Increased healthcare utilisation among atopic children compared to non-atopic children in general practice

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Submitted

Abstract

Purpose: To investigate the use of general practice resources (i.e. consultation visits, telephone contacts and home visits) in children with physician-diagnosed atopic disorders compared with non-atopic children.

Method: All children (aged 0-18 years) listed in a representative general practice database were selected in 2014. Children diagnosed with atopic eczema, asthma, allergic rhinitis or 'having all three atopic disorders' were matched on age and gender with non-atopic controls within the same practice. For all these different groups, the number and frequency of children contacting the general practitioner (GP) were calculated.

Results: Of the children with atopic eczema (n=15,202), 80% consulted the GP compared with 67% of their matched controls. Also, of the asthmatic children (n=7,754) 80% consulted the GP compared with 65% of their matched controls, and for children with allergic rhinitis (n=6,710) this was 82% (controls: 66%). Children with all three atopic disorders consulted the GP most often in 2014 (91%), compared with 68% of their matched controls. On average a child with atopic eczema contacted the GP 2.8 times a year (controls: 1.9), for asthmatic children the contact frequency was 3.0 (controls: 1.9), and for allergic rhinitis 3.2 (controls: 1.9). For having all three atopic disorders the contact frequency was 4.3 (controls: 2.0). Consultations related to the atopic disorders investigated only explain a smaller part of the increased healthcare utilisation in atopic children.

Conclusions: Atopic children use more general practice resources compared to non-atopic children, although this is not explained by regular follow-up visits of the atopic children.

Background

Atopic eczema, asthma and allergic rhinitis (AR) are among the most common chronic disorders in children (1, 2). As they are all associated with atopy (i.e. the tendency to develop an IgE-mediated immune response to allergens) they are often referred to as 'atopic disorders'. Although these atopic disorders in children represent a burden on general practice resources, the extent to which is largely unknown. A recent study examined healthcare utilisation in atopic children in a general practice setting. This study, based on health surveys, showed that children with atopic eczema, asthma, and AR used more healthcare resources than children without these disorders (3). However, questionnaire-based diagnoses cannot be simply inter-changed with physician-based diagnoses (1). When studying healthcare utilisation in a general practice setting, a diagnosis based on a physician's assessment, e.g. general practitioner (GP), provides more realistic results and should therefore be preferred. Previous studies examining healthcare utilisation of atopic children were often conducted in different clinical settings (e.g. birth cohorts). Also, whereas most of the studies on healthcare utilisation have focused on asthma (3-9), only a few focused on atopic eczema (3, 10) and allergic rhinitis (3). All these studies demonstrated that the healthcare utilisation of atopic children is significantly higher compared with non-atopic children. However, to our knowledge no study has examined to what extent this increased use of healthcare resources reflects extra consultations regarding the atopic disorders (e.g. consultations for follow-up), or reflects consultations regarding (non-)atopic comorbidity (e.g. consultations for common symptoms occurring in childhood).
Additional knowledge on healthcare utilisation in general practice is important for the planning of healthcare services and the workforce required. Therefore, the present study aimed to quantify the current health burden posed by atopic eczema, asthma, AR and children having all three atopic disorders, on general practice resources, as based on electronic health records. Furthermore, a differentiation is made between atopic-related consultations and non-atopic related consultations.

Methods

NIVEL Primary Care Database

Generally, all non-institutionalized residents in the Netherlands are registered in a general practice, even if they do not contact the GP. Since 2001, NIVEL-Primary Care Database (NIVEL-PCD) includes routinely extracted data from electronic

health records (EHRs) from a representative sample of Dutch general practices (11), including information about declared encounters, prescribed medication, and diagnoses. Diagnoses were recorded and classified according to the International Classification of Primary Care 1 (ICPC-1) (12). In 2014, we used data from all NIVEL-PCD practices (at least 500 listed patients; standard practice size: 2,350 patients) with sufficient data quality, fulfilling the following criteria: complete medical and financial registration of encounters (defined as ≥ 46 weeks per year), and sufficient ICPC coding of diagnostic information (defined as ≥ 70% of the recorded encounters with an ICPC code). An additional requirement was a minimum follow-up of three years for an individual child (e.g. data had to be available for 2012-2014), to reduce the risk of registration bias; for this reason, only data for children aged ≥ 2 years are presented here.
Dutch law allows the use of extracts of EHRs for research purposes under certain conditions. According to Dutch legislation, for the present type of observational study, neither informed consent nor approval from a medical ethics committee was required (Dutch Civil Law, Article 7:458).

Atopic children

When available, the EHRs from 2002-2014 were examined to avoid missing any relevant atopic diagnosis made in the past. Since GPs inevitably work with probability diagnoses, there is a risk of misclassification. Therefore, ICPC codes (e.g. S87: atopic dermatitis; R96: asthma; R97: AR) and their related episodes of care were corrected to select cases with a higher probability of the clinically relevant disorder. This method is described in detail elsewhere (2). In practice, an atopic episode of care was maintained if (based on available data from EHRs in the period 2002-2014) the child had at least two contact moments in that episode of care (e.g. S87; R96; R97) and had received at least two relevant prescriptions. In the Dutch setting, prescriptions are linked with a code based on the Anatomical Therapeutic Chemical (ATC) Classification System, making the identification of these relevant prescriptions possible. For atopic eczema the ATC code D07 (dermatological corticosteroids) was used, for asthma the ATC code R03 (drugs for obstructive airway diseases) was used, and for allergic rhinitis the ATC codes R01AC (nasal preparation of antiallergic agents, excluding corticosteroids), R01AD (nasal preparation of corticosteroids) and R06 (antihistamines for systemic use) were used. These medication proxies have been tested by Mulder et al. using registered diagnoses as a gold standard (13). If the child did not meet these criteria, the child was considered not to have that atopic disorder. It was not a requirement that the patient had contacted the GP in 2014 for that specific atopic disorder.

Atopic triad

In contrast to the traditional classification of children with atopic eczema or asthma or AR, according to a meta-analysis a fourth distinct group of children, with all three atopic disorders, might exist (1). Therefore, 'atopic triad' episodes were developed for research purposes to learn more about this potentially unique group of children. An atopic triad was only defined when a child was diagnosed with all three atopic disorders (corrected to select cases with a higher probability of the clinically relevant disorder), based on available data from EHRs in the period 2002-2014.

Design

In a nested case-control study design, for each atopic child one matched control patient was selected (not diagnosed with an atopic disorder) within the same general practice, based on age and gender (in 2014). When studying children with atopic eczema, asthma or AR for this study, only those children that had one atopic disorder were selected.

Statistical analyses

In the Netherlands, a financial declaration is automatically created in the EHRs at the end of every consultation (i.e. consultation visits, telephone contacts and home visits; the ordering of repeat medication was excluded). Financial declaration recordings from the year 2014 where therefore used to determine healthcare utilisation in general practice. Diagnoses were linked with declared encounters on the same day. If a child consulted the GP for both an atopic-related problem as well as for a non-atopic-related problem, the declared encounter was considered atopic related. All patients aged between 0 and 18 years were selected. Two different epidemiological markers were calculated: i) the percentage of patients consulting the GP in one year, including the percentage of patients consulting the GP for the specific atopic disorder of interest, and ii) contact frequency, defined as the number of declared encounters overall, including the number of declared encounters for a specific atopic disorder in one year.

For the year 2014, health care utilisation and contact frequency rates were calculated for atopic eczema, asthma, AR and the atopic triad in males and females for the age groups 2-6 years, 7-12 years, 13-18 years and 2-18 years. For the analyses of children with either atopic eczema or asthma or AR, the child was not diagnosed with any of the other atopic disorders. Statistical differences between the groups were tested using chi-square tests (the percentage of patients consulting) and t-tests (contact frequency). Due to multiple testing, differences were considered statistically significant with a p-value < 0.001. All analyses were performed with Stata 14.1.

Results

General characteristics

In 2014, 409,312 children were identified from the NIVEL-PCD. From this group children were identified fulfilling the selection criteria with: i) only eczema (n=15,202), ii) only asthma (n=7,754), iii) only AR (n=6,710) and iv) all three atopic disorders (n=555). For all these atopic children, one control patient (not diagnosed with an atopic disorder) was matched. For this study, 307 different general practices were involved. Of the included children with only atopic eczema, only asthma, only AR and with all three atopic disorders, 48.2%, 58.9%, 57.9% and 61.6%, respectively, were male.
In both the atopic and non-atopic group, girls visited the GP more often compared with boys. When examining age in more detail, boys showed an overall decrease in consultation rates as they became older, whereas girls showed a dip in the consultation rate just before adolescence (7-12 years). Both these trends were the same in atopic as well as non-atopic children (Tables 1 and 2).

Children with only atopic eczema

In 2014, 80% of the children diagnosed with only atopic eczema consulted their GP, compared with 67% in the control group ($p<0.001$). Of the children with atopic eczema, only 24% consulted their GP because of their atopic eczema. When examining the contact frequency, children with atopic eczema consulted their GP on average 2.8 times/year, compared with 1.9 consultations a year in the control group (difference 0.9 times/year; $p<0.001$). The average contact frequency for atopic eczema-related consultations was only 0.4 times/year; therefore, 0.5 of the additional consultations a year were due to non-atopic related reasons for consultation. The differences in contact frequencies (presented here and also below) are not explained by the few children who consulted their GP very often.

Children with only asthma

In 2014, 80% of the asthmatic children consulted their GP (not having another atopic diagnosis), compared with 65% in the control group ($p<0.001$). Only 28% of the asthmatic children had asthma related consultations with their GP. Asthmatic children consulted their GP on average 3.0 times/year, compared to 1.9 consultations a year in the control group (difference 1.1 times/year; $p<0.001$). Since an asthmatic child consulted their GP for asthma-related problems only 0.5 times/year, this implies that an atopic child consults the GP 0.6 times/year extra for other morbidity.

Table 1 Healthcare utilisation in 2014 for children with only atopic eczema, only asthma, only allergic rhinitis (AD: atopic disorder).

	Total no. of children	Children consulting a GP (%) *		Children consulting a GP for disorder (%)	Contact frequency (contact/ year) *		Contact frequency for disorder (contact/ year)
	n	No AD	AD	AD	No AD	AD	AD
Atopic eczema							
Male	**14,662**	**66**	**78**	**22**	**1.8**	**2.6**	**0.3**
Male 2-6 years	6,264	72	84	24	2.1	3.0	0.4
Male 7-12 years	5,322	63	75	21	1.6	2.3	0.3
Male 13-18 years	3,076	60	73	23	1.5	2.2	0.3
Female	**15,742**	**68**	**81**	**26**	**2.1**	**3.0**	**0.4**
Female 2-6 years	5,728	71	82	27	2.1	3.0	0.4
Female 7-12 years	6,126	62	77	23	1.7	2.5	0.3
Female 13-18 years	3,888	72	85	31	2.5	3.6	0.5
Total group	**30,404**	**67**	**80**	**24**	**1.9**	**2.8**	**0.4**
Asthma							
Male	**9,132**	**62**	**78**	**27**	**1.6**	**2.7**	**0.5**
Male 2-6 years	2,174	72	86	32	2.1	3.4	0.6
Male 7-12 years	3,698	60	78	28	1.4	2.5	0.5
Male 13-18 years	3,260	59	73	23	1.5	2.3	0.4
Female	**6,376**	**69**	**83**	**30**	**2.2**	**3.5**	**0.6**
Female 2-6 years	1,440	73	86	35	2.3	3.5	0.7
Female 7-12 years	2,292	63	79	24	1.7	2.7	0.4
Female 13-18 years	2,644	73	85	32	2.5	4.2	0.7
Total group	**15,508**	**65**	**80**	**28**	**1.9**	**3.0**	**0.5**
Allergic rhinitis							
Male	**7,766**	**62**	**79**	**35**	**1.6**	**2.7**	**0.5**
Male 2-6 years	326	75	94	52	2.3	4.4	1.0
Male 7-12 years	2,682	64	82	42	1.6	2.8	0.7
Male 13-18 years	4,758	59	77	30	1.5	2.4	0.4
Female	**5,654**	**71**	**87**	**39**	**2.4**	**3.8**	**0.6**
Female 2-6 years	218	77	95	48	2.2	5.0	0.9
Female 7-12 years	1,608	63	82	41	1.7	3.0	0.7
Female 13-18 years	3,828	74	88	38	2.7	4.1	0.6
Total group	**13,420**	**66**	**82**	**37**	**1.9**	**3.2**	**0.6**

* All differences are significant ($p < 0.001$)

Table 2 Healthcare utilisation in 2014 for children with atopic triad (AT) (AR: allergic rhinitis).

	Total no. of children	Children consulting a GP (%) *		Children consulting a GP for eczema (%)	Children consulting a GP for asthma (%)	Children consulting a GP for AR (%)	Contact frequency (contact/year) *		Contact frequency for eczema (contact/year)	Contact frequency for asthma (contact/year)	Contact frequency for AR (contact/year)
	n	No AT	AT	AT	AT	AT	No AT	AT	AT	AT	AT
Male	**684**	**65**	**89**	**29**	**35**	**35**	**1.7**	**3.9**	**0.5**	**0.7**	**0.5**
Male 2-6 years	98	67	98	35	49	53	1.9	5.8	0.5	0.9	1.1
Male 7-12 years	352	66	89	27	35	32	1.6	3.6	0.5	0.6	0.5
Male 13-18 years	234	63	85	28	31	32	1.6	3.4	0.4	0.6	0.4
Female	**426**	**72**	**93**	**38**	**39**	**40**	**2.4**	**5.0**	**0.6**	**0.9**	**0.6**
Female 2-6 years	36	72	94	67	50	44	2.8	5.0	1.2	1.3	0.8
Female 7-12 years	166	70	94	31	37	39	1.7	4.3	0.5	0.7	0.6
Female 13-18 years	224	74	93	38	39	40	3.0	5.5	0.7	0.9	0.6
Total group	**1,110**	**68**	**91**	**32**	**37**	**37**	**2.0**	**4.3**	**0.5**	**0.7**	**0.6**

* All differences are significant ($p < 0.001$)

Children with only allergic rhinitis

In 2014, 82% of the children diagnosed with only AR consulted their GP (controls 66%; $p<0.001$). Of the children with only AR, 37% consulted their GP because of this condition. Contact frequency of children with AR was on average 3.2 times/year, compared with 1.9 consultations a year in the control group (difference 1.3 times/year; $p<0.001$). Therefore, 0.6 times/year, such a consultation can be attributed to AR, whereas 0.7 times/year this is due to other health related reasons.

Children with all three atopic disorders

In 2014, only a small group of children were identified as being diagnosed with all three atopic disorders, of which 91% consulted their GP (controls: 68%; $p<0.001$). Examining how often these children consulted their GP in 2014 for atopic eczema, asthma and AR, revealed percentages of 32%, 37% and 37%, respectively. The contact frequency of children with all three atopic disorders was on average 4.3 times/year, compared with 2.0 consultations a year in the control group ($p<0.001$). The contact frequency for atopic eczema-related consultations was 0.5 times/year. For asthma-related consultations this contact frequency was 0.7 and for AR it was 0.6. Therefore, of the excess consultation rate of 2.3 times/year in this group, 1.8 is caused by the three atopic disorders and 0.5 is due to non-atopic related reasons for consultation.

Discussion

Main findings

This study is the first to examine healthcare utilisation of all three atopic disorders in a general practice setting, using physician based diagnoses. This study contributes new and detailed data on the increased healthcare utilisation associated with atopic eczema, asthma, and AR in a representative sample of Dutch children, selected from a representative general practice database. Children with atopic disorders use more general practice resources compared with children without atopic disorders. Remarkably, the excess consultation rates in children with only atopic eczema, only asthma and only AR, are mainly due to (non-)atopic symptoms and diagnoses (i.e. not labeled as any of the studied atopic disorders). In children with all three atopic disorders, a comparable excess rate (0.5 times/year) is caused by this (non-)atopic morbidity, suggesting that excess morbidity occurred in all four groups at an equal frequency. Nevertheless, children with all three atopic disorders consulted the GP

most frequently, indicating that this might be a unique group. Atopic disorders did not explain the trends regarding age and gender, that were observed in the present study.

Interpretation of findings in relation to previously published work

Our findings are in agreement with other studies (3-10) that also concluded that atopic children utilised more healthcare; however, we extended their findings by examining whether the extra consultations are a result of a child's specific atopic disorder or are due to other symptoms or diseases. Based on the present study, ≤ 50% of the extra consultations can be explained by atopic eczema, asthma and AR-related consultations. Therefore, the remainder of the consultations can be attributed to other symptoms or diseases. Although part of these consultations could still be related to atopy (i.e. food allergy or symptoms of undiagnosed atopic disorders), also non-atopic-related morbidity will most likely explain an important part of it. Future research might further unravel the precise reasons for the increased healthcare utilisation.

In 2015, a Dutch child (aged 5-17 years) consulted the GP (on average) twice a year (14), which is in accordance with the contact frequency of the control groups in the present study and endorses the conclusions that atopic children utilise more healthcare due to their atopic constitution. In contrast, senior elderly (>85 years) had 13 consultations a year (14). Unfortunately, it is not possible to compare the healthcare utilisation of atopic children with other chronic conditions in paediatric patients. Diseases like diabetes, auto-immune disorders and other serious chronic diseases in children are treated by experienced physicians (e.g. paediatricians), since the prevalence rates of these diseases are too low for GPs to gain the necessary experience. Therefore, problems associated with these chronic conditions in children will most likely be handled in secondary healthcare. Healthcare utilisation of children with these chronic conditions in general practice can therefore not be compared with atopic disorders (that are mostly treated by GPs). However, when comparing healthcare utilisation of atopic disorders with adult patients with chronic obstructive pulmonary disease (COPD) and diabetes mellitus (DM), an interesting difference emerges. Of the atopic children, at least 24-37% consulted their GP once a year for their specific atopic disorder. This is substantially lower compared to the 54% of COPD patients consulting their GP for COPD-related problems at least once a year (15) or even the 85% of diabetic patients that consults the GP at least once a year for this disease (16). The most likely explanations for this observation is that, in the Netherlands, adult patients with COPD and DM receive routine follow-up consultations as a result of 'integrated multidisciplinary care'. Unfortunately, such a follow-up system is not implemented for paediatric patients in general practice.

However, identifying asthmatic patients with insufficient follow-up and improving their medication management in accordance with asthma clinical guidelines is likely to result in lower healthcare utilisation (5) and may improve the quality of life of these children. The Dutch asthma guideline for children recommended at least one evaluation a year (17). As shown by others (18, 19), unawareness and undertreatment of asthma and AR is common and needs to be addressed. The problem of undertreatment becomes even more relevant when considering that when, for example, AR is undertreated, this can have a negative impact on asthma control (20, 21). Therefore, we suggest that atopic children will probably benefit from better follow-up (e.g. as part of 'integrated multidisciplinary care') and thereby provide them with the care they deserve.

Children with all three atopic disorders seem to have a different phenotype compared with children having one atopic disorder (22); the present study is in agreement with the conclusions of previous reports. Children with all three atopic disorders consult their GP more often than children with only one disorder. Only a minority of the extra consultations can be attributed to the specific atopic disorders of these children, suggesting that also most of these children consult the GP for associated morbidity. Therefore, children with all three atopic disorders should be considered by GPs as a separate group requiring additional attention.

Study strengths and limitations

The present study used an extensive and representative primary care database; the number of included children gives this study substantial power. Data from databases are generally considered reliable and there is no risk of recall bias. Furthermore, the present study included only practices with complete data regarding declared consultations. Using physician-based diagnosis of atopic disorders and selecting cases with a higher probability of a clinically relevant disorder (at least 2 consultations and 2 relevant prescriptions) made this study highly relevant for studying healthcare utilisation in the general practice setting.

Some limitations also need to be discussed. The present study is based on the assumption that the relevant ICPC codes are not missed; however, this risk cannot be excluded, neither can it be quantified. This study also lacks an objective measure of atopic disorders, such as lung function or allergy tests and the results of simple questionnaires to measure the severity of the disorder. For both index patients and controls, the lack of these details could mean that we did not correct for an important confounder. The study might also have included some children not currently affected, possibly due to insufficient follow-up by the GP. Finally, although our findings support the hypothesis that childhood atopic disorders increase

healthcare utilisation, we did not examine the effect on health service costs or, the precise comorbidity causing the increased healthcare utilisation.

Conclusion

Atopic children use significantly more primary healthcare resources compared with non-atopic children. Remarkably, consultations related to atopic disorders only explained a smaller part of the increased healthcare utilisation in atopic children. The majority of the excess consultations were therefore related to (non-)atopic comorbidity. Moreover, the present study provides evidence of insufficient follow-up of atopic children. Since this could result in insufficient treatment (and unnecessary loss of quality of life), we urge GPs to be more aware of their atopic children and take appropriate action so that atopic children can also benefit from 'integrated multidisciplinary care'.

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