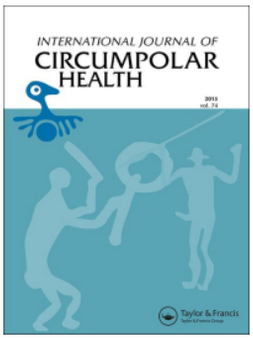

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Acute respiratory infections hamper training and competition in cross-country skiers, especially in those with asthma

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ABSTRACT

Acute respiratory infections (ARinf) are one of the leading causes that prevent athletes from training and competing. The aim of this study was to investigate the burden of ARinfs during one season among cross-country skiers. All Finnish cross-country skiers enrolled in the largest national competitions in winter 2019 ($n = 1282$) were sent a postal questionnaire. A higher proportion of skiers with than without asthma had to refrain from competitions because of ARinf (76.9% vs. 62.2%, $p = 0.011$) but there was no significant difference in refraining from training (91.2% vs. 83.8%, $p = 0.084$). In skiers with asthma, the median duration of a single ARinf episode was longer (5.0 days, IQR 3.8–6.8 vs. 4.0 days, IQR 3.0–6.7, $p = 0.017$), and they had more days of absence because of ARinf throughout the season (median 15 days (IQR 8–28) vs. 10 days (IQR 6–18), $p = 0.006$) in comparison to non-asthmatics. However, many of the skiers either trained (54.4%) or competed (22.5%) during an ARinf.

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Introduction

Acute respiratory infections (ARinfs) are one of the main causes that prevent athletes from training [1]. Previously, the burden of ARinfs has been assessed in cross-country skiers only in a few studies with different designs. A retrospective study by Svendsen et al. [2] investigated 7000 weeks of training diaries from 37 skiers and found that, on average, skiers suffered from ARinf three times a year and that the median duration of symptoms was 19 days (range 6–43 days). After intense competition periods, such as the Tour de Ski, the participating athletes were at three times higher risk of ARinf compared to athletes not participating in the Tour de Ski [3]. Furthermore, during the Nordic Ski World Championships, skiers were at a seven times higher risk of ARinf than the controls of the general population [4]. The prevalence of asthma among cross-country skiers is high, ranging between 20% and 30% [5] and we have also previously reported higher prevalence of asthma in skiers compared to general population in Finland (25.9% vs. 9.6%) [6]. Given the potential relationship between asthma and ARinfs [7], the current study aimed to investigate the burden of ARinfs during one season among cross-country skiers within the same study sample and whether asthma is related to the burden.

Methods

The present study protocol has been described in detail previously [6]. In short, all Finnish cross-country skiers who had enrolled in either national championships in spring 2019 (from 17 years of age onwards to seniors) or the largest national junior skiing competition (13–16 years of age, Hopeasompa competition) were invited to participate in this cross-sectional questionnaire survey. The Finnish Ski Association participated in the study by sending questionnaires to the athletes ($n = 1282$). Written informed consent was obtained from each respondent and from guardians for subjects under 18 years old. The study was approved by the Ethics Committee of Pirkanmaa Health Care District (R18108).

Current asthma was defined as self-reported physician-diagnosed asthma and at least one of the following: currently having three asthma-related symptoms (cough, chest pain, shortness of breath, wheezing or

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sputum production), active use of any asthma medication or asthma control test (ACT) score of less than 25 points.

Refraining from training or competition was defined with answering "yes" to the following questions: "Did you have acute respiratory infections (e.g. flu, common cold, cough, sinusitis) during the last 12 months that prevented you from training?" or "Did you have to abstain from competition because of an acute respiratory infection in the last 12 months?", respectively.

Engaging in sports during an ARinf was defined with answering "yes" to the following questions: "Have you trained during an acute respiratory infection during the last 12 months?" and "Have you competed during an acute respiratory infection during the last 12 months?".

Further data collection included weekly training volume, and FIS points for skiers to measure competition success were obtained from the International Ski Associations (FIS) 8th FIS points list from season 2018/2019, which was in effect at the time of the study [8]. In total, 163 skiers had collected FIS points.

Statistical analyses were performed using SPSS version 27.0 (IBM Corp., Armonk, NY). The continuous variables were skewed (Kolmogorov – Smirnov), and Mann Whitney U-test was used for the comparisons between the groups. A chi-square test or Fisher's exact test was used for comparisons of the categorical variables. A P value of <0.05 was considered statistically significant.

Results

Details of the study sample have been previously published [6]. The response rate was 27.3% ($n = 351$), 58% of the responders were women, and 25.9% ($n = 91$) had current asthma. The median age was 16.6 years (IQR 14.3–21.4), and the weekly median training volume was 10.0 hours (IQR 8.0–12.5). The majority of skiers had refrained at least once from training (85.8%) or competing (66.0%) due to ARinfs during the season. A higher proportion of asthmatics (76.9%) than non-asthmatics (62.2%, $p = 0.011$) had refrained from competing (Table 1). The odds ratio, with asthma as a risk factor for having to refrain from training, was 2.00 (CI 95% 0.90–4.43, $p = 0.089$), and from competition, it was 2.03 (CI 95% 1.17–3.51, $p = 0.011$). About half of the skiers trained, and one-fifth competed during ARinf, with no difference in relation to asthma.

There were no notable differences between the sexes, between juniors and seniors (cut-off age 16 years) or between quartiles grouped by training volume or competition success (FIS points) in refraining from training or competition because of an ARinf or in training or competing during an ARinf (Table 2).

Cross-country skiers with asthma had more days of absence from training because of an ARinf during the season compared with skiers with no asthma (median 15 days (IQR 8–28) vs. 10 days (IQR 6–18), $p = 0.006$ (Figure 1)). There were no differences in the days of absence because of an ARinf between quartiles when grouped by training volume (11, 11.5, 10 and 14.5 days in descending order, p = 0.105) or by FIS points (competition success) (10, 13, 10 and 10 days in descending order, p = 0.893). Skiers with asthma had a higher number of ARinf episodes than skiers with no asthma (3 (IQR 2–4) vs. 3 episodes (IQR 2–3), $p = 0.028$), but no difference was found between quartiles grouped by training volume (3, 3, 3, 3 events in descending order, p = 0.846) or by FIS points (3, 3, 3, 3 episodes, p = 0.418). The median duration of a single ARinf episode was longer in skiers with asthma (5.0 days, IQR 3.8–6.8 vs. 4.0 days, IQR 3.0–6.7, $p = 0.017$).

Discussion

In the present study, we found that the majority of skiers had to refrain from training because of an ARinf during the season, and two-thirds of skiers had to refrain from competition because of an ARinf. Despite this, about half of the skiers trained and about one-fifth had competed during an ARinf. Skiers with asthma had more and longer episodes of ARinf, leading to increased

Table 1. Number and proportion of cross-country skiers who reported refraining from training and competing because of acute respiratory infections at least once, and who reported training or competing during acute respiratory infections at least once during the 2018/2019 season. The results were grouped by current asthma.

	Response	"Yes" in all skiers		"Yes" in skiers with asthma		"Yes" in skiers without asthma		
	n	n	%	n	%	n	%	p*
Refrained at least once from								
training because of ARinf	351	301	85.8	83	91.2	218	83.8	0.084
competition due ARinf	350	231	66.0	70	76.9	161	62.2	**0.011**
During ARinf at least once								
training	309	168	54.4	44	58.7	124	53.0	0.391
competing	351	79	22.5	25	27.5	54	20.8	0.188

*p-value between skier with and without asthma.

Table 2. Subject characteristics, training volume, prevalence of asthma, use of asthma medication and asthma control in cross-country skiers divided by performance level according to FIS points.

	Refrained from training due to ARinf			Refrained from competition due to ARinf		
	n	%	p	n	%	p
Male (147)	120	81.6		100	68.0	
Female (204)	181	88.7	0.061	131	64.5	0.496
Under 16 years of age (130)	108	83.1		85	65.4	
Over 16 years of age (221)	190	86.0	0.464	143	64.7	0.898
FIS points range (points)						
The best quartile (0–120.54)	37	90.2		30	73.2	
2nd quartile (120.25–185.13)	35	85.4		28	68.3	
3rd quartile (185.14–247.52)	33	80.5		22	53.7	
4th quartile (247.53–999)	35	87.5	0.632	27	67.5	0.280
Weekly training (hours)						
1st quartile (12.5–25.0)	75	85.2		61	69.3	
2nd quartile (10–12.5)	74	84.1		50	56.8	
3rd quartile (8.0–10.0)	78	88.6		58	65.9	
4th quartile (1.9–8.0)	74	85.1	0.837	62	72.1	0.160

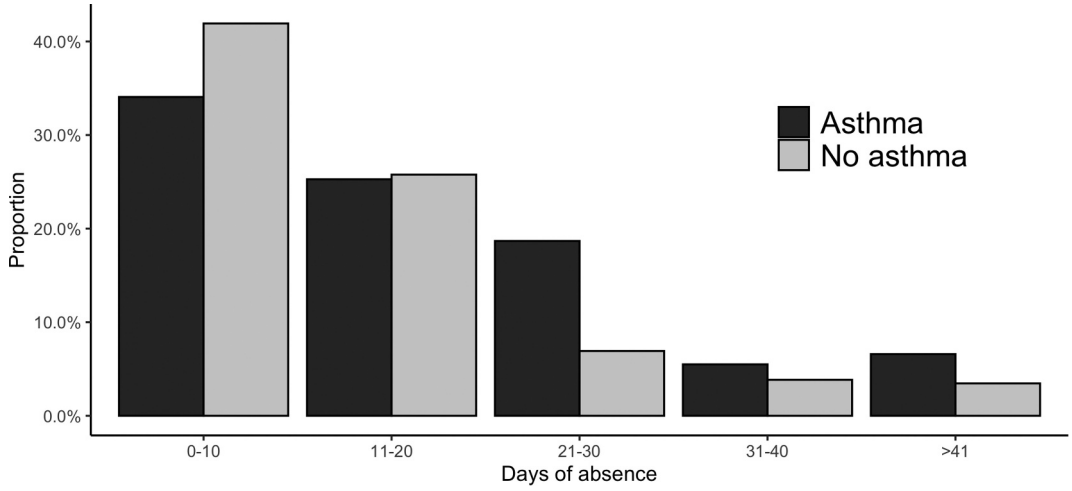

Figure 1. Days of absence from training because of ARinf in cross-country skiers as grouped by asthma status (median 15 days (IQR 8–28) in those with asthma vs. 10 days (IQR 6–18) in those without asthma, $p = 0.006$).

days off from training and a higher rate of withdrawal from competitions.

Considering the high prevalence of asthma among cross-country skiers (20–30%) [5], its potential association with ARinfs could have a significant impact on a considerable number of athletes. Higher proportion of asthmatic skiers missed competition because of an ARinf and had more days with ARinf symptoms, which could be due to longer recovery times with chronic inflammation of the airways [9,10]. The literature is scarce in investigating the effects of asthma on acute respiratory infections in athletes. In a recent study by Hull et al., 63% of 122 athletes were classified as susceptible to RTI (respiratory tract infection, equivalent to ARinf in the current study) if they had at least two or more RTI episodes in the past 18 months [11]. In their analysis, all athletes with asthma were classified as RTI (ARinf) susceptible ($n = 9$) [11]. Because of the moderate sample size, no significant difference was found between the groups [11]. Notably, we found no difference in days of absence because of an ARinf or ARinf episodes when skiers were grouped by training volume or competition success contrasting with findings in competitive swimmers, where international-level swimmers had fewer days of absence than national-level swimmers [12].

We did not investigate whether the athletes in the current study started training in the late stage of the infection with mild symptoms before becoming fully asymptomatic and, thus, reporting training during and ARinf. In a recent meta-analysis, the mean duration of ARinf in athletes was 7 days, but only 20% of ARinf prevented training for more than 1 day [13]. Since ARinfs are among the most common conditions in athletes and there is no knowledge of when it is safe to return to training, well-documented studies on safe return to sports are required.

Although this sample is the largest ever collected in competitive cross-country skiers, as measured by the number of participating skiers, the results are limited by factors such as the response rate, potential recall bias and lack of verification of training absences or ARinf periods from training diaries or similar records and whether training during an ARinf affected symptom severity and duration. The present study was conducted in a single country, and a similar study in another country and under different training cultures and considerations for training under ARinf could have produced different results. Future studies should investigate whether training and competing during an ARinf could increase the risk of developing asthma or major complications and whether this causes longer breaks from training and competitions.

Conclusion

We conclude that training and competing under an ARinf is very common in cross-country skiers. Notably, skiers with asthma, exhibit a higher propensity to abstain from competition, endure more frequent and longer ARinfs, and consequently, take more days off training due to ARinfs in a season compared to non-asthmatic skiers. Despite previous research suggesting a successful athletic career is achievable with asthma, our findings highlight a greater burden posed by ARinfs for asthmatic athletes. Thus, it is critical for asthmatic athletes and their coaches to understand the potential need for an extended recovery period following an ARinf.

In the future, prospective studies should focus on the objective verification of training absences, detailed symptom reporting, assessment of ARinf severity, its impact on training and performance while also exploring the incidence of possible major complications because of training during an ARinf. Moreover, randomised controlled trials are needed to establish evidence-based protocols for safe and as quick as possible returning to sports after the acute phase of an infection to avoid detraining. Further research should also explore the reasons behind extended absences due to ARinfs among asthmatic skiers and the potential consequences of such absences, including early retirement. This will help better comprehend the full impact of asthma on winter athletes.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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Data curation: Rikhard Mäki-Heikkilä, Heini Huhtala
Formal analysis: Rikhard Mäki-Heikkilä, Heini Huhtala
Funding acquisition: Rikhard Mäki-Heikkilä, Jussi Karjalainen, Lauri Lehtimäki
Investigation: Rikhard Mäki-Heikkilä
Methodology: all authors
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