intervention teams with high compliance and adherence to the programme had a lower risk of injury than the control group: the incidence rate ratio between the high compliance group and control group for non-contact leg injury was 0.19 (95% confidence interval 0.06 to 0.64, P=0.007), for non-contact ankle ligament injury was 0.19 (0.05 to 0.82, P=0.026), and for non-contact knee ligament injury was 0.32 (0.04 to 2.59, P=0.284).

DISCUSSION
A neuromuscular training programme was effective in preventing acute non-contact leg injuries in female
WHAT IS ALREADY KNOWN ON THIS TOPIC

Floorball players have an increased risk of ligament injuries of the ankle and knee, and about half of these injuries occur in non-contact situations

Studies providing evidence for prevention of sports injuries have been methodologically limited

WHAT THIS STUDY ADDS

A neuromuscular training programme to enhance the motor skills and body control of female floorball players reduced the risk of leg injury by 66%

The risk of non-contact ankle and knee ligament injury could be reduced by 65%

Neuromuscular training is recommended to be included in the weekly training programme of floorball

Floorball players. The programme reduced the risk of leg injuries by 66%. The intervention focused on improving the players’ motor skills and body control and preparing the neuromuscular system for sports specific manoeuvres. Compared with the control group that continued usual training, the intervention group had significantly fewer injuries. A reduced injury rate was found overall for leg injuries as well as for acute non-contact leg injuries. The greatest effects were observed in non-contact injuries of the ankle ligament.

Some studies have indicated that neuromuscular training probably plays a crucial part in the prevention of injuries and this intervention study supports these findings. In one study a multiple training programme for six weeks in high school teams reduced the rate of serious knee ligament injuries as well as the rate of non-contact knee ligament injuries. Another study showed that structured warm-up among young handball players reduced the risk of traumatic knee and ankle injuries and the overall risk for severe and non-contact injuries. We found similar reductions in the risk of non-contact leg injuries. The 51% reduction in non-contact knee ligament injuries did not reach significance, but the trend was parallel to that of overall non-contact leg injuries.

Strengths and limitations

The potential for not achieving double blinding in this type of study limits the strength of the conclusions. The randomisation phase and data collection and analysis were blinded, but the coaches and players could not be blinded. The sample size was sufficient for analyses of non-contact leg injuries but too small for detailed analysis of anatomical subgroups.

The validity of the data was high as 86% of eligible players participated. In addition, both groups were similar for baseline characteristics, dropout rate, and training and play during follow-up. Compliance in collecting data on exposure and injuries was also good.

The programme was a modified combination of interventions from previous studies, and the exercises were easy to learn. It was designed to reduce the incidence of acute non-contact leg injuries, although contact injuries are common in floorball.

Five teams (36%) from the intervention group carried out the programme regularly, six (43%) had irregularities, and three (21%) interrupted training. On the basis of information in the exercise diaries and players’ subjective estimation of participation, it seemed that training activity was highest during the first two training periods, after which it declined. The intervention teams were included in analyses regardless of training activity and therefore the effect of the programme might be higher than reported. The efficacy analysis confirmed that the risk of injury was lower among teams that trained regularly.

Although severe knee ligament injuries, particularly injuries of the anterior cruciate ligament, are of concern in floorball, we could not analyse the effect of the warm-up programme because there were too few such cases. None of these ruptures occurred among the five teams that trained regularly.

Training among controls who already did exercises similar to those of the programme did not reach the level of the intervention group. If this biased the results of the study it erred on the side of underestimating the effect of the training on risk of injury.

This intervention study focused on women floorball players in three top level leagues in Finland. Because floorball players have a similar pattern of leg injuries and injury mechanisms, the training programme could be effective for a range of floorball players.

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