CHAPTER 1

Epidemiology of asthma, allergy and bronchial hyperresponsiveness in sports

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Asthma has a higher prevalence in athletes compared with the general population. In summer sport events, the prevalence ranges 3.7–22.8%, as reviewed by HELENIUS and HAAHTELA [1]. In winter sport events, the occurrence is even higher, ranging 2.8–54.8% (table 1) [2–8]. A total of 17% of 253 Finnish elite summer sport athletes used asthma medication, most commonly inhaled β_2-agonists [1]. Also, 17% of the USA Winter Olympic Team (Nagano, Japan) were current users of asthma medication [5], while the figure was twice as high (36%) amongst Swedish cross-country skiers [2]. In a Swedish study in upper secondary schools for young skiers, 15% had phsysician-diagnosed asthma and 18% were treated with anti-asthma drugs compared with 6% and 7%, respectively, amongst the controls [9].

Occurrence of bronchial hyperresponsiveness

Bronchial hyperresponsiveness (BHR) is correlated with clinical asthma symptoms, but the relationship is not straight forward. LARSSON *et al.* [2] observed that 23 out of 42 (54.8%) cross-country skiers had BHR and asthma symptoms. Two skiers had BHR without symptoms and 17 had symptoms, but no BHR. LEUPPI *et al.* [7] found that 35% of Swiss ice hockey players had BHR, but clinical asthma was diagnosed in 19% and exercise-induced bronchospasm (EIB) in 11% of them. The respective figures for BHR, clinical asthma and EIB were lower in floor ball players: 21%, 4.2% and 4.2%.

SUE-CHU *et al.* [3] reported that in cross-country skiers the figures for BHR and clinical asthma were closer to each other: 14% and 12% in Norway, and 43% and 42% in Sweden, respectively. KARJALAINEN *et al.* [10] studied 40 young elite skiers and 12 healthy control subjects. BHR to methacholine was found in 30 (75%) of the skiers, and one-third of them had symptoms suggestive of asthma.

BHR is also prevalent in swimmers. ZWICK *et al.* [11] found competitive swimmers to have BHR significantly more often than control subjects (78% *versus* 36%). In another study, BHR was detected in 60% of swimmers and in 12% of nonswimming athletes [12]. The prevalence of BHR was higher in swimmers (36%) than in speed and power athletes (18%) and in long-distance runners (9%) [13]. A "healthy runner effect" certainly takes place, especially in long-distance runners. BHR was significantly associated with atopy.

Conclusions of the associations are problematic in cross-sectional studies because dynamic variables fluctuate over time depending on various factors. HEIR *et al.* [14] observed that acute respiratory tract infections were associated with a transient increase

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Table 1. – Prevalence of asthma amongst highly trained winter sports athletes

Group of athletes	Subjects n	Method	Prevalence %	First author [Ref.]
Cross-country skiers	42	Questionnaire, spirometry, methacholine challenge	54.8	LARSSON [2]
Cross-country skiers	171	Questionnaire, spirometry, methacholine challenge	12 (Norway) 42 (Sweden)	SUE-CHU [3]
Figure skaters	124	Exercise test	35 (exercise-induced bronchospasm)	MANNIX [4]
Ice hockey players	#	Questionnaire, spirometry, methacholine challenge, exercise test	19.2 11.5 (exercise-induced bronchospasm)	LEUPPI [7]
Ice hockey players	88	Questionnaire, spirometry, histamine challenge	22 (total asthma) 13 (current asthma)	LUMME [8]
1998 USA Winter Olympic team	196	Questionnaire	21.9 60.7 (cross-country, *etc.*) 24 (alpine, *etc.*) 2.8 (bobsleigh, *etc.*)	WEILER [5]
1998 USA Winter Olympic team	#	Exercise challenge, spirometry	23 (all, exercise-induced bronchospasm) 50 (cross-country)	WILBER [6]

#: Source population n=196.

in BHR in athletes performing physical training, but not in nonactive control subjects. Exercise and breathing cold air causes transient BHR even in asthmatic nonathletes [15, 16].

Occurrence of eosinophilic airway inflammation

Asthma symptoms and lung function abnormalities, including BHR, are a consequence of airway inflammation, which in asthma is predominately of an eosinophilic type. However, in athletes a mixed type of eosinophilic and neutrophilic airway inflammation has been shown to affect ice hockey players, cross-country skiers and elite swimmers [8, 10, 17].

Sputum eosinophilia (>2% of the differential cell count) affected one-fifth of highly trained swimmers [17, 18] and one-tenth of ice hockey players [8]. Those swimmers with exercise-induced bronchial symptoms had significantly higher sputum eosinophil cell counts (mean 7.6%) than the symptom-free swimmers (mean 0.7%) [17]. After 5-yr follow-up, sputum eosinophilia was detected in 38% (6% at baseline) of those swimmers who continued their active career, and in 8% (19% at baseline) of those who had stopped intensive training [18].

KARJALAINEN *et al.* [10] showed that the number of activated eosinophils, T-lymphocytes and macrophages in the subepithelial tissue are much higher in cross-country skiers than in sedentary control subjects. Elite swimmers have shown increased concentrations of eosinophil peroxidase (EPO) and human neutrophil lipocaline (HNL) in the supernatant of induced sputum samples as compared with control subjects, which suggests that both eosinophils and neutrophils are more activated in swimmers than in controls [17].

Type of training as a risk factor

Highly trained athletes are repeatedly and strongly exposed to cold air during winter training and to many inhalant irritants and allergens all year long. The type of training has been associated with the occurrence of bronchial symptoms, BHR and asthma in elite athletes [13, 19].

Asthma is most commonly found in athletes performing endurance events, such as cross-country skiing, swimming or long-distance running. Mild asthma (defined usually as increased BHR and asthma symptoms) is most common in endurance athletes, such as cross-country skiers (14–55%) [2, 3], swimmers (13–44%) [13, 17, 18, 20] and long-distance runners (15–24%) [13, 21]. Also, speed and power athletes, *e.g.* ice hockey players (15–19%) [6, 7, 8], and track and field athletes (16%) [13, 19], have a somewhat increased risk of asthma.

Atopy as a risk factor

Evidence for an increase in immunoglobulin E-mediated allergy has been shown in the general population [22, 23]. It seems that an increasing proportion of young athletes are atopic [8, 13] and suffer from symptoms caused by inhalant allergens. Hay fever, the most clear-cut atopic condition, is more common in summer sports athletes than in control subjects [13, 24].

Atopic disposition is a major risk factor along with the type of training. Risk of asthma is closely associated with atopy and its severity amongst athletes. When the risk factors "sporting event" and "atopy" were combined in a logistic regression model, the relative risk of asthma was surprisingly large: 25 fold in atopic speed and power athletes, 42 fold in atopic long-distance runners, and 97 fold in atopic swimmers compared with nonatopic control subjects [13].

Outcome of asthma and asthma-like symptoms

Outcome of asthma in athletes has not been widely studied. In swimmers who stopped intensive training, BHR and asthma attenuated or even disappeared, whilst symptoms increased and eosinophilic airway inflammation was aggravated in swimmers who remained active during the 5-yr follow-up, irrespective of asthma treatment [18]. Thus, asthma in athletes is at least partly reversible, and intensive training seems to cause airway inflammation and asthmatic symptoms in susceptible individuals.

Summary

Clinical asthma, exercise-induced bronchospasm and bronchial hyperresponsiveness are more common in competitive athletes compared with the general population. Various atopic conditions (e.g. pollen allergy) seem to be more common in summer sports athletes than in control subjects. Type of training and atopy are major risk factors for lower airway symptoms. Asthma is most commonly found in athletes performing endurance events, such as cross-country skiing, swimming or long-distance running. These athletes are repeatedly and strongly exposed to cold air and many inhalant irritants and allergens all year long. In symptomatic athletes, a mixed type of eosinophilic and neutrophilic airway inflammation often occurs leading in some individuals to functional abnormalities. Asthmatic symptoms in athletes are usually mild and at least partly reversible as they may disappear in those who stop intensive training.

Keywords: Allergy, asthma, bronchospasm, bronchial hyperresponsiveness, epidemiology, exercise.

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