

Birth season variation in asthma and allergic rhinitis

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Summary

The prevalence of asthma and allergic rhinitis was analysed in relation to birth month in two cohorts of 18-year-old males born in 1953 ($n = 55\,393$) and 1963 ($n = 57\,150$), in schoolchildren ($n = 19\,814$) and in children with defined specific allergies ($n = 1080$). Among the 18-year-olds, a marked variation with respect to birth season was only found in those born in 1963, with the highest prevalence of asthma in those born August–January and of allergic rhinitis in those born November–May. In the schoolchildren with allergic rhinitis the birth season pattern was found to be similar to that in the conscripts born in 1963. The influence of month of birth on the onset of allergic rhinitis was maximum about 6 years of age and was not seen before 2, and after 10 years of age. Obvious similarities in birth season patterns were found between the unselected populations and the children with defined pollen and animal dander allergies. The differences in birth season pattern between the two cohorts of 18-year-olds were interpreted as an effect of unidentified adjuvant factors that might have developed over a 10-year period.

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Introduction

Studies on the relation between birth month and allergic disease have indicated that allergen exposure in early life seems to be important for later development of specific allergies [1–3]. Children born 3–6 months before the birch pollen season have shown an increased risk of allergy to birch pollen in adolescence [4,5]. In students with ragweed allergy, exposure during the first weeks of life has proved to be of importance [6]. In other studies it has not been possible to demonstrate an increased prevalence of grass pollen allergy after early exposure [3,7] and, especially in asthma, the subject of birth month influence remains controversial [8].

Geographical variation in the prevalence of asthma and allergic rhinitis in Sweden has been described in schoolchildren [9] and military conscripts [10]. In conscripts, the geographical differences seem to have developed over recent decades as a prominent feature of a total increase in these diseases. The pattern of increasing prevalence could not be explained in terms of allergen exposure, such as pollen or animal dander. An obvious association between an increase of prevalence and cold

climate suggested influence from as yet unidentified factors [10].

The present study describes the variation of prevalence of asthma and allergic rhinitis with birth month in the large unselected populations of schoolchildren and conscripts mentioned above [9,10]. As reference, a group of children with established diagnoses of airway allergies from a paediatric allergy clinic was selected.

Subjects and methods

The month of birth was analysed in relation to present symptoms of asthma and allergic rhinitis in the populations described in Table 1. The conscripts and the schoolchildren have been described in detail in previous papers [9,10]. Both represented total populations investigated by means of questionnaires. The schoolchildren were from three different geographical areas of Sweden [9] and the conscripts comprised entire Swedish male age classes [10]. The information on the conscripts was derived from the computer records of the compulsory military examinations. The geographical distribution of the conscripts born in 1963 represented areas of birth and was based on four distinct steps of prevalence of allergic rhinitis at 18 years of age, with higher prevalence in each more northerly area in the country [10].

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Table 1. Populations studied

Group (subgroup)	Sex	Age	Year of birth	n
Conscripts	Male	18	1953	55 393
Conscripts	Male	18	1963	57 150
Region 1(south)				8414
Region 2 + 3(middle)				43 944
Region 4(north)				4596
Schoolchildren (Gothenburg)	Male-female	7-14	1964-72	19 814 (11 766)
Allergy Clinic	Male-female	3-16	1963-84	1080
Allergic rhinitis with allergy to pollen				613
Pollen rhinitis without concomitant asthma				394
Asthma with allergy to animal dander				463
Asthma or allergic rhinitis with allergy to house dust mite				69

Asthma was defined as heavy breathing and/or wheezing with no other disease as the origin of symptoms, and with a history of one or more attacks during the last year. Allergic rhinitis was defined as recurrent or chronic rhinitis and/or conjunctivitis related to allergen exposure, and with symptoms present during the last year. The reported symptoms in the schoolchildren were evaluated both in relation to collection of the answered questionnaires [9] and in a thorough check up of hospital files of children with asthma in one of the three areas [11]. More than 95% accuracy of the reported symptoms was obtained. The diagnoses in the routine military registration are made by a physician at an interview and physical examination when the reported symptoms from the health questionnaire are evaluated. In a special study of conscripts in Gothenburg in 1981 ($n=1187$) the same questionnaire as in the school study was used and followed by a personal interview by the author. The prevalences of both asthma and allergic rhinitis were found to be higher than in the routine military registration of diagnoses, the latter missing 1/5 of the cases. In principle, all diagnoses of present symptoms should have been noted in the routine registration, even those not expected to affect military service. In practice, slight and sporadic symptoms might have been ignored, either because of difficulties in evaluation or because of conscious

under-reporting by the recruits, who did not want to affect their own opportunities for advancement adversely.

In order to obtain a reference population with defined allergies, consecutive records of children attending the Asthma and Allergy Unit, Department of Pediatrics, Gothenburg University from 1979-86 were studied. This unit is the only referral clinic covering the population of Gothenburg schoolchildren. Children were included who were allergic to inhaled allergens, as established by both history and skin-prick test or RAST. The birth season distribution of specific allergies in this group was adjusted for the distribution of births in the schoolchildren from Gothenburg. The seasons used were based on the mean temperature [12] with the coldest months (December-February) as winter, the warmest months (June-August) as summer, and spring (March-May) and autumn (September-November) as intermediates. The mean annual temperature ranged from 7.2°C in the southernmost to 0.9°C in the northernmost region. The regional differences were at their maximum in winter and virtually absent in summer.

The computer processing and statistical analyses were made at Gothenburg Universities' Computing Centre with the statistical package, SAS. In analyses of the statistical significance of group differences the chi-square test was used, or for parametrical variables, the *t*-test. In

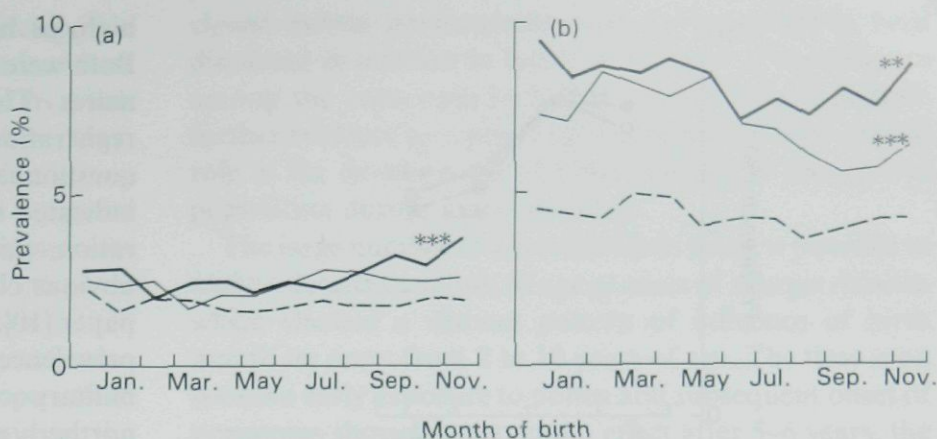


Fig. 1. Prevalence of (a) asthma and (b) allergic rhinitis in conscripts born in 1953 (---) and 1963 (—) and in schoolchildren (···) expressed as a percentage of all children born each month. ** $P < 0.01$, *** $P < 0.001$; indicates the significance of the total birth month differences (Chi-square test, d.f. = 11).

evaluation of the differences between the geographic areas, the General Linear Model (GLM) procedure was also used.

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

Results

The prevalence of asthma and allergic rhinitis in the different birth month cohorts is shown in Fig. 1. In the conscripts born in 1953 no significant birth month variation was found, either for asthma or for allergic rhinitis. In the conscripts born in 1963 a birth month variation was obvious for both diseases. For asthma there was an increased prevalence in those born from August to January ($P < 0.001$). For allergic rhinitis an increased prevalence was found in those born from November to May ($P < 0.001$). In the schoolchildren no significant birth month variation was found for asthma prevalence but the prevalence of allergic rhinitis showed a marked birth month variation, with a pattern similar to the conscripts born in 1963.

When the conscripts born in 1963 were divided into geographical regions with different prevalence of allergic rhinitis [10], the birth season variation of the prevalences of allergic rhinitis was as shown in Fig. 2. The two middle regions of Sweden showed identical patterns and were therefore combined. This area provided the majority of the conscripts and showed a birth month pattern similar to that shown in Fig. 1 for all the conscripts born in 1963. In the southernmost region there was a peak only in spring, and the winter peak seen in most of the country was absent. In the northernmost region, on the other hand, the highest prevalence was found in individuals born in autumn. Thus, the difference between south and north was highest for those born in autumn and winter ($P < 0.001$, GLM).

With regard to the children in the Gothenburg area (Fig. 3), the birth season variation of allergic rhinitis was

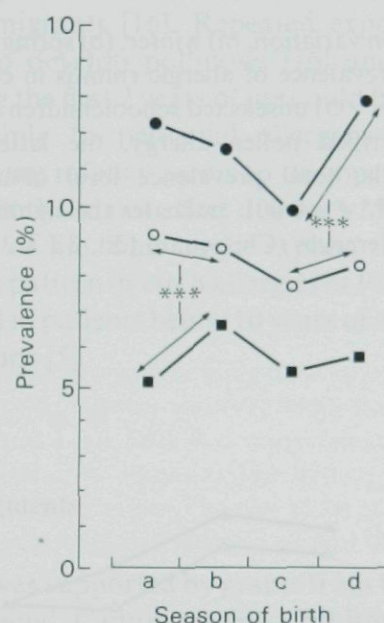


Fig. 2. Prevalence of allergic rhinitis in conscripts in the northern (●), middle (○) and southern (■) regions in relation to birth season in 1963; (a) winter, (b) spring, (c) summer, (d) autumn. *** $P < 0.001$, refers to the significance of the geographic divergence of the differences (↔) between two consecutive birth seasons (t -test).

almost identical in the reference group with verified pollen allergy and in the unselected group of schoolchildren. In the children with verified pollen allergy without concomitant asthma, or allergy to animal dander, a still higher spring peak and autumn dip (ratio 2:1) was found. In the reference group of children with asthma, animal dander was the dominating allergen, and this allergy showed a birth season variation, with a higher level in autumn–winter birth and a lower level in spring–summer birth (ratio autumn–winter/spring–summer 1.25:1; $P < 0.001$). No other combination of symptoms and specific allergies showed any birth season variation.

Boys and girls showed the same birth month pattern of allergic rhinitis, and this was not influenced by heredity, breast-feeding or current animal keeping at school age.

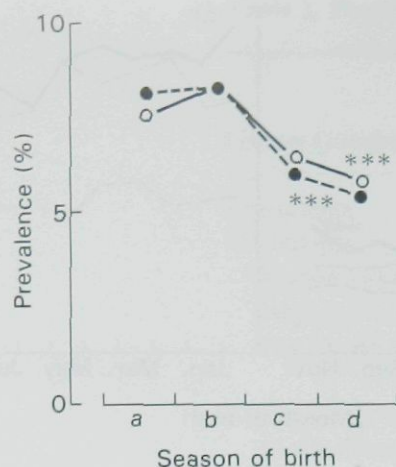


Fig. 3. Birth season variation, (a) winter, (b) spring, (c) summer, (d) autumn, of prevalence of allergic rhinitis in children from Gothenburg; (○—○) unselected schoolchildren and (●—●) children with verified pollen allergy, the latter a relative distribution of the total prevalence level obtained in the schoolchildren. *** $P < 0.001$, indicates the significance of the total seasonal differences (Chi-square test, d.f. = 3).

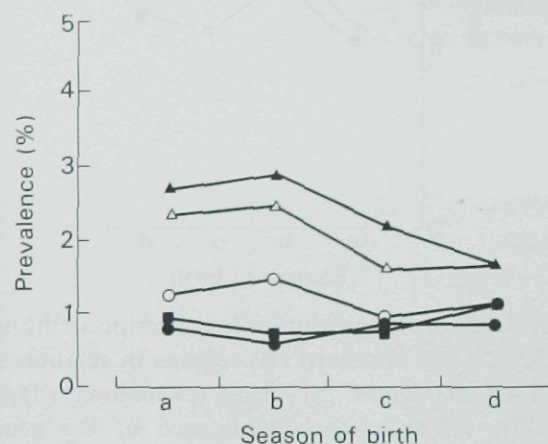


Fig. 4. Birth season variation, (a) winter, (b) spring, (c) summer, (d) autumn, of prevalence of allergic rhinitis in schoolchildren in relation to age at onset. (●) 0-1, (○) 2-3, (▲) 4-6, (△) 7-10, and (■) ≥ 11 .

The reported age at onset of allergic rhinitis in the schoolchildren was analysed in relation to birth season (Fig. 4). The age at onset for children with a similar birth season pattern was combined into five groups. The birth month variation increased gradually from onset at 2 years of age and was most pronounced in allergic rhinitis with onset of symptoms around 6 years of age. Onset before 2 and after 10 years of age was not influenced at all by birth season.

Discussion

The accuracy of the diagnoses of asthma and allergic rhinitis in Swedish schoolchildren and conscripts was

high, as has been discussed in previous papers [9-11]. Both were total populations investigated using questionnaires. The comparison between the routine military registration and the conscripts investigated by the school questionnaire and subsequent interview by the author indicated some degree of selection in the routine registration; this was probably a selection of cases of more obvious clinical significance, as discussed in a previous paper [10]. This previous paper describes the increase in prevalence of asthma and allergic rhinitis between the two military cohorts, with a higher increase with more northerly region in the country. The finding of developing geographical differences in prevalence was the main argument for a real increase, not substantially biased by increased awareness between 1971 and 1981 [10]. The appearance of birth season variation in the cohort born in 1963 and not in the cohort born in 1953 provides further evidence to the validity of the increases in prevalence. The main increase in asthma prevalence occurred in those born in autumn-winter, a pattern which could not be biased by increased awareness; nor could the developing birth season pattern in prevalence of allergic rhinitis, contributing to a substantial part of the geographical variation of the increase. Rather, the findings indicate increases in prevalence of the diseases influenced by factors with marked geographical and seasonal variations. The birth season variations described in this paper are of the same size as the effect of early birch pollen exposure on subsequent development of birch pollen allergy [5]. It can be assumed that factors of importance for the birth season variation also have an effect throughout childhood with a subsequent increase in prevalence, independent of birth month. The environment during the relatively short period of the first months of life therefore appears to be vital for studies in relation to development of allergic diseases.

The obvious birth season variation found in children with asthma and animal dander allergy was not seen in the unselected material of schoolchildren. The reason for this discrepancy can probably be ascribed to the heterogeneity of the schoolchildren population, consisting of children both with and without specific allergies. In the conscripts a birth month variation of asthma prevalence developed over a 10-year period, a variation similar to the one found in children with animal dander allergy. The fact that a birth season variation was found in the conscripts and not in the schoolchildren might depend on a selection of asthma in the conscripts, in terms of an under-reporting of disease of lower clinical significance in the routine military registration [10].

Pollen allergy was the dominating allergy in allergic rhinitis, both in the children with verified allergies and in the conscripts [10]. A peak of prevalence in spring births

might be expected, in analogy with studies on birch pollen allergies in Finland [5]. The pollen period in Sweden starts with hazel and alder in March–April followed by birch pollen as the dominating allergen with a peak in May, often with more than 1000 pollen grains/m³. From June to August there are lower levels of grass and mugwort pollens (<100 pollen grains/m³). All pollens are less numerous in the northern area [S. Nilsson, personal communication]. The marked birth month variation of allergic rhinitis found in the schoolchildren was also dominated by a peak in February–May. The period of birth with high prevalence of allergic rhinitis in the conscripts born in 1963, from November to May, was more extended than the period of increased sensitivity to pollen reported from Finland [4,5]. The highest prevalence of allergic rhinitis in the main part of the country was actually found in those born in winter (December to February). The absence of this winter peak in the southernmost region, as well as the finding of the highest prevalence in those born in autumn in the northernmost region, indicates climate-related factors potentiating the effect of early allergen exposure, particularly considering the relatively low pollen exposure in the northernmost region.

The differences in birth season pattern between asthma and allergic rhinitis are probably a reflection of differences in aetiology. Allergic rhinitis was related to pollen allergy in 80% of cases [10] and asthma more to perennial allergens. Bronchial hyperreactivity and the role of viral infections in the pathogenesis of asthma [13,14] may also be of importance in this respect. Other studies on the subject of birth season and allergic diseases have centered only on the influence of specific allergens [1–6]. The fact that birth season variation developed over a 10-year period concomitant with a geographically related increase in the prevalence of asthma and allergic rhinitis, indicates environmental influences other than allergen exposure only. The latter has not changed over the period in question, neither has the outdoor climate, but new factors in the indoor environment appearing between 1953 and 1963 might have potentiated the effect of the allergens present. One consequence of the climate in Sweden is that the children born in autumn or winter spend more time indoors during their first 6 months of life than the children born in spring or summer. This early exposure to indoor environment increases with the longer and colder winter period in each more northerly region in the country, which also implies that people live in a more closed indoor environment, especially because of energy saving measures undertaken in recent decades. In addition, new building materials have been introduced that emit substances which have been related to 'sick building syndrome' [15]. Such factors are more concentrated in

closed indoor environments and have previously been discussed in relation to the total increase of the diseases among the conscripts [10]. The present results provide further evidence to support the hypothesis of their central role in the development of these diseases in the general population during recent decades.

The large number of schoolchildren made it possible to make a detailed analysis of age at onset of allergic rhinitis, which showed a distinct pattern of influence of birth month on onset from 2 to 10 years of age. The time span between early exposure to pollen and subsequent onset of symptoms showed a maximum effect after 5–6 years, the same mean period as observed in sensitization to ragweed in U.S. immigrants [16]. Repeated exposure is usually necessary to develop pollinosis [16] and children with onset during the first 2 years of life could be assumed to be allergic mainly to perennial allergens. The effect of priming during infancy seems to disappear over time, as the birth month did not affect disease with onset after the first decade of life. This might explain the fact that the birth month pattern in birch allergies in Finland was more pronounced in patients below 10 years of age than in older patient groups [5].

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