

PHARMACOTHERAPY

Asthma Medication Is Increasingly Prescribed for Finnish Olympic Athletes—For a Reason?

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Background. Use of asthma medication is common among athletes. In 2009, the World Anti-Doping Committee (WADA) and the International Olympic Committee removed the need to document asthma by lung function tests before the use of inhaled β_2 -agonists. **Methods.** We assessed the changes in asthma medication use in Finnish Olympic athletes 8 years apart in 2002 ($N = 446$) and 2009 ($N = 372$). The athletes filled out a questionnaire on asthma symptoms, diagnosis, and medication. **Results.** The use of asthma medication increased from 9.4% in 2002 to 12.6% in 2009 (adjusted odds ratio (OR) = 1.71, 95% confidence interval (CI) 1.08–2.69). Fixed combinations of inhaled long-acting β_2 -agonists (LABAs) and inhaled corticosteroids (ICSs) were used three times more in 2009 vs. 2002 (OR = 3.38, 95% CI 1.26–9.12). At the same time, no significant changes were observed in the occurrences of physician-diagnosed asthma (13.9% vs. 15.9%) or wheezing (10.3% vs. 10.2%). In 2002, all athletes on asthma medication also had a physician-diagnosed disease, but in 2009, 11.8% of the athletes on medication were lacking it. **Conclusions.** Especially, the use of combination therapy of LABAs and ICSs is increasing among Finnish Olympic athletes. This trend is worrying as it is not based on increasing occurrence of symptoms, asthma diagnoses, or objective lung function measurements. More data, also from other countries, are needed to change recommendations or WADA rules.

Keywords allergy, asthma, elite athletes, inhaled corticosteroids, inhaled β_2 -agonists

BACKGROUND

Asthma, symptoms suggesting asthma, and the use of asthma medication are common among Olympic athletes (1–4). Recently, data from the European study on allergy and asthma in Olympic athletes revealed that one in four European athletes participating in the Beijing Olympic Games reported chest tightness and wheezing (5).

According to the guidelines of the International Olympic Committee (IOC), the management of asthma in athletes should be similar to that in nonathletes. Athletes should avoid training under certain conditions, such as at times of impaired air quality and extreme cold and humidity since these may increase the frequency of asthma-like symptoms. Similar to nonathletes, the most effective long-term treatment of asthma is inhaled corticosteroids (ICSs). Inhaled β_2 -agonists are effective in achieving immediate relief of intermittent symptoms of asthma and exercise-induced bronchospasm (6).

In recent years, there has been a great deal of debate about the ergogenic effects of β_2 -agonists in non-asthmatic athletes (7). Inhaled β_2 -agonists are not considered to

improve performance in non-asthmatic athletes, although high doses of oral salbutamol may increase strength and endurance performance (8). As a consequence, during the past decade, the World Anti-Doping Agency (WADA) has introduced several changes to the prohibited list concerning the use of β_2 -agonists. The decree allows the use of salbutamol and salmeterol since September 2009 and also the use of formoterol by inhalation in therapeutic doses without the need for the documentation of asthma via pulmonary function tests since 2012 (9). This strategy may be questioned as Ansley et al. reported recently that only half of the English professional soccer players with a physician diagnosis of asthma or exercise-induced bronchoconstriction (EIB) had objective evidence of reversible airway obstruction. Still 88% of them used asthma medication regularly (10).

Two different phenotypes of asthma may exist in elite athletes: “classical” asthma, characterized by early-onset childhood asthma, metacholine responsiveness, atopy, and signs of eosinophilic airway inflammation; “another” phenotype, having the onset of symptoms occurring during the sports career, bronchial responsiveness in a eucapnic hyperventilation test, and a variable association with atopic disposition and eosinophilic airway inflammation (11). These two phenotypes may require different therapeutic approaches, resulting in changes in the types of asthma medications being used by athletes.

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Only one longitudinal study has been conducted on the frequency of asthma and the use of asthma medication in Olympic athletes. Weiler et al. (12) reported that approximately 22% of the US athletes participating in the 1998 Olympic Winter Games in Japan and one in five of those who took part in the 1996 Summer Olympic Games in Atlanta had a previous diagnosis of asthma. However, nothing is known about how the new IOC and WADA regulations and the new treatment strategies have affected the frequency of asthma medication being used by elite athletes. The aim of this study was to assess the frequency of asthma and the use of asthma medication by examining a large sample of Finnish Olympic athletes in two years, 2002 and 2009.

METHODS

Study Design for Athletes

A follow-up study was conducted among the Finnish elite athletes receiving financial support from the Finnish Olympic Committee. The first survey was carried out in 2002 and the second in 2009.

In Finland, the National Olympic Committee provides financial support for (1) the Finnish national teams of sport associations that have adequate training organization in order for athletes to acquire Olympic success at the next Olympic Games, (2) individual skilled athletes who are not associated with any such sport association, (3) future Olympic hopefuls, and (4) team sports with possible success in the Olympic Games. The characteristics of the groups in both study years are shown in Table 1.

Most athletes filled in the questionnaire in their national team camps. The questionnaire was sent by mail to those who were absent from their national team camps. A total of 446 athletes (response rate 90.3%) completed the semi-structured questionnaire in 2002 and 372 athletes (91.9%) did so in 2008–2009. In 2009, the response rate of the athletes in the national team camps was 98.6% (285/289) of the athletes, whereas the response rate of those who received the questionnaires by mail was 75.0% (87/116) of the athletes.

The athletes were divided into four groups according to their type of sport: speed and power athletes ($N = 112$, number of athletes in 2009), endurance athletes ($N = 80$), athletes in motor skills demanding events ($N = 69$), and team sport athletes ($N = 111$). Track and field athletes (sprinters, jumpers, throwers, and decathletes; total $N = 65$) were the largest subgroup of speed and power athletes and cross-country skiers ($N = 24$) were the largest subgroup of endurance athletes. The largest subgroup of the athletes in skill-based events and team sport events were sailors ($N = 13$) and volleyball players ($N = 37$), respectively. When defining these groups, we used the same classification utilized before by our study group (13). Further details on the study population in 2002 have been described in detail elsewhere (13).

TABLE 1.—Characteristics of the study groups in 2002 and 2009.

	All athletes		Speed and power events		Endurance events		Motor skills demanding events		Team sport events	
	2002 ($N = 446$)	2009 ($N = 372$)	2002 ($N = 113$)	2009 ($N = 112$)	2002 ($N = 108$)	2009 ($N = 80$)	2002 ($N = 73$)	2009 ($N = 69$)	2002 ($N = 152$)	2009 ($N = 111$)
Sex (men/women)	261/185	218/154	82/31	74/38	62/46	45/35	45/28	40/29	72/80	59/52
Age (years), M (SD)	23.0 (4.5)	21.2 (4.3)	23.8 (4.1)	21.8 (3.7)	23.6 (4.0)	23.5 (4.1)	23.6 (6.5)	21.4 (4.7)	21.6 (3.6)	18.7 (3.7)
Duration of active sports, career (years), M (SD)	11.7 (4.3)	10.2 (4.5)	12.2 (3.7)	10.8 (4.5)	12.4 (4.6)	11.8 (5.0)	11.9 (5.0)	10.2 (4.2)	10.8 (4.1)	8.2 (3.4)
Training amount, hr/week, M (SD)	15 (6)	14 (5)	15 (4)	14 (4)	17 (5)	16 (4)	15 (7)	14 (5)	14 (6)	13 (6)
Response rate (%)	90.3	91.9	89.0	86.2	90.8	92.0	82.0	94.5	95.6	96.5

Questionnaire

The athletes answered a semistructured questionnaire that was based on a national health survey, Health 2000, coordinated by the Finnish National Institute for Health and Welfare. The questionnaire for the second study was piloted in 2008 with national-level ice hockey players and track and field athletes ($N = 30$) who were not included in the final survey. A researcher described the study to athletes and was available to answer any questions that concerned the study and study protocol. After providing written informed consent, the athletes filled in a semistructured questionnaire. The off-site athletes were given the possibility to consult the researcher by phone or e-mail. The questionnaire was filled in anonymously, and it was confidentially stored, analyzed, and reported. The ethics committee of the University of Turku granted ethical approval for the study.

The questions concerned asthma and allergy, exercise-induced bronchial symptoms, the use of asthma medication, and characteristics of their sports activities. The athletes were asked the following question: (1) "Do you have asthma diagnosed by a physician?" If the athletes answered positively, they were further asked: (2) "Do you use currently any anti-asthmatic medication for it?" The athletes were also asked to name all the physician-prescribed preparations they had used during the previous 12 months and whether they had used the above-mentioned medication (a) regularly or (b) as needed. We also asked: (3) "Do you have allergic rhinitis diagnosed by a physician?" The following question was also asked: (4) "How often do you have cough, shortness of breath, or wheezing in connection to exercise (each question asked separately)? (a) daily, (b) weekly, (c) monthly, (d) in connection to respiratory infections, or (e) never".

Asthma medication was classified as inhaled β_2 -agonists, ICSs, cromones (sodium cromoglycate and nedocromil), leukotriene antagonists, and ipratropium bromide. Inhaled β_2 -agonists were further classified as short-acting (salbutamol and terbutaline) β_2 -agonists and long-acting (salmeterol and formoterol) β_2 -agonists (LABAs).

Statistical Analyses

The odds ratios (ORs) for the presence of asthma medication and their 95% confidence intervals (CIs) for different athletic groups were analyzed using a logistic regression model (SPSS 16.0 software, SPSS Inc., Chicago, IL 60606, USA). Age, sex, type of sport, and study year

were included as independent covariates in the analysis. The changes in the winter and summer athletes were evaluated separately using age, sex, and study year as independent covariates. Significances of the covariate terms were tested with likelihood ratio statistics and are expressed as exact p -values.

RESULTS

Prevalence of Asthma and Asthma-like Symptoms

Physician-diagnosed asthma was reported by 13.9% (62/446) of the athletes in 2002 and by 15.9% (59/372) in 2009 (OR = 1.33, 95% CI 0.89–1.99, after adjusting for age, sex type of sport, and 2002 vs. 2009 (adjusted₁)) (Table 2). There was no significant difference detected in the occurrence of wheezing between the study years (Table 2).

Use of Asthma Medication

Asthma medication was being used by a total of 10.1% (45/446) of the athletes in 2002 and a total of 13.7% (51/372) of the athletes in 2009 (adjusted₁OR = 1.71, 95% CI 1.08–2.69; $p = .021$) (Figure 1). After adjusting for age, sex, and 2002 vs. 2009 (adjusted₂), the most significant increase in the use of asthma medication occurred among the endurance athletes during the study period (OR = 2.39, 95% CI 1.17–4.90). After similar adjustment, the use of asthma medication tended to increase in both winter (OR = 1.84, 95% CI 0.94–3.60) and summer athletes (OR = 1.77, 95% CI 0.95–3.28).

Asthma medication was used by none of the athletes in 2002 but six athletes in 2009 (11.8% of the asthma medication users) without their asthma being diagnosed by a physician. The asthma medications that were used without diagnosis were inhaled β_2 -agonists ($N = 1$), ICSs ($N = 4$), and fixed combinations of ICSs and LABAs ($N = 1$).

Fixed combinations of ICSs and LABAs were used by a total of 1.3% (6/446) of the athletes in 2002 and a total of 3.8% (14/372) of the athletes in 2009 (adjusted₁OR = 3.38, 95% CI 1.26–9.12). The use of fixed combinations of ICSs and LABAs increased significantly between the study years among the endurance athletes (adjusted₂OR = 5.20, 95% CI 1.02–26.46). A significant difference was observed in the use of fixed combinations of ICSs and LABAs among the summer athletes between the study years (adjusted₂OR = 4.14, 95% CI 1.03–16.72).

TABLE 2.—Prevalence (%) of physician-diagnosed asthma, the use of anti-asthmatic medication, and occurrence of wheezing in the athletes in 2002 and 2009.

	Physician-diagnosed asthma			Use of anti-asthmatic medication			Occurrence of wheezing		
	2002	2009	p^*	2002	2009	p^*	2002	2009	p^*
All athletes	13.9 (62/446)	15.9 (59/372)	.17	10.1 (45/446)	13.7 (51/372)	.02	10.3 (46/446)	10.2 (38/372)	.76
Motor skills demanding events	8.2 (6/73)	8.7 (6/69)	.77	2.7 (2/73)	5.8 (4/69)	.26	2.7 (2/73)	5.8 (4/69)	.44
Endurance events	22.2 (24/108)	28.8 (23/80)	.27	16.7 (18/108)	31.2 (25/80)	.02	19.4 (21/108)	16.2 (13/80)	.57
Speed and power events	8.8 (10/113)	14.3 (16/112)	.34	7.1 (8/113)	9.8 (11/112)	.52	8.8 (10/113)	9.8 (11/112)	.74
Team sport events	14.5 (22/152)	12.6 (14/111)	.62	11.2 (17/152)	9.9 (11/111)	.81	8.6 (13/152)	9.0 (10/111)	.52

*After adjusting for age, sex, type of sport, and 2002 vs. 2009.

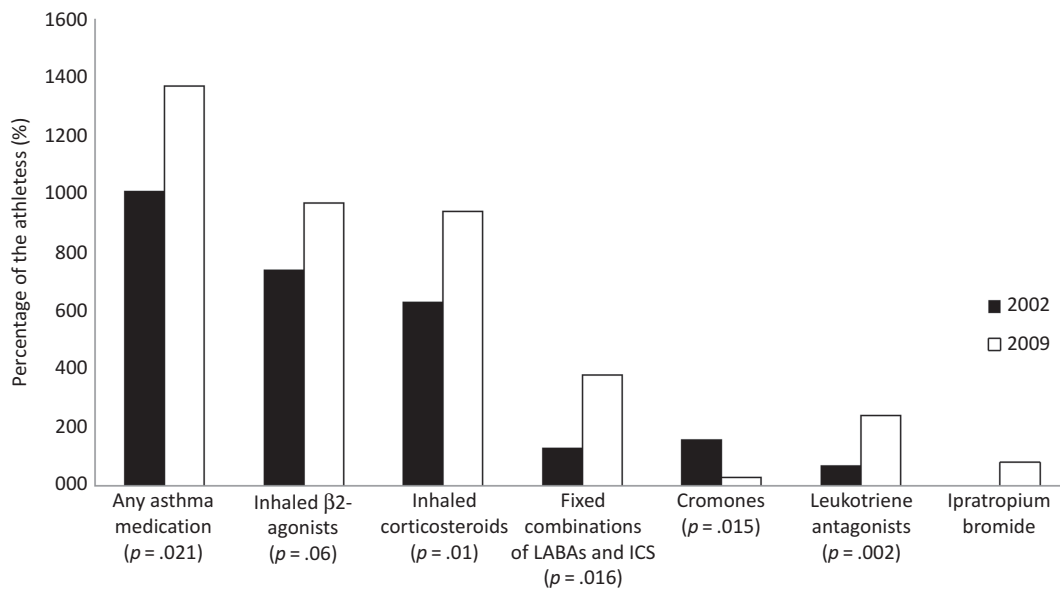


FIGURE 1.—Prevalence (%) of asthma medication use in 2002 and 2009.

Inhaled β_2 -agonists were the most frequently used asthma medications in both study years. This class of drugs were being used by a total of 7.4% (33/446) of the athletes in 2002 and a total of 9.7% (36/372) of the athletes in 2009 (adjusted₁OR = 1.64, 95% CI 0.97–2.76; p = .06) (Figure 1). The use of inhaled β_2 -agonists increased significantly between the study years among the endurance athletes (adjusted₂OR = 2.57, 95% CI 1.09–6.05). LABAs (salmeterol and formoterol) were used by 2.7% (12/446) of the athletes in 2002 and by 4.6% (17/372) of the athletes in 2009 (adjusted₁OR = 2.20, 95% CI 0.96–4.87). Short-acting β_2 -agonists (salbutamol and terbutaline) were used by 6.5% (29/446) of the athletes in 2002 and by 7.5% (28/372) of the athletes in 2009 (adjusted₁OR = 1.36, 95% CI 0.76–2.44). In both study years, two athletes reported having used inhaled β_2 -agonists regularly without using ICS medication.

ICSs were being used by 6.3% (28/446) of the athletes in 2002 and by 9.4% (35/372) of the athletes in 2009 (adjusted₁OR = 2.00, 95% CI 1.15–3.46; p = .01) (Figure 1). ICSs were being used regularly by 5.4% (24/446) of the athletes in 2002 and by 6.5% (24/372) of the athletes in 2009 (adjusted₁OR = 1.53, 95% CI 0.81–2.90) and occasionally by 0.9% (4/446) of the athletes in 2002 and by 3.8% (14/372) of the athletes in 2009 (adjusted₁OR = 4.90, 95% CI 1.56–15.38). The use of ICSs increased most significantly between the study years among the endurance athletes (adjusted₂OR = 2.83, 95% CI 1.21–6.66). A significant increase was seen in the use of ICSs among the summer athletes between the study years (adjusted₂OR = 2.48, 95% CI 1.18–5.18).

DISCUSSION

A significant increase was seen in the use of asthma medication among Finnish Olympic athletes. The use of asthma medication without physician-diagnosed asthma

also increased between the study years. Based on our findings, a critical review is needed in the treatment of asthma in Olympic athletes as there may be some inappropriate usage of asthma medication among athletes. Further studies, also in other countries, are needed of the Olympic athletes' asthma medication use. Attention should lead to implementation of the new anti-doping regulations considering the use of asthma medication by the WADA and IOC.

Validity of the Data

A follow-up study with high response rate and large number of Finnish Olympic athletes was conducted. Athletes filled out semistructured, similar questionnaires in both study years and had the opportunity to consult researchers on these occasions.

When collecting data for the second study, our main intention was to ensure that the source population was similar to the study population in 2002. However, between the study years, the National Olympic Committee had somewhat raised the criteria for receiving financial support, and therefore, some smaller sport federations did not obtain support for adult athletes in 2009, and this resulted in a slightly smaller study population. However, the subgroup sizes in 2002 and 2009 (speed and power athletes, endurance athletes, athletes in motor skills demanding events, and team sport athletes) were rather similar. Raising the criteria for financial support also led to slight changes in the age profile of the study population between the study years: the athletes' mean age was greater in 2002 than in 2009 (23.0 vs. 21.2 years) (Table 1). However, all results were calculated using logistic regression models in order to adjust for these possible confounding factors. Although we adjusted possible confounding factors in logistic regression model, physician-diagnosed asthma could not be included, as it was strongly associated with

the use of asthma medication. Thus, change in the occurrence of asthma would have also affected the frequency of anti-asthmatic treatment.

Comparison with Previous Studies

The occurrence of physician-diagnosed asthma in this study was 14% in 2002 and 16% in 2009. These percentages are in accordance with previous studies (2–4, 12, 14–17). The frequency of wheezing did not change during the follow-up period.

According to literature, the frequency of asthma medication use in athletes varies between 2% and 10% (4, 12, 15, 16, 18). In this survey, the prevalence of asthma medication use was 9% in 2002 and 13% in 2009, which is high when compared with other studies. However, in this study, the athletes were considered to be asthma medication users if they had used asthma medication during the previous 12 months.

In response to the apparent increase in the use of inhaled β_2 -agonists by athletes from Los Angeles (1984) to Atlanta (1996) Olympic Games and further from Nagano (1998) to Sydney (2000) Olympic Games (19), WADA started to demand the evidence of asthma or EIB in athletes who used inhaled β_2 -agonists in 2001. The reason for this was health-related since significant unwanted effects of β_2 -agonists have been documented (20–22). In recent years, the regulation concerning athletes' asthma medication use has been changed on several occasions. In 2002, when the first data were collected, LABAs and short-acting inhaled β_2 -agonists, as well as ICSs, were allowed only if they were accompanied by a certificate issued by a specialized physician. In 2008, an abbreviated process (abbreviated therapeutic use exemption (ATUE)) was implemented for all asthma medication use. In 2009, the use of ICSs was permitted with an announcement made by the athlete (declaration of use), but a TUE (also made retroactive for national-level athletes) was needed for inhaled β_2 -agonists (9). In this study, none of the athletes in 2002, but six in 2009, were using asthma medication without physician-diagnosed asthma (ICSs or β_2 -agonists). This may partly be explained by the changes in the regulations concerning asthma medication made by WADA between the study years. Thus, our findings may indicate inappropriate use of asthma medication by elite athletes. In all patients, athletes or not, long-term asthma medication should only be employed, if objective lung function measurements give the rationale.

Similar to other studies, the prevalence of inhaled β_2 -agonist use was higher than ICS use in both study years (12, 15, 18, 19). However, a significant increase was seen in the use of ICSs, and there was a trend toward increased regular use of them. Furthermore, the use of fixed combinations of ICSs and LABAs increased threefold. According to the recommendations made by the IOC, the first-line pharmacotherapy for asthma in athletes should be ICSs that are used for an adequate period of time (6). Regular treatment with β_2 -agonists increases the sensitivity of the airways to bronchoconstrictive stimuli including exercise and allergens (23). In addition, both the

bronchodilator and bronchoprotective effects of β_2 -agonists diminish after a few days of regular use (20). This tolerance occurs to both LABAs and short-acting β_2 -agonists, and it is neither prevented by ICS treatment nor overcome by using a higher dose of β_2 -agonists, that is, there is no known way to prevent tolerance (21, 24, 25). Based on these facts, the IOC has recommended that β_2 -agonists should only be used infrequently and that alternative treatment and ICSs be used instead. Additionally, asthmatic airway inflammation and increased airway hyperresponsiveness are known to disappear after finishing high-level athletic sports (26). It is not known whether this positive finding is affected by the long-term use of LABAs in elite athletes during their athletic careers.

The major increase in the use of fixed combinations of ICSs and LABAs observed in this study is far from trivial in elite athletes. LABAs have been associated with serious adverse asthma outcomes such as asthma-related hospitalization, need for intubation, and even asthma deaths (27). However, it is not known whether there are similar risks when LABAs are added to ICSs. Therefore, in April 2011, the FDA issued a requirement for all manufacturers of LABAs to conduct controlled clinical trials to assess the safety of a regimen of LABAs plus ICSs compared with ICSs alone. In contrast, WADA's decision to remove documentation of asthma via pulmonary function tests before allowing the use of asthma medication seems to have resulted in increased use of inhaled β_2 -agonists and fixed combinations of ICSs and LABAs.

CONCLUSION

The use of asthma medication, especially fixed combinations of LABAs and ICSs, is clearly increasing among Finnish Olympic athletes. This trend is not based on an increased occurrence of asthma symptoms, asthma diagnoses, or objective lung function measurements. Attention needs to be paid to asthma diagnosis and treatment in elite athletes. More data, also from other countries, are needed to change recommendations or WADA rules.

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DECLARATION OF INTEREST

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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