# Injury Incidence in Cross-Country Skiers.

WORTH, S[1,2]., REID, D[2]., HENRY, S[1,3].

1. The University of Vermont, USA;
2. Auckland University of Technology, NZ;
3. The University of Vermont Medical Center, USA.

## INTRODUCTION

**BACKGROUND:**

- Cross country skiing is a biomechanically complex sport [1].
- There is limited prospective cross-country ski injury incidence data to confirm whether the repetitive endurance training predisposes skiers to overuse injuries.
- In retrospective studies reporting injury percentages, overuse and acute traumatic injuries to the lower leg, and spine are most commonly reported [2, 3, 4, 5, 6].
- Cross-country ski injury incidence rates of 1.35 overuse injuries, and 0.73 acute injuries per 1000 exposure hours have been reported [7].
- Injury and training surveys help to establish the incidence and severity of injuries and provide data for the first step of injury prevention research.
- Movement screening may be useful to identify risk factors for future injury, providing data for research into aetiology and mechanisms of injury.

**STUDY OBJECTIVES:**

- To describe the demographics, movement characteristics, injury type and incidence of elite cross-country skiers in north-eastern America.
- We hypothesized that lower extremity injury incidence would be higher than other body regions.
- Secondary aims were to determine if new injury correlated with any movement, demographic, history, training or injury factors.

## METHODS

### 1. STUDY PROCESS

**Recruiting**
- E-mail coaches of north-eastern USA professional and university cross-country ski teams to establish interest.
- Researcher attended ski team meeting to explain study process, and invite skiers to participate.

**Enrolment**
- Complete paper consent.
- Complete online intake survey including demographics, and history of injury and skiing.
- Log on to personal email to receive unique link to month 1 training and injury survey.

**Movement Screening**
- MCS video recording. 5 movements, 3 repetitions in 3 views (Fig A).
- Active straight leg raise Degrees of hip flexion left and right (Fig B).
- McGill trunk flexor endurance time (Fig C).
- Biering-Sorenson trunk extensor endurance time (Fig D).

**Year Long Activities**
- Complete automated monthly survey for 12 consecutive months.
- 35 men and 36 women enrolled
- 18 men and 23 women completed the study

FIG A. MOVEMENT COMPETENCY SCREEN (MCS) [8]


FIG B. ACTIVE STRAIGHT LEG RAISE

FIG C. TRUNK FLEXOR ENDURANCE

FIG D. TRUNK EXTENSOR ENDURANCE

### 2. DATA ANALYSIS

I. Descriptive statistics were used to describe and explore the characteristics of the subjects.
II. Injury incidence was calculated as: mean number of injuries per subject per 1000 training hours.
IIII. Spearman's correlation was used to determine if a relationship existed between new injury and the following variables: MCS score, hamstring length, trunk muscle endurance ratio, injury history, years of skiing, training/exposure hours.
IV. The frequency of new injuries by anatomic region was reported.

## RESULTS

### I. MALE SUBJECTS HAD HIGHER MCS SCORES THAN FEMALES

| Subject enrolment variables and mean MCS and muscular scores | Men (SD) n=35 | Women (SD) n=36 | p-value |
|---|---|---|---|
| Mean height (cm) | 177.9 (6.8) | 168.5 (6.7) | < .05* |
| Mean weight (kg) | 71.1 (7.3) | 62.3 (7.1) | < .05* |
| Mean BMI | 22.5 (1.4) | 21.9 (1.7) | 0.17 |
| MCS Score | 14.4 (1.5) | 12.6 (1.4) | <.05* |
| Right hamstring length (degrees) | 73.7 (12.3) | 75.5 (11.0) | 0.51 |
| Left hamstring length (degrees) | 72.7 (10.8) | 76.1 (11.4) | 0.19 |
| Trunk muscle endurance ratio (flexor/extensor) | 1.0 (0.6) | 0.9 (0.4) | 0.25 |

### II. HIGH INCIDENCE OF LOWER EXTREMITY INJURIES

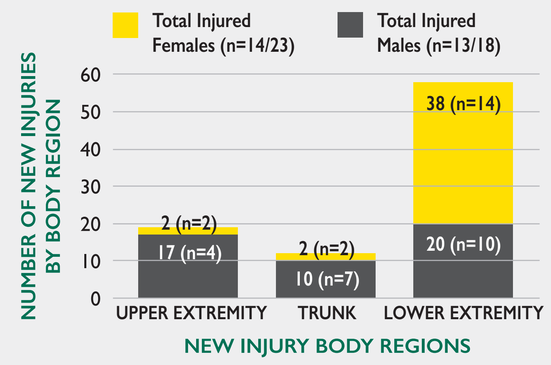
| Type of injury | Injury incidence | Type of injury | Injury incidence | p-value |
|---|---|---|---|---|
| All injuries | 3.81 | | | |
| LE | 2.13 | UE | 0.46 | < .05* |
| LE | 2.13 | Trunk | 0.22 | < .05* |
| LE | 2.13 | Low Back | 0.08 | < .05* |
| Overuse Non-traumatic | 2.76 | Acute Traumatic | 1.05 | < .05* |
| Off season | 5.25 | Ski season | 2.27 | 0.07 |

### III. NEW INJURY CORRELATES WITH INJURY HISTORY

| Variable | Spearman's correlation result |
|---|---|
| MCS score | p = .63 |
| Right hamstring length | p = .17 |
| Left hamstring length | p = .36 |
| Trunk muscle endurance ratio | p = .97 |
| Injury history | p = .04* |
| Years of skiing | p = .54 |
| All training/exposure hours | p = .30 |
| Run training hours | p = .08 |
| Roller ski hours | p = .93 |

** = significant at .05 level*

### IV. LOWER EXTREMITY INJURIES OCCURRED MOST OFTEN




*Number of new injuries by body region and by gender. Numbers in bars show number of new injuries, number in parentheses show number of subjects reporting the new injuries.*

## DISCUSSION AND CONCLUSIONS

- Cross-country skier new injury correlated with previous injury (consistent with current literature[12]) suggesting prevention of initial injury, and close monitoring of previously injured athletes, are important injury reduction and prevention strategies.
- Cross-country skier new injury did not correlate with:
  - mean MCS score (contrary to dancers[10], but comparable to rowers[11]).
    - » The relationship between movement screening and injury needs further study.
  - exposure hours (contrary to endurance sport literature[2, 10, 11, 12]).
    - » Training exposure in our study may have been insufficient to influence injury.
- Consistent with the current literature:
  - the incidence of overuse and lower extremity injuries were highest[12], supporting ongoing research into the reduction and prevention of these injury types in cross-country skiers.
- Training and injury data from multiple consecutive years may better demonstrate differences between ski season and off-season injuries.
- Cross-country skier mean MCS score is comparable to netball players[9], dancers[10], and rowers[11].
  - Ongoing study of MCS scores and injury incidence from active populations will improve knowledge about the relationships between movement patterns and injury.

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