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# Regional variation in the diagnosis of asthma among preschool-age children

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To study potential regional variation in asthma diagnostics, we retrospectively analyzed the management of 800 acutely wheezing preschool-age children in two university clinics in Finland. Multivariate modelling indicated that the place of treatment was a strong independent predictor of asthma diagnosis during acute symptoms. Similar regional preferences in diagnostic activity may exist in other countries.

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During the past two decades the reported numbers of children with asthma and asthma hospitalizations have significantly increased in most industrialized countries (1–3). It is unclear whether this phenomenon is the result of a true increase in disease prevalence or of a change in disease surveillance or diagnostic activity (1–5). The controversies over the definition of asthma, especially among the youngest, preschool-age children, further complicate this issue.

We have previously observed marked regional differences in the prevalence of nationally reported asthma among young children in Finland. To analyze whether this variation was associated with the use of different diagnostic criteria, we compared, for two university hospital emergency rooms, the probability of an acutely wheezing child to receive an asthma diagnosis. To control for potential confounders, the analyses were adjusted for the patient's age, gender, previous wheezing histories, and asthma diagnoses, as well as other diagnoses obtained in the emergency room.

## Subjects and methods

The study was a retrospective analysis of data collected from individual patient files in Turku and Tampere University hospitals. The centres are staffed similarly and they both function as the primary referral hospital for approximately 85 000 children. All children between 6 months and 7 years of age who had been treated for acute wheezing during 1995–96 in either of the hospitals were identified with International Classification of Diseases codes (ICD 9 and 10) through the hospital discharge registers. Of the 1429 identified children (668 in Turku and 761 in Tampere), 800 were randomly chosen to form the study cohort. Individual patient files were retrieved and appropriate data extracted by two research assistants blinded to the research hypothesis.

Previous wheezing history was defined as the number of all physician-diagnosed episodes of respiratory distress. Previous asthma was defined as an earlier physician-made diagnosis documented in the patient file prior to or in the admission text for the index episode. The child was considered as having been given an asthma diagnosis in the emergency room if the attending physician had recorded it either in the management plan or as a diagnostic code for the index episode. Concomitant respiratory infections were verified from the main text as well as from diagnostic codes indicated in the patient records.

Data entry and analyses were performed using EPI-INFO 6.04b, PARADOX 8.0, and SPSS 7.5 computer programs. In univariate analyses for dichotomous or categorical variables, we calculated relative risks and used the chi-square test to assess the statistical

significance of the findings. For multivariate modelling of the probability of receiving asthma diagnosis, we used logistic regression analysis. The model included all predictor and potential confounder variables that were tested in the univariate analyses.

The study had the approval of the Ethics Committee of Tampere University Hospital.

## Results

There were no major differences in the gender and weight distributions or previous wheezing histories among the children treated in the two university hospitals (Table 1). However, in Turku, asthma was diagnosed significantly more often than in Tampere (44.2% vs. 15.8% of children, relative risk 2.78, 95% confidence interval 2.16–3.58, $p < 0.001$). Multivariate modeling indicated that the place of treatment (Turku vs. Tampere) was a strong independent predictor of asthma diagnosis in the emergency room (adjusted odds ratio 8.30, Table 2). Previous asthma diagnosis, a high number of earlier wheezing episodes, and older age of the child were also independently associated with the probability of receiving an asthma diagnosis in the emergency room (Table 2). In contrast, concomitant infections or gender of the patient had no statistically significant association with asthma diagnosis.

## Discussion

Most available evidence suggest that the incidence of diagnosed asthma is rapidly increasing among young children, although decreasing numbers in hospital admissions have also been reported (1–5). There are, however, large regional differences in paediatric asthma prevalence, even within individual countries (6). In Finland, for instance, approximately 2.4% of all preschool-age children in Turku, but only 1.2% in Tampere were, in 1996, entitled to preferably refundable anti-inflammatory asthma medication (Timo Klaukka, Social Insurance Institution in Finland, personal communication). Concomi-tantly, no differences in the frequency of asthma symptoms or hospital contacts owing to acute wheezing have been reported (7). These data suggest the existence of significant regional variation either in the use of diagnostic criteria or in reporting patients to the national registers.

In the present study, we compared asthma diagnostics for 800 acutely wheezing preschool-age children in two Finnish university hospitals, Turku and Tampere. According to national guidelines in Finland, an asthma diagnosis is recommended for any child of at least 3 years of age with acute wheezing, and for those under 3 years of age who have had two or more similar episodes earlier in life. These variables are often included in the criteria for asthma because of their suggested association with the development of chronic pulmonary symptoms (8, 9). Our aim was to determine whether physicians who saw an acutely wheezing child in an emergency unit actually followed the national guidelines and used the child's age and prior wheezing history in setting an asthma diagnosis. The possible viral etiology of individual episodes was not analyzed because the Finnish guidelines do not suggest that this factor is taken into account when setting a diagnosis for acutely wheezing children.

In our data, the suggested guidelines were followed by the attending physicians in both hospitals. Adherence to the national recommendations was, however, much more common in Turku than in Tampere. As a result, the probability of children receiving an asthma diagnosis was markedly higher in this centre, despite the fact that the numbers of earlier wheezing episodes were identical among patients in the two hospitals. The difference remained significant even

Table 1. Characteristics of the 800 randomly chosen children treated in the emergency room in Turku or Tampere university hospitals for wheezy bronchitis or asthma during 1995–96

| | All children | | 6–35 months of age | | 3–6 years of age | |
|---|---|---|---|---|---|---|
| Variable | Turku | Tampere | Turku | Tampere | Turku | Tampere |
| Number of children (%) | 400 (100%) | 400 (100%) | 256 (64%) | 252 (63%) | 144 (36%) | 148 (37%) |
| Ratio of boys to girls | 2.0 | 2.0 | 1.9 | 2.3 | 2.3 | 1.7 |
| Mean (SD) age* | 32.6 (19.8) | 31.6 (19.6) | 19.9 (8.3) | 19.1 (8.7) | 55.2 (13.2) | 53.0 (13.4) |
| Mean (SD) weight† | 14.1 (4.3) | 13.7 (4.5) | 11.8 (2.4) | 11.5 (2.5) | 18.1 (3.8) | 17.5 (4.6) |
| Previous wheezing episodes | | | | | | |
| none | 50.9% | 49.5% | 63.0% | 57.5% | 28.8% | 35.8% |
| one | 15.9% | 21.2% | 16.7% | 22.3% | 14.4% | 19.4% |
| two or more | 33.2% | 29.3% | 20.3% | 20.2% | 56.8% | 44.8% |

*Months; †kg.

Table 2. Adjusted odds ratios for predictors of asthma diagnosis in the emergency room

| Variable | Adjusted odds ratio (95% CI) | p-value |
|---|---|---|
| Hospital (Turku) | 8.30 (4.55–15.13) | 0.000 |
| Previous asthma diagnosis | 27.39 (10.80–69.48) | 0.000 |
| Number of previous wheezing episodes | | |
| none (referent) | 1.00 | – |
| one | 2.31 (1.20–4.44) | 0.012 |
| two or more | 7.28 (3.83–13.81) | 0.000 |
| Age | | |
| <1 year (referent) | 1.00 | – |
| 1 year | 1.12 (0.48–2.60) | 0.787 |
| 2 years | 1.22 (0.52–2.84) | 0.646 |
| 3 years | 2.07 (0.83–5.14) | 0.117 |
| 4 years | 2.70 (0.91–7.99) | 0.074 |
| 5 years | 4.78 (1.38–16.58) | 0.014 |
| 6 years | 8.68 (2.28–32.99) | 0.002 |
| Gender (boy) | 0.83 (0.48–1.41) | 0.484 |
| Concomitant respiratory infections | | |
| upper respiratory tract infection | 0.56 (0.28–1.10) | 0.093 |
| pneumonia | 0.52 (0.11–2.61) | 0.430 |

Logistic regression analysis, controlling for all dichotomous and categorical variables, is shown in the table.
Hosmer and Lemeshow Goodness-of-fit Statistic for the model $\chi^2 = 4.54$; d.f. = 8; $p = 0.805$.
95% CI, 95% confidence interval.

when the patient data were adjusted for age and a number of other potential confounders. Such variability in the adherence to diagnostic criteria probably explains, in part, the regional differences in the prevalence of childhood asthma in Finland. Similar variation will probably also exist in other countries, although we could not identify any published data on the subject.

Retrospectively, it is impossible to determine the severity of each individual wheezing episode. The two clinics were, however, similar in relation to their coverage area, patient numbers, staffing, and use of ICD codes. Furthermore, the incidence and hospitalization rates for acute wheezing among preschool-age children were comparable in the two centres (P. Csonka et al., unpublished observations). Thus, the observed difference in diagnostic activity was not likely to be caused by variation in the clinical presentation of patients with acute wheezing.

The present data offer no explanation for the regional variation in diagnosis of early childhood asthma. It is possible that the opinion of a small number of pediatric allergists have guided the diagnostic practises and development of different local habits in the two study areas. Because anti-inflammatory therapy is, in Finland, refundable for children with asthma but not for those with bronchiolitis or wheezy bronchitis, drug marketing may also have indirectly influenced asthma diagnostics. Whatever the cause, the failure of attending physicians to follow national guidelines is likely to result in under-diagnosis of early childhood asthma in some regions of Finland. As the lack of diagnosis will delay the establishment of appropriate anti-inflammatory therapy, many children may be at risk of developing chronic symptoms and possibly irreversible airway impairment (10–13). Therefore, the use of nationally recommended uniform guidelines for asthma diagnosis among preschool-age children should be more strongly enforced.

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## References

1. Gergen PJ, Weiss KB. Changing patterns of asthma hospitalization among children: 1979 to 1987. JAMA 1990: 246: 1688–92.
2. Nystad W, Magnus P, Gulsvik A, Skarpaas IJ, Carlsen KH. Changing prevalence of asthma in school children: evidence for diagnostic changes in asthma in two surveys 13 years apart. Eur Respir J 1997: 10: 1046–51.
3. Stromberg L. Decreasing admissions for childhood asthma to a Swedish county hospital. Acta Paediatrica 1996: 85: 173–6.
4. Mitchell EA, Dawson KP. Why are hospital admissions of children with acute asthma increasing? Eur Respir J 1989: 2: 470–2.
5. Magnus P, Jaakkola JJK. Secular trend in the occurrence of asthma among children and young adults:

critical appraisal of repeated cross sectional surveys. BMJ 1997: 314: 1795–9.
6. Anonymous. Worldwide variation in prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and atopic eczema: ISAAC. The International Study of Asthma and Allergies in Childhood (ISAAC) Steering Committee. Lancet 1998: 351: 1225–32.
7. Pekkanen J, Remes ST, Husman T, et al. Prevalence of asthma symptoms in video and written questionnaires among children in four regions of Finland. Eur Respir J 1997: 10: 1787–94.
8. Dodge R, Martinez FD, Cline MG, Lebowitz MD, Burrows B. Early childhood respiratory symptoms and the subsequent diagnosis of asthma. J Allergy Clin Immunol 1996: 98: 48–54.
9. Remes ST, Korppi M, Remes K. Outcome of children with respiratory symptoms without objective evidence of asthma: two-year, prospective, follow-up study. Acta Paediatr 1998: 87: 165–8.
10. Agertoft L, Pedersen S. Effects of long-term treatment with an inhaled corticosteroid on growth and pulmonary function in asthmatic children. Respir Med 1994: 88: 373–81.
11. Hogg JC. Bronchial mucosal permeability and its relationship to airways hyperreactivity. J Allergy Clin Immunol 1981: 67: 421–5.
12. Laitinen L, Heino M, Laitinen A, et al. Damage of the airway epithelium and bronchial reactivity in patients with asthma. Am Rev Respir Dis 1985: 131: 559–606.
13. Pool J, Greenough A, Gleeson JGA, Price JF. Persistent lung hyperinflation in apparently asymptomatic asthmatic children. Respir Med 1989: 83: 433–6.