Ann Allergy Asthma Immunol xxx (2017) 1–7

Contents lists available at ScienceDirect

Sex differences in asthma in swimmers and tennis players

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ARTICLE INFO

Article history:
Received for publication November 7, 2016.
Received in revised form December 13, 2016.
Accepted for publication December 15, 2016.

ABSTRACT

Background: Elite athletes, independent of sport, have increased risk of developing asthma, but little is known about sex difference among adolescent athletes.
Objective: To investigate and compare sex-related differences according to symptoms and treatment of asthma, allergy, and health among elite athletes and a reference group.
Methods: Adolescent elite swimmers (n = 101), tennis players (n = 86), and a reference group (n = 1,628) responded to a questionnaire about respiratory symptoms, allergy, health behavior, psychosomatic symptoms, self- esteem, and well-being. The athletes performed a mannitol provocation and a sport-specific exercise provocation. Atopy was assessed by skin prick tests, and fractional exhaled nitric oxide was measured.
Results: The females reported more asthma symptoms than the males in both the reference group (29.1% vs 22.3%) and the athlete group (56.4% vs 40.2%). However, no significant differences were found in physician-diagnosed asthma or treatment with inhaled corticosteroids. More female athletes had a positive mannitol provocation result (48.7% vs 35.8% in male athletes), and more female swimmers had a positive exercise provocation result (15.1% vs 7.7% in male swimmers). The females in all groups had more psychosomatic symptoms compared with the respective males, and the males in the reference group reported higher self-esteem and felt more well-being compared with the reference group females.
Conclusion: Overall, we found a higher prevalence of asthma symptoms in the females. However, the frequency of physician-diagnosed asthma and the prescription of inhaled corticosteroids were the same in both sexes. This finding demonstrates an insufficient diagnosis of asthma in females.

Introduction

Asthma and allergic diseases are common and have increased during the last 4 decades even if prevalence seems to have stabilized during the most recent years. The increase in asthma and allergies has been especially prominent among children and adolescents.[1] The cause of the increasing prevalence might to some extent be improved diagnostics, but a multifactorial explanation has been suggested in which allergen exposure, environmental factors, and lifestyle changes play a role.

Before puberty, the prevalence of asthma is higher in boys than in girls. A sex switch in the prevalence of asthma occurs in adolescence, with females having a higher prevalence than males.[2,3] The use of asthma-related health care is higher in males from 2 to 13 years old and greater in females older than 23 years.[4] Because this change in asthma prevalence seems to occur during puberty, hormonal changes have been discussed as one potential underlying factor. The prevalence of asthma seen in each sex could be related to hormonal differences through influence on airway size, inflammatory conditions, and smooth muscle and vascular functions.[2,5,6]

There have been major changes in society, with changes in both lifestyle factors and physical activity. It is common knowledge that physical activity is a health-promoting factor, and physical activity in adolescence leads to a higher level of physical activity in adults.[7] Regular physical activity reduces the risk of premature mortality and the frequency of many common diseases and is also recommended as a part of treatment for several chronic diseases.[7] Physical activity increases tolerance to exercise and thereby decreases the sensitivity to exercise-induced symptoms among children with asthma.[8] It is also suggested that physical activity in adolescence promotes a healthy adult lifestyle and is positively associated with mental health characteristics, such as higher self-esteem, quality of life,[7,9] fewer psychosomatic symptoms,[10] and improved academic performance.[11] Exercising on the elite level may at the same time be a risk factor for allergic sensitization and the development of both asthma and rhinitis.[12] However, the type

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Disclosures: Authors have nothing to disclose.
Funding Sources: This study was supported by independent grants from Astra-Zeneca, Schering-Plough, MSD, Pharmaxis/Nigaard, and Aerocrine.

http://dx.doi.org/10.1016/j.anai.2016.12.013
1081-1206/

Table 1
Study Population

Characteristic	Reference group (n = 1626)		Swimmers and tennis players (n = 187)		Swimmers (n = 101)		Tennis players (n = 86)	
	Male	Female	Male	Female	Male	Female	Male	Female
Sex, No. (%)	828 (50.9)	798 (49.1)	109 (58.5)	78 (41.5)	55 (54.5)	46 (45.5)	54 (62.8)	32 (38.6)
Age, median (IQR), y	16 (15–17)	16 (15–17)	16 (15–18)	16 (14–18)	16 (14–17)	16 (14–18)	17 (15–18)	16 (14–18)
Training >6 years, No. (%)	268 (32.4)	246 (30.8)	95 (87.1)	70 (89.7)	44 (80.0)	44 (97.5)	51 (94.4)	26 (81.3)
Weekly training, median (IQR), h	4 (0–8)	3 (0–6)	15 (12–18)	15 (12–18)	18 (16–20)	18 (14–20)	13 (11–15)	12 (10–15)

Abbreviation: IQR, interquartile range.

of exercise and the surrounding environment connected to the sporting activity are closely connected to this risk.

We previously reported an increased prevalence of asthma among elite-aspiring swimmers compared with healthy controls.[13] The increased prevalence was not related to atopy or evident allergic sensitization and seemed to be related to duration and intensity of training in the sport-specific environment. The increased prevalence of asthma symptoms found is objectively supported by an increased number of individuals who test positive to mannitol, either direct or measured as increased reversibility (defined as improvement of forced expiratory volume in 1 second [FEV_1] by 15% or more after terbutaline compared with the maximum decrease in FEV_1).[14] There was also an increased prevalence of exercise-induced asthmatic responses.

The aim of the present study was to explore sex-related differences in asthma-related outcomes in elite-aspiring swimmers, tennis players, and a reference group, matched by age and sex (ie, if the asthma prevalence and the expression of airway disease differed between males and females). A second aim was to investigate and compare sex differences in lifestyle, psychosomatic symptoms, and well-being in the different groups.

Methods

Study Participants

In the year 2007, all students 13 to 20 years old in the community of Vellinge (n = 1,773) were invited to participate in the study, and 1,628 (92%) were included. In 2007–2012 adolescent elite and elite-aspiring swimmers and tennis players were recruited from 3 elite swimming clubs and 6 elite tennis clubs in the southwestern part of Sweden to participate in studies of airway hyperresponsiveness. A total of 105 swimmers were invited, and 101 swimmers were included; 87 tennis players were invited, and 86 were included.

Questionnaire

The questionnaire addressed the presence of respiratory and allergic symptoms, lifestyle factors, psychosomatic symptoms, and well-being.[13] The questions related to respiratory symptoms, allergy, and some of the lifestyle questions are validated and have previously been used in the International Study of Asthma and Allergies in Childhood[15] and Obstructive Lung Disease in Northern Sweden.[13,16,17] The other questions concerning lifestyle, psychosomatic symptoms, and quality of life have previously been used in different school studies in Sweden and Europe.[13,18] The remaining, mainly sport-related questions have been tested for understanding and corrected by sample interview.

Three indexes were created based on the questionnaire. Psychosomatic symptoms were based on self-reported frequency of symptoms of headache, stomach ache, dizziness, irritability, nervousness, depression, and sleep disorders. Each symptom (7 in total) was scored (0, as not at all; 1, monthly; 2, weekly; and 3, every day), with a total maximum score of 21. The quality of life index was measured as a mean (visual analog scale score of 1–10) of responses to questions that involved general well-being with regard to both well-being in school and at leisure and questions about friends, loneliness, meaning in life, stress, and anxiety. The self-esteem index was measured as a mean (visual analog scale score of 1–10) of responses to the questions concerning school performance and how healthy and how physically fit they consider themselves to be.

The reference group completed the questionnaire in their classrooms, and the swimmers completed the questionnaire in their training center. Completion of the questionnaire was the first study-related event for the athletes. The questionnaire was filled in by the study participants. Both the reference group and the swimmers had the opportunity to ask questions, and the staffs were the same for both groups.

Table 2
Respiratory Symptoms and Physician-diagnosed Asthma in the Reference Group

Variable	No. (%) of participants		*P* value
	Males (n = 828)	Females (n = 798)	
Exercise-induced symptoms	201 (24.5)	292 (36.6)	**<.001**
Asthma ever	227 (28.8)	266 (33.3)	**.05**
Current asthma symptoms	183 (22.3)	322 (29.1)	**.002**
Current asthma symptoms in relation to airborne allergens	52 (6.3)	72 (9.0)	**.04**
Current asthma symptoms in relation to exercise	102 (12.4)	155 (19.4)	**<.001**
Current asthma symptoms in relation to irritants	75 (9.1)	130 (16.3)	**<.001**
Asthma exacerbations last year	44 (5.3)	52 (6.5)	.07
Rhinitis with impact on daily living	165 (20.1)	190 (23.8)	NS
Physician-diagnosed asthma	146 (17.8)	129 (16.2)	NS
Inhaled corticosteroids regularly	43 (5.2)	36 (4.5)	NS

Abbreviation: NS, not significant.
Boldface indicates significant numbers.

Table 3
Respiratory Symptoms and Physician-diagnosed Asthma in Athletes

Variable	No. (%) of study participants		*P* value
	Males (n = 109)	Females (n = 78)	
Exercise-induced symptoms	64 (59.8)	56 (71.8)	.09
Asthma ever	52 (48.6)	49 (62.8)	.06
Current asthma symptoms	43 (40.2)	44 (56.4)	**.03**
Current asthma symptoms in relation to airborne allergens	13 (12.1)	13 (16.7)	NS
Current asthma symptoms in relation to exercise	34 (31.8)	40 (51.3)	**.007**
Current asthma with hyper-reactive symptoms	26 (24.3)	21 (26.9)	NS
Asthma exacerbations last year	10 (9.3)	13 (16.7)	NS
Rhinitis with impact on daily living	35 (32.7)	26 (33.3)	NS
Physician-diagnosed asthma	29 (27.1)	29 (37.2)	NS
Inhaled corticosteroids regularly	12 (11.2)	10 (12.8)	NS
Positive skin prick test result	54 (51.4)	38 (49.4)	NS

Abbreviation: NS, not significant.
Boldface indicates significant numbers.