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The Prevalence of Allergic Diseases in Poland – the Results of the PMSEAD Study in Relation to Gender Differences

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Abstract

Background. Males and females exhibit different susceptibility to allergic diseases.

Objectives. The aim of the study was to evaluate gender-related differences in the prevalence of allergic diseases in Poland.

Material and Methods. To evaluate this problem, data from the Polish Multicenter Study of the Epidemiology of Allergic Diseases (PMSEAD) was analyzed. There were assessed 16,238 individuals, aged 3 to 80 years, among them 12,970 adults and 3,268 children.

Results. In adults the prevalence of asthma was 5.4%, seasonal allergic rhinitis 8.5%, persistent allergic rhinitis 3.0%, atopic dermatitis 1.6%, contact dermatitis 2.0%, and drug allergy 8.6%. In children asthma was diagnosed in 8.6% of the individuals assessed, seasonal allergic rhinitis in 8.6%, persistent allergic rhinitis in 2.1%, atopic dermatitis in 4.7%, contact dermatitis in 1.1% and drug allergy in 8.9%. Among the children in the sample, significantly higher prevalence rates were found in boys than in girls for asthma (10.9% vs. 6.3%; OR = 1.81; $p < 0.001$), seasonal allergic rhinitis (9.8% vs 7.4%; OR = 1.37, $p = 0.018$) and persistent allergic rhinitis (2.6% vs. 1.5%; OR = 1.74, $p = 0.029$). When comparing the differences by gender among adults, there was a lower proportion of male than female subjects suffering from asthma (4.9% vs. 5.8%; OR = 0.83, $p = 0.018$), seasonal allergic rhinitis (7.6% vs. 9.3%; OR = 0.81, $p = 0.001$), atopic dermatitis (1.1% vs. 2.0%; OR = 0.53, $p < 0.001$), contact dermatitis (1.1% vs. 2.8%; OR = 0.39; $p < 0.001$) and drug allergy (5.1% vs. 11.6%; OR = 0.41, $p < 0.001$).

Conclusions. The opposite susceptibility to allergic diseases among children and adults may indicate that sex hormones play an important role in this phenomenon (*Adv Clin Exp Med* 2014, 23, 5, 757–762).

Key words: allergic diseases, prevalence, gender differences.

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The expression of many diseases is commonly viewed as an interaction between genetic predisposition and environmental influences. Among the genetic factors, gender has frequently been evaluated. In particular, sex differences have been clearly shown to be important in the development of autoimmune diseases, with females comprising approximately 75% of all cases [1]. Data concerning allergic diseases are more ambiguous [2]. While many studies have evaluated the association between specific genetic variants and allergic diseases in general, relatively few studies have assessed the role that sex might play in modifying these associations, although some lines of evidence suggest that sex may influence the expression and course of allergic diseases [3–6]. Therefore, an individual's gender specific susceptibility to suffer from allergies is still worth comprehensive investigation.

To evaluate this problem, data from the Polish Multicenter Study of the Epidemiology of Allergic Diseases (PMSEAD) was analyzed. The PMSEAD, designed under the auspices of the Polish Society of Allergology, was carried out from 1998 to 1999. The study was approved by the Ethics Committee of Wroclaw Medical University (Wroclaw, Poland). The aim of this report is to evaluate the prevalence of asthma, seasonal allergic rhinitis, persistent allergic rhinitis, atopic dermatitis, contact dermatitis, and drug allergy in relation to gender differences.

Material and Methods

The PMSEAD study protocol has been described in detail elsewhere [7]. Data collection was started in 1998 and completed in 1999. The study population encompassed individuals of both sexes, including children (3–16 years) and adults (17–80 years) living in 11 selected areas throughout Poland. Cluster random sampling of the study subjects was applied in each selected area. Home addresses were drawn by lottery to obtain a total of around 600 residents in a sample that included individuals of both genders aged 3–80. The planned

number of subjects in each region was 1500 and the total sample size was 16,500. Five different questionnaires were used: 1) a residential questionnaire, 2) a screening questionnaire for adults, 3) a detailed questionnaire for adults, 4) a questionnaire for children and 5) a questionnaire for subjects not responding, to determine the reasons for their absence or refusal. The questionnaires were completed by trained personnel (medical students or nurses) at the homes of selected subjects. In the case of young children, the information was taken from their parents. In each area diagnoses were established by a single countrywide recognized expert in allergy on the basis of the collected data and the available medical documentation.

The data are presented as prevalence rates with corresponding 95% confidence intervals (CI), and as arithmetic means (SD). Differences between proportions were assessed by a χ^2 test with odds ratios (OR). A *p* value < 0.05 was considered statistically significant. All statistical evaluations were carried out using STATISTICA 10 software.

Results

Complete and reliable data were obtained from a total of 16,238 individuals (98% of the predicted sample size), among them 12,970 adults (5939 men and 7031 women) with a mean (SD) age of 42.8 (17.0) years and 3268 children (1666 boys and 1602 girls) aged 9.4 (3.7) years (Table 1). This was 70.5% of the 18,378 individuals living at the sampled home addresses.

Mean age and gender in the adult sample were very similar to the total Polish population in the same age range [8]. In the case of children, the sample surveyed was slightly younger (population mean age = 10.1, SD = 4.0) and had a slightly lower proportion of boys (51.0% vs. 56.2% in total population).

Among adults the prevalence of asthma was 5.4%, seasonal allergic rhinitis 8.5%, persistent allergic rhinitis 3.0%, atopic dermatitis 1.6%, contact dermatitis 2.0% and drug allergy 8.6% (Table 2). Among children, asthma was diagnosed in 8.6% of

Table 1. Demographic characteristics of the sample examined

	Adults			Children		
	overall	male	female	overall	boys	girls
Number of subjects examined	12,970	5939	7031	3268	1666	1602
Age – years x ± SD	42.8 ± 17.0	41.6 ± 16.6	43.8 ± 17.2	9.4 ± 3.7	9.5 ± 3.7	9.3 ± 3.7

x – arithmetic mean; SD – standard deviation.

Table 2. Prevalence of allergic diseases

	Adults (n = 12,970)	Children (n = 3268)
Disease	n % (95% CI)	n % (95% CI)
Asthma	702 5.4 (5.0–5.8)	282 8.6 (7.7–9.6)
Seasonal allergic rhinitis	1106 8.5 (8.0–9.0)	282 8.6 (7.7–9.6)
Persistent allergic rhinitis	390 3.0 (2.7–3.3)	67 2.1 (1.6–2.5)
Atopic dermatitis	203 1.6 (1.4–1.8)	154 4.7 (4.0–5.4)
Contact dermatitis	262 2.0 (1.8–2.3)	35 1.1 (0.7–1.4)
Drug allergy	1115 8.6 (8.1–9.1)	290 8.9 (7.9–9.8)
Allergic diseases	2431 18.7 (18.1–19.4)	751 23.0 (21.5–24.4)

Table 3. Prevalence of allergic diseases in children in relation to gender

Disease	Prevalence		p	OR (95% CI)
	male n % (95% CI)	female n % (95% CI)		
Asthma	181 10.9 (9.4–12.4)	101 6.3 (5.1–7.5)	< 0.001	1.81 (1.39–2.35)
Seasonal allergic rhinitis	164 9.8 (8.4–11.3)	118 7.4 (6.1–8.6)	0.018	1.37 (1.06–1.77)
Persistent allergic rhinitis	43 2.6 (1.8–3.3)	24 1.5 (0.9–2.1)	0.029	1.74 (1.03–2.97)
Atopic dermatitis	81 4.9 (3.8–5.9)	73 4.6 (3.5–5.6)	0.681	1.07 (0.76–1.50)
Contact dermatitis	19 1.1 (0.6–1.7)	16 1.0 (0.5–1.5)	0.694	1.14 (0.56–2.34)
Drug allergy	150 9.0 (7.6–10.4)	140 8.7 (7.4–10.1)	0.790	1.03 (0.81–1.32)
Allergic diseases	428 25.7 (23.6–27.8)	323 20.2 (18.2–22.1)	< 0.001	1.37 (1.16–1.62)

p – probability; OR – odds ratio; CI – confidence interval.

the sample, seasonal allergic rhinitis in 8.6%, persistent allergic rhinitis in 2.1%, atopic dermatitis in 4.7%, contact dermatitis in 1.1% and drug allergy in 8.9%.

Among the children in the sample (Table 3), significantly higher prevalence rates were found

in boys than in girls for asthma (10.9% vs. 6.3%; OR = 1.81, $p < 0.001$), seasonal allergic rhinitis (9.8% vs. 7.4%; OR = 1.37, $p = 0.018$) and for persistent allergic rhinitis (2.6% vs. 1.5%; OR = 1.74, $p = 0.029$). There were no significant gender differences in the remaining allergic diseases analyzed.

Table 4. Prevalence of allergic diseases in adults in relation to gender

Disease	Prevalence		p	OR (95% CI)
	male n % (95% CI)	female n % (95% CI)		
Asthma	291 4.9 (4.4–5.4)	411 5.8 (5.3–6.4)	0.018	0.83 (0.71–0.97)
Seasonal allergic rhinitis	453 7.6 (7.0–8.3)	653 9.3 (8.6–10.0)	0.001	0.81 (0.71–0.92)
Persistent allergic rhinitis	162 2.7 (2.3–3.1)	228 3.2 (2.8–3.7)	0.087	0.84 (0.68–1.03)
Atopic dermatitis	63 1.1 (0.8–1.3)	140 2.0 (1.7–2.3)	<0.001	0.53 (0.39–0.72)
Contact dermatitis	66 1.1 (0.8–1.4)	196 2.8 (2.4–3.2)	<0.001	0.39 (0.29–0.52)
Drug allergy	301 5.1 (4.5–5.6)	814 11.6 (10.8–12.3)	<0.001	0.41 (0.35–0.47)
Allergic diseases	868 14.6 (13.7–15.5)	1563 22.2 (21.3–23.2)	<0.001	0.60 (0.55–0.66)

p – probability; OR – odds ratio ; CI – confidence interval.

However, due to the proportions found for allergic airway diseases, the overall prevalence of analyzed allergic disorders reached statistical significance in favor of boys.

When comparing the differences by gender among adults (Table 4), there was a lower proportion of male than female subjects suffering from asthma (4.9% vs. 5.8%; OR = 0.83, $p = 0.018$), seasonal allergic rhinitis (7.6% vs. 9.3%; OR = 0.81, $p = 0.001$), atopic dermatitis (1.1% vs. 2.0%; OR = 0.53, $p < 0.001$), contact dermatitis (1.1% vs. 2.8%; OR = 0.39, $p < 0.001$) and drug allergy (5.1% vs. 11.6%; OR = 0.41, $p < 0.001$). Only the occurrence of persistent allergic rhinitis was similar in both genders.

Discussion

The identification of gender-related prevalence rates for allergic diseases may have implications not only as theoretical knowledge; it may also be helpful during diagnostic and therapeutic procedures.

So far, the most consistent and reliable data are available for asthma. As in the current study, the prevalence of asthma has previously been reported to have male predominance only in childhood. A study carried out in Belgium found an increased prevalence of asthma as well as allergic rhinitis and eczema in primary school boys. In older boys,

aged 13–14, only asthma was more prevalent than in girls [9]. Similar findings were revealed in cross-sectional surveys in England, which found a higher prevalence of allergic rhinitis in prepubertal males [10, 11]. One of the most seminal studies was performed in Scotland and involved a population sample of 266,733 [12]. The prevalence of asthma in early childhood was significantly higher in boys, but by age 15 the diagnosis was reversed to female predominance. This gender bias remained consistent throughout adulthood. Within the Global Allergy and Asthma European Network (GA²LEN) project, Almqist et al. [13] performed a Medline search for the words gender or sex, child, childhood or adolescence and asthma. It revealed that boys had more prevalent wheezing and asthma than girls. In adolescence, the pattern changed in favor of the female population. As a possible explanation for this switch, the authors suggested hormonal changes and gender-specific differences in environmental exposures.

In another study by Tollefsen et al. [14] the risk of reporting wheezing and asthma at the follow-up age of 17–19 was greater in girls compared to boys among subjects reporting no respiratory symptoms at the baseline age of 13–15. More girls than boys reported current wheezing at the follow-up, both among those with current wheezing (girls 60%, boys 48%) and previous wheezing (girls 33%, boys 28%) at baseline. In girls, the development of current wheezing was significantly associated with

current smoking (OR = 2.8) and stable current wheezing was significantly associated with being overweight (OR = 2.4). Similar associations were not significant in boys. The impact of smoking and being overweight may put girls at a higher risk of respiratory symptoms than boys.

The age- and gender-related pattern for allergic rhinitis was similar to that of asthma. Prevalence rates for this disease were higher in 6 – to 7-year-old boys than in girls [9]. This male predominance lasted up to age 15, then a reverse sex ratio was observed in post-pubescent girls and adult females [12]. Those data are slightly different from the findings of the Epidemiology of Allergic Disorders in Poland (ECAP) study performed in 2006–2008 [15, 16]. Samolinski et al. revealed that allergic rhinitis was more frequent (24.0%) in adult males aged 20–44 yrs than in females (21.2%). Possible reasons for the discrepancy between the studies may include different timing of the data collection and a smaller representation of individuals in middle and old age due to the narrow age range. The prevalence of eczema was evaluated in the International Study of Asthma and Allergies in Childhood (ISAAC) study and was lower in boys aged 6–7 (OR = 0.94) and 13–14 (OR = 0.72) than in girls [17]. Different results were obtained by Osman et al. [12], whose study of a Scottish population revealed that eczema was predominant in boys, but its prevalence diminished in adolescence and remained stable throughout adulthood. In contrast, in the female population the prevalence of eczema rose and was twice as frequent as in adult males. This phenomenon was observed until the age of 45–49 years, when rates equalized in both genders.

Gender differences in contact dermatitis have been the subject of very few epidemiological studies. Marinovic-Kulisic et al. [18] found that most common allergens were of similar relevance in contact dermatitis, regardless of the patients' age and sex. In contrast, the results of a German study indicated that contact dermatitis was more frequent in women than in men (50.2% vs. 29.9%, OR 2.36, CI 1.84–3.03), and that this involved fragrance mix, nickel, turpentine, cobalt chloride and thimerosal [19]. Gender-related drug allergy patterns have not been thoroughly studied, and the issue is awaiting further elucidation.

Compared to the reports in the available literature, the current study is the only one which provides complex data for a wide range of ages (from 3 to 80 years) on the gender proportions in the expression of a wide spectrum of allergic diseases including asthma, seasonal and persistent allergic rhinitis, atopic and contact dermatitis as well as drug allergies. The results obtained clearly show female predominance among adult subjects suffering from allergies. Even in the single case where the difference did not reach statistical significance (persistent allergic rhinitis, $p = 0.09$), women appeared to be at higher risk for this disorder than men (3.2% vs. 2.7%). In contrast, in the sample of children, the overall prevalence of allergic diseases was higher among boys, but this was due solely to the proportions found for allergic airway diseases (asthma and rhinitis). The current study needs to be compared with the results of the ECAP project, which collected data in 2006–2008 [20]. A comparison of the 2 studies could clarify whether the general development of civilization may influence gender differences in the prevalence of allergic diseases.

The most compelling message from the striking contrast in predispositions to allergy in childhood and adulthood is that sex hormones may play the substantial role in this phenomenon, although gender-specific lifestyles and job patterns cannot be neglected.

Female sex hormones have long been postulated to have a stimulating effect on allergic reactions. Recently, it has been shown in 2 experimental studies [21, 22] that estradiol and estrogen-like compounds stimulate (through a mast cell membrane estrogen receptor- α) the synthesis and release of allergic mediators. They also enhance IgE-dependent mast cell activation and degranulation. In turn, treatment of female rats with tamoxifen, the estrogen receptor antagonist, reduced the development of allergic airway diseases [23].

Very little is known about androgen receptor expression and function on human mast cells. Chen et al. have shown that androgen receptors are present on these cells. However, testosterone treatment did not influence mast cell degranulation [24].

Further investigations are needed, particularly studies performed on human mastocytes and other immunologically active cells, as well as clinical studies, to elucidate more clearly the pathogenesis of gender-related expression of allergic diseases.

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