

Asthma and allergic rhinitis in Swedish conscripts

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Summary

The computer records of Swedish conscript examinations in 1971 and 1981 were analysed regarding the prevalence of asthma and allergic rhinitis. The material comprised ~55 000 18-year-old males in each cohort. During the 10-year period the prevalence of asthma increased from 1.9 to 2.8% and of allergic rhinitis from 4.4 to 8.4%. The prevalence of allergic rhinitis was already higher in the northern than in the southern part of the country in 1971. The increase in both diseases was higher in the northern parts of Sweden, giving double prevalence figures in the northern part of the country compared to the southern part in 1981. The distribution of the prevalence was similar to the temperature pattern in the country, the higher prevalence being associated with a colder outdoor climate. Both diseases were more prevalent in urban than in rural areas.

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Introduction

In school children, a significantly higher prevalence of allergic diseases was found in a northern town in Sweden than in two southern areas of the country [1]. Whether these differences were only accidental, due to local conditions in a small mountain town with a sub-arctic climate or a reflection of a more generalized geographical pattern could not be determined. No similar geographical differences are reported by others. The present study was designed to give further evidence to the possibility of geographical differences and simultaneously elucidate the current question of a possible change in prevalence over time [2]. For this purpose two full age cohorts with a 10-year interval, taken from the compulsory military conscript examinations, were studied. As the military enrollment medical examinations are uniformly performed throughout the country and have not changed over the period in question, they can be used for comparisons both as to differences in geography and time.

Material and methods

The material was derived from the computer records of the compulsory military conscript examinations performed in Sweden in 1971 and 1981. The two entire age classes comprised of 55 393 young men in 1971 and 57 150

in 1981. They were 17–20 years of age, with 95% of the sample 18 years of age.

Examination of the conscripts includes a health questionnaire, personal interview by a medical doctor and a comprehensive physical and psychological examination. Diagnosis registration is made on a practical clinical basis from the military point of view, and thus some slight disease not expected to influence the military service might be missed. The diagnoses used in this study were asthma and allergic rhinitis/rhinoconjunctivitis (AR). These diagnoses were asked for in the health questionnaire sent home to the conscripts prior to the examination. The eventual diagnoses were made at the personal interview by the examining doctor and based on the patient's history. Repeated attacks of heavy breathing and/or wheezing that could not be explained by other conditions were considered as asthma. AR was stated in the conscripts who reported recurrent symptoms of rhinitis and/or conjunctivitis related to allergen exposure, such as pollen or animals. The same diagnostic criteria were used in a detailed study of allergic diseases at the Conscript Office in Gothenburg. During one month in 1981 all 1187 conscripts were interviewed and examined with special emphasis on allergies. Most conscripts with asthma or other allergic disease and all with doubtful symptoms were evaluated by a trained allergist (N.Å.). The prevalence of both asthma and AR were higher than in the routine diagnosis registration, the latter missing

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Table 1. Factors of housing and living from Census of Population and Housing 1975

<i>Size and kind of municipality</i>		
Countryside	Town-city (at least 200 residents and less than 200 m between the houses)	
<i>Kind of house</i>		
Farm	1-2 family house	Apartment house
<i>Year of construction of housing</i>		
Before 1956	1956-65	After 1965
<i>Housing standards</i>		
With bathroom	Small apartment (< 2 bedrooms)	
Overcrowding (> 2 persons/bedroom)		

20% of the cases. Pollen allergy was found in 78% of the cases of AR.

From the routine examinations, height, weight, and test results for maximal exercise capacity, intelligence test and mental performance under stress were used in the analyses. Place of birth and the housing and living factors listed in Table 1 were obtained for each 1981 individual from the Swedish Census of Population and Housing 1975, at the time the 18-year-old group was 12. In the computer record from 1971 the 24 counties of birth were derived directly from the civic number series in the national identification numbers prior to deletion of individual identification.

Computer processing and statistical analyses of the material were performed at Gothenburg Universities' Computing Centre with the statistical package SAS. In analyses of the statistical significance of group differences the chi-square-test of two-way tables was used except for differences in parametric variables, when the *t*-test was used. Multiple regression analyses were made using stepwise multiple regression analysis or the general linear model procedure (GLM) with diagnoses as dependent variables.

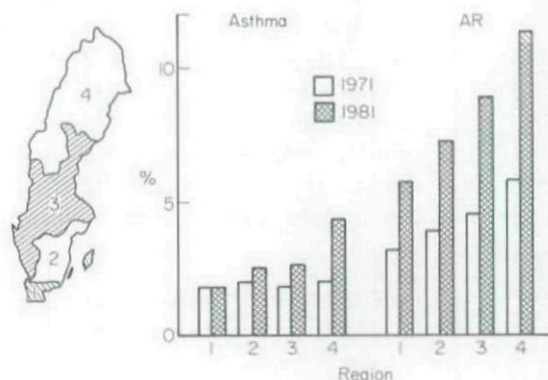
The study was approved by the Ethics Committee of Gothenburg University.

Results

The prevalence of asthma and AR in 1971 and 1981 is shown in Table 2. In 1981 there was a marked trend towards higher prevalence of AR with each more northerly county of birth ($P < 0.001$). On the basis of this trend, counties with similar AR prevalence were brought together to form four main regions numbered from south to north. These regions were also used in the subsequent analyses of the 1971 cohort and gave a prevalence pattern

Table 2. Prevalence of asthma and AR in Swedish conscripts

	1971 (%)	1981 (%)	<i>P</i>
Asthma	1.9	2.8	<0.001
AR	4.4	8.4	<0.001

**Fig. 1.** Prevalence of asthma and AR in conscripts born in various regions of Sweden.

as seen in Fig. 1. The differences between the regions were significant for AR ($P < 0.001$) both in 1971 and 1981. In 1971 there was no difference between the regions for asthma. During the next decade the asthma prevalence increased in the three northern regions resulting in geographical differences ($P < 0.001$) in 1981 similar to those found for AR. The increase in prevalence between 1971 and 1981 was significantly higher for both diseases with each more northerly region ($P < 0.001$, GLM).

In 1981 the 1.6% of the conscripts born in Finland and the 1.1% born in other foreign countries had lower prevalences of asthma (2.1% and 0.7%) and AR (6.1% and 4.9%) than the Swedish average. The regional pattern was not influenced by the conscripts born abroad, nor by the further 10% of 1981 year conscripts who had moved to another region between birth and 12 years of age.

Height, weight and test data for the 1981 year conscripts varied among the diagnosis groups as seen in Table 3. The variation of height, weight and exercise capacity was minor and smaller than the variation of the mental function tests including intelligence test.

The subsequent analyses are all based on the information on the 1981 year cohort with the housing and living conditions from the time this cohort was 12 years of age.

Table 3. Test results in Swedish conscripts in 1981 in relation to asthma and AR

		Asthma	AR only	Not asthma or AR
<i>n</i>		1548	4046	50 006
Height (cm)	mean	178.5*	179.3	179.4
	s.d.	6.56	6.53	6.52
Weight (kg)	mean	69.0*	69.3*	69.9
	s.d.	10.4	10.0	10.2
Maximal exercise capacity (watt/kg)	mean	3.55*	3.68	3.67
	s.d.	0.57	0.57	0.57
Mental function under stress (estimate 1-9)	mean	4.63*	5.00	5.09
	s.d.	1.53	1.60	1.67
Intelligence test (estimate 1-9)	mean	5.04	5.42*	5.09
	s.d.	1.85	1.87	1.85

* $P < 0.001$.

The significance (*t*-test) refers to the deviation from the group with none of the diagnoses.

Table 4. Prevalence of asthma and AR in municipalities of different size

	Asthma	AR
Countryside	2.5%	6.9%†
Town (200-450 000 inhabitants)	2.7%	8.5%†
City of Stockholm (670 000 inhabitants)	3.3%*	10.1%†

* $P < 0.05$.

† $P < 0.001$.

The significance (chi-square test) refers to the divergence from the other categories of municipalities.

The prevalence of asthma was higher in the capital of Sweden, Stockholm, than in smaller towns or in the countryside (Table 4) but was not influenced by any of the other living or housing variables. AR was also most prevalent in Stockholm, and showed a declining trend towards less densely populated areas. In the countryside the lowest prevalence of AR was found on farms (6%). In the 16% of the farms, located in smaller towns, AR was as common as in non-farming premises. In the northern area (region 4), there was no difference between towns and countryside. As many of the factors of living and housing listed in Table 1 were interrelated, all these factors in addition to geographical area and intelligence test were included in a stepwise multiple regression model with AR

Table 5. Ranking of factors of importance in stepwise multiple correlation analysis with allergic rhinitis as dependent variable

Rank	Factor	Correlation	<i>P</i>
1	Geographic region 1-4	+	< 0.001
2	Intelligence test	+	< 0.001
3	Living in town or city	+	< 0.001
4	Overcrowded conditions	-	< 0.001
5	Small apartment	+	< 0.001
6	Living in 1-2 family house	+	< 0.01
7	Living in a farm	-	< 0.05

as a dependent variable (Table 5). The ranking represents a falling degree of influence with geographical region responsible for the main variance, closely followed by intelligence test results. Among the remaining factors, living in a town or city had the greatest influence. The prevalence ratio for 'overcrowded/not overcrowded' conditions was 1/1.5, for 'small/large apartment' 1.5/1 and for '1-2 family house/apartment house' 1.2/1. Housing standard and year of residence construction had no bearing on the results.

Discussion

The routine medical examination of the conscripts is designed to meet the needs of the military organization. Slight symptoms of asthma or AR which may be harmless in civilian life, easily become aggravated under active-service conditions such as hard exercise in a harsh climate or crawling among pollinating herbs. Such considerations have probably contributed to the fairly high sensitivity of the routine military diagnosis registration, identifying 80% of the cases of asthma and AR in the special allergy study in one conscript office in 1981. As the system is run uniformly in the whole country, the prevalence figures used in the present study can be considered slightly underestimated but on the other hand probably representative for disease of clinical significance. The accuracy of the diagnosis registration from 1971 can only be evaluated on indirect grounds in relation to the increase with time as discussed below. As no remarkable changes in recognition of the diseases have taken place in the country during this period the level is probably adequate.

One prominent finding from the present study is the geographical pattern in 1981, with higher prevalence of both diseases with the more northerly regions, which was in accordance with results from a study in school children [1]. In principle, variations in morbidity can be related to genetic or environmental background factors. The theory

of a genetic background to the geographical pattern was not supported by the school study [1]. Otherwise, ethnic origin and country of birth are reported to influence the prevalence of asthma in the U.K. [2] and New Zealand [3]. The Swedish conscripts born abroad had low prevalence of the diseases, but distributed in the four regions they did not affect the general geographical pattern. Among environmental background factors, different allergens are the most readily identified. The most common specific allergies in Sweden are to pollen and animal dander [4,5] and 80% of the conscripts with AR in west Sweden 1981 had a history of pollinosis. Nevertheless, no direct relation was found between the pattern of prevalence and allergen exposure. The amount of allergenic pollens is lowest in the northern area (Siewert Nilsson, Palynological Laboratory, Stockholm, pers. comm.) and the occurrence of domestic animals is no higher in the northern than in the southern areas of Sweden [1]. House dust mite, the most important allergen in many countries [6-8] is less common in Sweden [4,5], particularly in the northern part of the country. Outdoor air pollution such as soot and SO_2 is also at generally lower levels in the northern parts of the country [9]. On the other hand, a basic environmental variable such as the temperature pattern has an obvious association with morbidity, with gradually colder temperatures northwards in the country [10]. As the geographical pattern of prevalence developed over time, a process can be assumed, through which additional background variables are included. One such variable, highly influenced by the outdoor temperature, is the indoor environment.

During recent decades, significant changes in the indoor environment have taken place in Sweden. New building materials were gradually introduced from the mid-1950s, followed by energy saving techniques in the 1960s. These were mainly based on decreased ventilation, and reached their maximum scope during the 1970s. As a consequence of this process, chemical pollution from new building materials [11] has been kept indoors by efficient insulation, more intensely applied in colder climates. Low ventilation may also increase the relative humidity and so cause mold damage [12]. In the northern part of Sweden, however, the indoor relative humidity is usually low and the dry indoor air is a general problem in the cold winter climate which lasts 6-9 months of each year. Viral infections are reported to be more frequent both in dry indoor air (<40% RH) and in more poorly ventilated environments [12]. Such infections in small children are common trigger factors of bronchial obstruction [13] and can induce IgE-production [14] with unknown consequences in respect of future allergic disease. Although the periods of the year for construction of the houses were chosen to distinguish between different technical

measures carried out in Sweden (C. Sjöström, National Swedish Institute for Building Research, pers. comm.), no correlation was found between the age of the housing and morbidity. This result might be biased by the influence of insulation and renovation of old houses with new materials, common measures during the 1970s which should have equivalent consequences to the year of construction. To further elucidate this matter, detailed information about character and duration of different exposure would be required.

A marked difference in the prevalence of both asthma and AR was found between the two cohorts. From Sweden there are no reports hitherto of increasing prevalences of these diseases, although statements to that effect have been made [15]. From the U.K. [2] and New Zealand [16], increasing figures of asthma prevalence in school children during recent decades have been reported, and the discussion has centred on whether the increase is real or due to previous under-diagnosis. In the present study, a growing awareness of the diseases would not explain the pattern higher increase with more northerly regions in the country. In fact, the northern region has a more or less permanent shortage of medical staff, which should act in the opposite direction. Consequently, these conditions substantially support the assumption of a real increase in the diseases.

Factors discussed in relation to geographical variation of the diseases also apply to the total increase during the period. Exposure to common allergens has not increased in Sweden but possible adjuvant factors, such as different kinds of chemical pollution have increased. Continuing urbanization also implies increased exposure to local air pollution, such as automobile exhausts, which have been reported as an adjuvant factor to pollinosis [17]. Urban living was the only factor, except for geographical variation, found to be related to a higher prevalence of both asthma and AR [6,18,19], with the trend being most pronounced for AR. To some extent urban living may imply selection with regard to skilled professions, in which a higher incidence of hay fever was already noted by Blackley in the 19th century [20]. The positive correlation between AR and high performance in intelligence tests as well as the lower prevalence of the disease in overcrowded conditions might be interpreted as a reflection of the same phenomenon. The high prevalence of AR in small apartments cannot be understood in these terms. Rather, it suggests multiple heterogenous background factors.

The principal feature of the increase in prevalence of the diseases, however, was the trend to a higher increase towards the north of the country. This cannot be ascribed to factors related to urban living, especially as no difference in morbidity between towns and countryside

was found in the northern region. In fact, no influence of the living and housing factors was stronger in the northern regions. The outdoor temperature probably interferes with the diseases in terms of some still unrecognized environmental factors dominating over other factors studied. One important field in this context is the changing indoor environment, a complex subject essentially remaining to be assessed.

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