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Military service-aggravated asthma improves at two-year follow-up

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Summary

Background: During military service young men (age 19–21 years) are exposed to many predisposing factors for asthma. We aimed to study the short-term prognosis of asthma after the military service. **Methods:** All 216 men with verified asthma in 2004–2005 from the register of the Central Military Hospital were included in the study. A questionnaire was mailed to them in autumn 2007 and the 146 responders (68%) formed the final study population. Asthma severity was evaluated during military service according to the medical records of the subjects and two years later based on the questionnaire using modified GINA guidelines. The results on lung function and allergy tests during military service and asthma history were used as predictors of asthma severity at two-year follow-up.

Results: Two groups of asthmatics were identified: those who already had asthma when entering the military service ($n = 71$, 48.6%) and those, who had a new onset of asthma during the service ($n = 75$, 51.4%). Overall asthma was less severe at two-year follow-up than during military service ($p = 0.036$). Both during military service and at two-year follow-up, asthma was milder among the men, who had a new onset of asthma during military service. Atopy ($p = 0.002$), number of positive skin-prick tests ($p = 0.005$) and higher total serum IgE ($p = 0.001$) were significant predictors for persistent asthma at follow-up.

Conclusions: Asthma, which had aggravated or started during military service, was significantly less severe two years later. The degree of atopy was a major determinant of the two-year prognosis of asthma after military service.

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Introduction

Asthma is a common chronic respiratory disease, and its prevalence is increasing. According to the FinEsS study the prevalence rate of having ever had asthma was 7.2% in the Finnish population overall and 6.1% among young men.¹ Both figures are considerably higher than in previous studies and indicate a rising prevalence. In longer term, the prevalence of asthma among young Finnish men has increased 12-fold between 1966 and 2003, while getting at the same time milder and better controlled.² A similar trend has been reported among 17-year-old men in Israel, where asthma prevalence has also increased 11-fold during the last 50 years.³

In Finland it is obligatory for all young men of sufficiently good health to participate in either military or civil service. About 81% of young men, typically at the age of 19–21, carry out a 6–12 months military service. Mild or moderate asthma is not a reason for exemption at call-up. According to Finnish Defence Forces' statistics, asthma is a common diagnosis among young men in military service and the major somatic reason for discharge from service. Many factors can aggravate asthma symptoms during military service, such as recurrent respiratory infections, physical exercise, and exposure to cold air, allergens or other dusts. An increased frequency of asthma exacerbation among recruits who already have the disease, and a new onset of asthma are reported as being associated with military service in combat units.⁴ Recognition of the risk factors for more severe asthma during and after military service can be useful for planning the criteria of exemption at call-up. The prognosis of asthma detected during military service, is unknown.

Identifying the clinical features associated with persistence and more severe asthma among young adults could lead to an improved treatment and better prognosis of the disease. We wanted to evaluate the determinants of asthma severity and its change among young male asthmatics (1) over a period of 6–12 months of military service during which they were exposed to many predisposing factors for asthma and (2) at a follow-up two years later.

Material and methods

Subjects

All 216 men with verified asthma in 2004–2005 from the register of the Central Military Hospital were included in the study base. These subjects represented an unselected population of men with mild or moderate asthma aged 18–27, from southern and central parts of Finland. A follow-up questionnaire was sent approximately two years later in autumn 2007. The mean follow-up time (time between completing military service and filling the questionnaire) was 29 months. Of the 216 men, 69 didn't answer the questionnaire after two reminders and one did not give his consent for the study and were excluded. The response rate of the questionnaire was 68% and the final study population comprised 146 subjects.

Two groups of asthmatics were included. The first group consisted of men ($n = 71$), who already had asthma when entering the military service, and was admitted to hospital

due to unstable or aggravated asthma. These asthmatics came mainly for restarting or adding medication or for evaluation of service ability. The other group of men ($n = 75$) suffered a new onset of asthma during service and came for confirmation of the diagnosis. The diagnosis of asthma was based on a history of asthma symptoms and a significant reversibility of bronchial obstruction in spirometry ($n = 13$), or bronchial hyperreactivity in the histamine challenge ($n = 12$) or a positive exercise test ($n = 26$). Twenty men had diagnostic findings in two or three of these tests. In four cases, the diagnosis was based on a two-week serial peak expiratory flow (PEF) follow-up showing at least three times either a diurnal variation of 20% or more or a bronchodilation effect of 15% or more. The diagnosis was made in a medical unit specialised in pulmonary and internal medicine and the diagnostic tests were performed in a laboratory specialised in clinical physiology using standard tests and quality assurance protocols. Only few of the patients, 16 of men with the previously diagnosed asthma and seven of those with new onset of asthma, had an acute exacerbation needing hospitalization during their military service.

About half of the subjects had started military service in January and the other half in July. A total of 11.8% of the men had discontinued service and in the rest of the subjects the duration of military service varied from 6 to 12 months. In the subgroup of men with previously established asthma, the mean delay between the start of the military service and the clinical investigations was 3.3 months as compared to 4.6 months among those men with new asthma diagnosed during the service. About half of the subjects were students, 45.2% were in full-time job and 5.5% of the men were unemployed at the time of questionnaire.

The study was approved by the Ethical Committee of the Department of Medicine of Helsinki University Central Hospital. A written informed consent was collected from the study subjects.

Collection of data

At baseline

All clinical investigations had been carried out during military service in the Central Military Hospital in 2004–2005. The following data were collected from the patient records: height, weight, the results of pulmonary function tests, allergy tests, and laboratory tests, use of asthma medication, asthma symptoms and exacerbations.

At follow-up

We used the previously validated Finnish questions of the Tuohilampi questionnaire on asthma, allergic rhinitis and atopic eczema.⁵ Data were collected on personal characteristics, asthma history and family history, asthma symptoms, use of asthma medication, medical history, life style, occupational and domestic exposures and social situation.

Methods used

Spirometry

It was performed according to the American Thoracic Society guidelines on the Jaeger Masterlab spirometer.⁶ We used the predicted values assessed for the Finnish population.⁷

An FEV₁ of $\geq 81\%$ of the predicted value was considered normal, 65–80% as mildly decreased, and 64% or less as moderately or severely decreased. A significant reversibility of airway obstruction was defined as an increase of at least 12% and 200 ml in FEV₁ after bronchodilator administration.

Airway hyperresponsiveness

Airway hyperresponsiveness to histamine was assessed using the method of Sovijärvi et al.⁸ It was defined by a histamine value PD15 (the concentration of histamine causing a 15% decrease in the FEV₁) of 1.6 mg or less. Airway hyperresponsiveness was classified as severe if PD15 values were ≤ 0.10 mg, moderate with PD15 values of 0.11–0.39 mg, and mild if $0.40 \text{ mg} \leq \text{PD15} \leq 1.6 \text{ mg}$.

An exercise test

It was performed out of doors on a 150 m circular track. Air temperature ranged from -18°C to $+26^\circ\text{C}$. Heart rate was monitored by a Sport Tester TM PE 3000 heart rate meter. Subjects raised their heart rate to 85% of the predicted maximal rate in a 2 min warm up and maintained this rate for the remaining 6 min of the test. PEF values were measured just before the run, then immediately, and 5, 10, 20, and 30 min after the test. Three measurements were obtained on each occasion and the highest value was taken as the result. PEF was measured with a mini peak flow meter and FEV₁ was not monitored. The method is described in more detail by Karjalainen.⁹ Positive exercise reaction was defined by PEF falling at least 15% either before or immediately after the exercise. The test was also considered positive, if the fall in PEF was over 10% with expiratory wheezing. Some of the exercise tests were done in cold weather, according to the guidelines concerning exercise test in cold-air exposure as a diagnostic tool for asthma.¹⁰

Skin-prick tests

These were performed using a panel of 10 common perennial and seasonal allergens with standardized allergen extracts (ALK Abello). Histamine dihydrochloride 10 mg/ml was used as the positive control and the solvent (glycerin) as the negative control. A wheal with a diameter of at least 3 mm and at least 50% of histamine control were considered positive in skin-prick tests.

Definition of atopy

It was based on skin-prick testing in 110 subjects. A subject was considered atopic when at least one positive skin test to common allergens was present. Subjects who reacted to at least four allergens were classified as multiply sensitized. If prick tests were missing or showed a dermatographism reaction, then subjects diagnosed with an allergic rhinitis or conjunctivitis by a doctor ($n = 18$), or a reliable anamnesis of positive skin-prick tests ($n = 12$) were considered atopic. In six subjects the atopy status remained undefined.

Blood eosinophils (B-eosinophils)

These were counted in a Bürker counting chamber.

Total serum IgE

It was measured by solid phase immunoassay, and a concentration of $\leq 110 \text{ kU/l}$ was considered normal.

Physical activity

It was evaluated by asking how often the subject participates in leisure time physical activity lasting at least 30 min, resulting in breathlessness and sweating. Questions also covered the amount of total leisure time physical activity in one week, and occupational physical activity. Physical activity was classified as low, moderate or regular, based on the frequency and duration of leisure time physical activity and occupational physical activity.

Body mass index (BMI)

It was calculated as weight in kilograms divided by the square of height in metres, from measured height and weight during military service and from self-reported measures at follow-up. Overweight was defined as a BMI $\geq 25 \text{ kg/m}^2$.

Assessment of asthma severity

The severity of asthma during military service was estimated from patients' records based on the modified GINA guidelines and presented current asthma severity. The following categories were used: intermittent, mild persistent, moderate persistent and severe persistent (Table 1).^{11,12} Subjects were placed into the most severe category for which they qualified. Those with intermittent symptoms, who only sometimes needed asthma medication, were categorized as having an intermittent disease. The remainder of the subjects (mild, moderate, and severe persistent) were categorized as having a persistent disease. None of the subjects was in remission at baseline. Classification was carried out without FEV₁ values in order to make it comparable with the questionnaire-based severity assessment at follow-up. Such a GINA classification without spirometry data has been used in previous studies.¹³ A chest physician (IL) made the classifications.

The severity of asthma at follow-up was based on a questionnaire and on validated questions concerning frequency of various asthma symptoms and the use of medication during last 12 months. Subjects were classified as at baseline (Table 1). Remission of asthma was defined as no attacks of shortness of breath with wheezing, no cough with wheezing, and no use of asthma medication during the last 12 months. Classification was carried out by two physicians (IL and PKo) separately, and proved congruent with each other. The kappa coefficient between two observations was 0.95.

Statistical analysis

Determinants of asthma severity were tested with the Kruskal–Wallis test for continuous, non-normally distributed variables and the χ^2 -test for categorical variables when comparing different asthma severity groups at the two-year follow-up. The same methods were applied, when comparing a new onset of asthma with asthma started before the military service. A p -value of <0.05 was considered statistically significant.

All the analyses were carried out using the SAS 9.1 programme.

Table 1 Asthma severity.

Class	Symptoms	Night-time symptoms	Medication
Remission	None	None	None
Mild intermittent	<1 time a week	<1 time a week	Only when needed
Mild persistent	≥1 time a week but <1 time a day	>1 time a week	Inhaled corticosteroids ≤ 800 µg/day OR combination therapy 1 puff/day
Moderate persistent	Daily		Inhaled corticosteroids >800–2000 µg/day OR inhaled corticosteroids and long acting β ₂ -agonist or leukotriene antagonist
Severe persistent	Physical activities limited by asthma		Oral corticosteroids OR inhaled corticosteroids >2000 µg/day

Classification was made according to the highest severity class in any category.

Results

Characteristics of the study population

Table 2 shows the characteristics of the study members during military service and at two-year follow-up. The mean age of the subjects was 19.7 years at baseline and 22.4 years at follow-up. About half of the patients (51.4%) suffered from a new onset of asthma during military service. A total of 34 (47.9%) of the subjects who already had asthma before military service regularly used asthma medication before clinical investigations in the Central Military Hospital. About 75% of the patients were atopic. After the visit to the Central Military Hospital, 52.7% of the subjects regularly used inhaled corticosteroids and 40.4% used combination therapy with inhaled corticosteroids and long acting β₂-agonists and/or leukotriene antagonists. The rest of the subjects (6.9%) used asthma medicines only as needed, and 23.3% of the men needed a course of oral corticosteroids during military service.

The subjects who had asthma before military service were more frequently sensitized in skin-prick tests than those suffering a new onset of asthma (Table 2). They also reported a higher prevalence of physician-diagnosed allergic conjunctivitis, allergic rhinitis and atopic eczema. There were no significant differences between the two groups in the results of lung function tests, total serum IgE, B-eosinophils or BMI.

Asthma severity during military service

Fig. 1 shows asthma severity during military service and at two-year follow-up. At baseline, asthma was intermittent in 4% of men, mild persistent in 26% of men, moderate persistent in 69% and severe persistent in 0.7% of men. Asthma was less severe in the subjects who suffered a new onset of asthma during military service ($p = 0.036$). Among these men, asthma at baseline was intermittent or mild persistent in 40%, as compared to 19.7% among those with asthma before military (Table 2). Similarly, the age of onset of asthma predicted asthma severity during military service. Asthma was moderate persistent in 88.9% of the 27 patients whose asthma had been confirmed under seven years of age, compared with the same severity in 72.5% and 62.3% of study members who had been diagnosed at the age of 7–18 and over 18 years respectively ($p = 0.108$). There

was no significant difference in asthma severity between atopic and non-atopic subjects during military service. The initial month of starting the military service had no influence on asthma severity during service.

Asthma severity at two-year follow-up

At follow-up, asthma was in remission in 19.7%, mild intermittent in 41.8%, mild persistent in 22.6%, and moderate persistent in 15.6% (Table 3). None of the respondents had severe persistent asthma. In most cases (78.1%, 114 cases), asthma was milder two years after military service than during it (Table 4). The severity had not changed in 20.5% respondents while asthma had worsened only 1.4% (2 cases). Asthma was significantly less severe at two-year follow-up than during the military service ($p = 0.036$).

At follow-up, asthma was less severe among subjects who suffered a new onset of asthma during military service as compared to those who already had asthma before military service ($p = 0.055$). In these groups the remission rates were 28.0% and 11.2%, respectively (Table 3). At follow-up, asthma was significantly milder among non-atopic than among atopic subjects ($p = 0.002$) (Table 4). Asthma severity during military service also predicted asthma severity at two-year follow-up.

A low level of total serum IgE, fewer positive allergy skin-prick tests and higher FEV₁/FVC of the predicted value at baseline correlated with milder asthma at follow-up (Table 4). No significant associations were found between asthma severity at follow-up and FEV₁ of the predicted value, PD15 and PEF decrease during exercise at baseline.

A relationship was found between physician-diagnosed allergic rhinitis and more severe asthma at follow-up (Table 5). The subjects with physician-diagnosed atopic eczema or the subjects with a history of both atopic dermatitis and allergic conjunctivitis and/or rhinitis also tended to have more severe asthma at follow-up, but these associations were not statistically significant (Table 5). Asthma was more severe in the subjects who did not have indoor pets.

Discussion

Our study population consisted of young men exposed for 6–12 months to many predisposing and aggravating factors for asthma, such as dusts, allergens, cold air, high

Table 2 Characteristics of the study population.

	All subjects, <i>n</i> = 146	Asthma before military service, <i>n</i> = 71	New onset of asthma, <i>n</i> = 75	<i>p</i> -value
Characteristics during military service				
Age, mean	19.7	19.6	19.7	0.472
BMI, mean	24.0	23.9	24.2	0.893
Age of asthma onset				
0–6 years	18.5%	38.0%	0.0%	
7–18 years	27.4%	55.0%	1.3%	
Over 18 years	52.7%	4.2%	98.7%	
Unknown	1.4%	2.8%	0.0%	
Atopy	74.7%	80.3%	69.3%	0.178
FEV ₁ , <i>n</i> = 144				
Normal	75.0%	79.7%	70.7%	0.065
Mildly worsened	17.4%	10.1%	22.7%	
Moderate or severe worsened	7.6%	10.1%	5.3%	
Significant reversibility	26.4%	20.2%	32.0%	0.111
Moderate or severe	37.9%	42.2%	35.2%	0.500
airways hyperreactivity, <i>n</i> = 87				
Positive exercise reaction, <i>n</i> = 121	45.5%	41.5%	48.5%	0.442
Skin-prick tests, <i>n</i> = 110				
1–3 positive	22.7%	11.9%	29.4%	0.017
4 or over positive	50.9%	69.0%	39.7%	
Total serum IgE over 110kU/l, <i>n</i> = 97	61.9%	67.5%	58.4%	0.634
Elevated blood eosinophils, <i>n</i> = 106	19.8%	19.5%	20.0%	0.951
Asthma severity				
Intermittent	4.1%	1.4%	6.7%	0.036
Mild persistent	26.0%	18.3%	33.3%	
Moderate persistent	69.2%	78.9%	60.0%	
Severe persistent	0.7%	1.4%	0.0%	
Characteristics at follow-up				
Age, mean	22.4	22.4	22.4	0.884
BMI, mean	25.2	25.2	25.3	0.919
Physician-diagnosed allergic conjunctivitis	35.9%	45.1%	26.7%	0.020
Physician-diagnosed allergic rhinitis	63.7%	76.0%	52.0%	0.008
Physician-diagnosed atopic eczema	34.9%	40.8%	29.3%	0.145
Eczema and allergic conjunctivitis and/or rhinitis	28.8%	38.0%	20.0%	0.016
Family history of asthma	39.3%	40.8%	38.7%	
Current smoker	41.7%	38.6%	44.6%	0.527
Former smoker	15.3%	18.5%	12.2%	
Passive exposure to tobacco smoke	17.4%	19.7%	15.3%	0.494
Indoor pets	31.7%	15.5%	48.0%	<0.0001
Physical activity				
Low	15.3%	15.7%	14.9%	0.835
Moderate	23.6%	21.4%	25.7%	
Regular	61.1%	62.9%	59.5%	

n = number of subjects with data; *p*-values determined by χ^2 -test for comparing the subjects with a new onset of asthma with the subjects with asthma before military service.

frequency of infections and physically demanding military training. Overall, their asthma was significantly less severe two years later. Asthma severity during military service, atopy, number of positive skin-prick tests, and total serum

IgE were significant predictors for persistent asthma. Subjects with a new onset of asthma had less atopic characteristics and also milder asthma at two-year follow-up. A low FEV₁/FVC% of the predicted value at baseline tended to

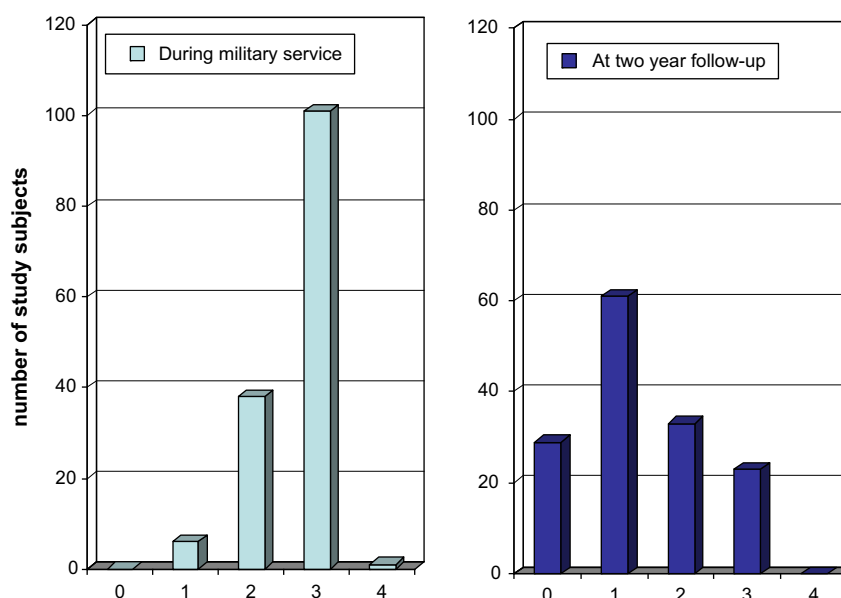


Figure 1 Asthma severity class according to the modified GINA guidelines during and two years after the military service. 0 = remission, 1 = intermittent, 2 = mild persistent, 3 = moderate persistent, 4 = severe persistent.

associate with more severe asthma, but below statistical significance. Onset of asthma under the age of seven associated with severe asthma during military service, but less so with that at two-year follow-up. However, the age of asthma onset was not a statistically significant risk factor for more severe asthma.

Other studies have reported similar factors being related to asthma persistence among young adults. Atopy and a low FEV₁/FVC ratio were found to be independent risk factors for an asthma relapse in young adults, whose asthma was in remission at 18 years of age.¹⁴ Fewer positive allergy skin tests and low total IgE concentrations were found to be

Table 3 Asthma symptoms, treatment and severity at two-year follow-up.

	Total subjects, <i>n</i> = 146	Asthma before military service, <i>n</i> = 71	New onset of asthma, <i>n</i> = 75	<i>p</i> -value
Frequency of asthma symptoms				
Daily or almost daily	3.5%	4.3%	2.7%	0.0849
Weekly or almost weekly	14.6%	18.6%	10.8%	
Monthly or almost every month	19.4%	25.7%	13.5%	
Less frequently	20.1%	18.6%	21.6%	
Only seasonally	24.3%	22.9%	25.7%	
No symptoms	18.1%	10.0%	25.7%	
Asthma medication during last 12 months				
None	32.6%	21.7%	42.7%	0.010
Only as needed/temporary	32.6%	34.8%	30.7%	
Inhaled corticosteroids	16.0%	15.9%	16.0%	
Inhaled corticosteroids and long acting β 2-agonists and/or leukotriene antagonists	18.8%	27.5%	10.7%	
Asthma severity				
Remission	19.7%	11.2%	28.0%	0.055
Intermittent	41.8%	42.3%	41.3%	
Mild persistent	22.6%	28.1%	17.3%	
Moderate persistent	15.7%	18.3%	13.3%	

p-values determined by χ^2 -test for comparing the subjects with a new onset of asthma with the subjects with asthma before military service.

Table 4 Relationship between asthma and atopy status during military service and asthma severity at two-year follow-up.

Total (n = 146)	Severity of asthma at follow-up				p-value
	Remission, n = 29	Intermittent, n = 61	Mild persistent, n = 33	Moderate persistent, n = 23	
BMI	24.3	24.1	24.0	23.7	0.919
Atopy status (n = 141)					
Atopic (n = 109)	15 (13.8%)	50 (45.9%)	25 (22.9%)	19 (17.4%)	0.002
Non-atopic (n = 32)	14 (43.7%)	8 (25.0%)	7 (21.9%)	3 (9.4%)	
Age of asthma onset (n = 144)					
0–6 years (n = 27)	3 (11.1%)	9 (33.3%)	10 (37.0%)	5 (18.5%)	0.180
7–18 years (n = 40)	5 (12.5%)	20 (50.0%)	8 (20.0%)	7 (17.5%)	
Over 18 years (n = 77)	21 (27.2%)	31 (40.3%)	15 (19.5%)	10 (13.0%)	
Asthma severity during military service (n = 146)					
Intermittent (n = 6)	2 (33.3%)	3 (50.0%)	1 (16.7%)	0 (0%)	0.036
Mild persistent (n = 38)	11 (29.0%)	20 (52.6%)	6 (15.8%)	1 (2.6%)	
Moderate persistent (n = 101)	16 (15.8%)	38 (37.6%)	26 (25.7%)	21 (20.8%)	
Severe persistent (n = 1)	0 (0%)	0 (0%)	0 (0%)	1 (100%)	
Number of positive prick tests (n = 106), mean (range)	2 (0–7)	4 (0–8)	4 (0–9)	5 (0–8)	0.005
Total serum IgE, kU/l (n = 97), mean (range)	157 (16–714)	250 (10–2734)	563 (45–2271)	1078 (33–10749)	0.001
FEV ₁ % of predicted value (n = 144), mean (range)	90.9 (61.3–106.7)	88.5 (57.0–111.1)	83.8 (29.5–116.7)	88.6 (47.6–116.9)	0.528
FEV ₁ /FVC% of predicted value (n = 144), mean (range)	89.9 (68.5–111.1)	88.5 (57.5–108.9)	83.9 (47.5–107.7)	83.3 (60.3–107.3)	0.077
Histamine FEV ₁ PD15 (mg) (n = 87), mean (range)	1.02 (0.03–>1.6)	0.74 (0.03–>1.6)	0.67 (0.00–>1.6)	0.59 (0.1–>1.6)	0.180
PEF fall % in exercise test, l/min (n = 123), mean (range)	14.6 (0–44)	15.2 (0–45)	14.8 (2–53)	15.2 (2–59)	0.237

p-values determined with Kruskal–Wallis test for continuous, non-normally distributed variables and χ^2 -test for categorical variables.

predictors of asthma remission or milder disease in The Childhood Asthma study.¹⁵ Another study of childhood asthma concluded that adulthood sensitization to house dust mites, airway hyperresponsiveness, sex, smoking and early onset age were the factors predicting persistence or relapse of asthma.¹⁶ In the Tucson Children's Respiratory study, frequent wheezing before puberty, obesity, early onset of puberty, active sinusitis, and skin test sensitization were predictors of unremitting asthma after the onset of puberty.¹⁷ Quitting smoking and the presence of mild disease appeared to favour remission in adult asthmatics in the RHINE study.¹⁸ In a 30-year follow-up study, asthma remission was associated with a higher lung function level in childhood and higher subsequent increases in FEV₁.¹⁹

Assessment of severity and of asthma control is more complex in population-based studies than in clinical work aiming at management of an individual case of asthma.^{11,12} We classified asthma severity both during military service and at two-year follow-up by using GINA-asthma severity classes, while levels of asthma control were not used. Combining parameters of both asthma treatment and frequency of asthma symptoms was considered relevant, because at the follow-up part of the symptomatic subjects did not use medication, while the other part had regular asthma medication. There is no golden standard for assessing asthma severity in population studies, but

a classification similar to ours has been suggested and used in previous studies.^{11,15} Due to the retrospective nature of our study, the severity assessment during the military service was done using medical records and presented current asthma severity at that time and not the severity during last 12 months as at two-year follow-up. These different time frames would rather overestimate than underestimate asthma severity at the follow-up, if compared with asthma severity assessment during military service. Sending the questionnaire in autumn, when pollen and cold-air exposure were absent, might have lead underreporting of seasonal asthma symptoms.

The prevalence of obesity is increasing among young people in developed countries. According to a recent meta-analysis of prospective studies, overweight and obesity are associated with a dose-dependent increase in the odds of incident asthma among men and women.²⁰ In a cohort of navy army subjects under 30 years of age, the median BMI was 25.6 kg/m² among men with intermittent asthma and 23.7 kg/m² among healthy subjects. The proportion of overweight or obese was 64.8% and 31.1%, respectively.²¹ In the OLIN study, 49.9% of male and female asthmatics aged 20–60 and only 34.8% of referents were overweight or obese.²² In our study, 36% of asthmatics in military service and 50% of them at two-year follow-up were overweight or obese. In our study the mean BMI of the subjects was 24.0 kg/m² during military

Table 5 Relationship between subject characteristics at two-year follow-up and current asthma severity.

Total (n = 146)	Severity of asthma at follow-up				p-value
	Remission, n = 29	Intermittent, n = 61	Mild persistent, n = 33	Moderate persistent, n = 23	
BMI, mean	25.9	25.3	24.7	24.9	0.827
Allergic rhinitis					
Yes	12.9%	44.1%	24.7%	18.3%	0.044
No	32.1%	37.7%	18.9%	11.3%	
Atopic eczema					
Yes	11.7%	47.1%	21.6%	19.6%	0.274
No	24.2%	39.0%	23.2%	13.7%	
Atopic eczema and allergic rhinitis and/or conjunctivitis					
Yes	11.9%	42.9%	21.4%	23.8%	0.225
No	23.1%	41.4%	23.1%	12.5%	
Family history of asthma					
Yes	17.2%	41.4%	24.1%	17.2%	0.862
No	22.5%	41.6%	21.4%	14.6%	
Smoking					
Never	14.5%	40.3%	27.4%	17.7%	0.391
Former or current	23.2%	43.9%	10.4%	14.6%	
Passive exposure to tobacco					
Yes	25.0%	37.5%	16.7%	20.8%	0.645
No	18.4%	43.9%	23.7%	14.0%	
Physical activity					
Little	27.3%	40.9%	13.6%	18.2%	0.680
Moderate	11.8%	47.1%	20.6%	20.6%	
Regular	21.4%	40.5%	24.7%	13.5%	
Indoor pets					
Yes	30.4%	41.3%	21.7%	6.5%	0.060
No	15.5%	41.4%	23.2%	20.2%	

p-values determined with Kruskal–Wallis test for continuous, non-normally distributed variables and χ^2 -test for categorical variables.

service and 25.2 kg/m² at two-year follow-up. In a recent cross-sectional study, obesity was associated with a lesser likelihood of asthma remission, and more severe asthma.¹³ In our study, however, we did not find a relationship between the severity of asthma and the BMI.

Our study population was homogenous as regards age and sex, and represented unselected young men with mild or moderate asthma from all parts other than the northernmost regions of Finland. The response rate was good (68%). All clinical tests were performed with uniform and validated methods in a unit specialised on internal and pulmonary medicine and connected with a laboratory of clinical physiology using standard tests and quality assurance protocols. The limitation of our study was that lung function test results were not used in the assessment of asthma severity. In a previous study, bronchial hyper-responsiveness and airway inflammation were observed despite of a clinically apparent remission of asthma.^{23,24} The other weakness of our work was some missing clinical data due to the retrospective design of the study. This may have affected the analysis of risk factors for asthma severity. The definition of atopy was based on skin-prick testing in the majority of the study subjects, but some 20%

of men were classified as atopic according to a history of positive skin-prick tests or diagnosis of an allergic rhinitis or conjunctivitis by a doctor. This might have lead to some misclassification. However, the associations between asthma severity and atopy, the number of positive skin-prick tests, and total serum IgE were strong and unlikely due to any bias. Finally, as regards young men with asthma already before military service, our study was limited to those whose asthma aggravated to such an extent that they were referred for a clinical evaluation in a pulmonary medicine unit. In 2004 and 2005 altogether about 55 000 young men aged around 20 years started their military service in Finland. Assuming a 6% prevalence of ever having had asthma before that age one can conclude that the majority of young men with an asthma history could complete their service without being referred for a clinical evaluation. No conclusions can be drawn on the prognosis of such cases of asthma.

The remission rate of subjects who suffered a new onset of asthma was high. It is possible that some of them might have had undiagnosed mild asthma already before military service. Several studies have found underdiagnosis of asthma in both adolescents and young adults.^{25,26} Cases of

mild asthma and exercise-induced asthma are the most overlooked types. Exercise-induced asthma is a condition in which vigorous physical activity triggers acute airway narrowing in people with an increased airway reactivity.²⁷ Generally it is not considered that exercise *per se* can cause asthma in normal individuals. Exercise-induced bronchoconstriction may occur in any climatic condition, but it is more common when the patient is breathing dry, cold air and less common in hot, humid climates.²⁸ In a recent study, the risk of asthma was more increased in soldiers in heavy military service in combat units than among those in maintenance units or clerical tasks.²⁹ Exercise-induced asthma was observed as the only manifestation of asthma in 32% of the soldiers posted in combat units compared with 13% and 11% in maintenance units and clerical tasks respectively. In Finland, during wintertime, the outside air temperature can be as low as -30°C and military training is performed outside despite of the cold weather. In our study, about half (48.5%) of the cases of a new onset of asthma had a positive exercise test result. The high remission rate among the subjects with a new onset of asthma during military service might be associated with mild exercise-induced asthma.

In summary, allergic sensitization and being overweight or obese were common in our study population of young male asthmatics. We have demonstrated that asthma is significantly milder two years after military service than during service. The subjects who suffered a new onset of asthma during service had a particularly good prognosis and the majority of them was in remission or had only intermittent asthma at two-year follow-up. Atopy was associated with more severe asthma. Asthma onset during early childhood tended to be associated with more severe asthma, but below statistical significance in this relatively small population. These prognostic factors can be used when planning the criteria of exemption at call-up. However, further studies are required in order to ascertain the longer term prognosis of asthma among young male asthmatics after military service.

Conflict of interest

None of the authors declare any conflict of interest.

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