A population-based study of different antibiotic prescribing in different areas

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ABSTRACT

Background

Respiratory tract infections are the most common reason for antibiotic prescription in Sweden as in other countries. The prescription rates vary markedly in different countries, counties and municipalities. The reasons for these variations in prescription rate are not obvious.

Aim

To find possible explanations for different antibiotic prescription rates in children.

Design of study

Prospective population based study.

Setting

All child health clinics in four municipalities in Sweden which, according to official statistics, had high antibiotic prescription rates, and all child health clinics in three municipalities which had low antibiotic prescription rates.

Method

During one month, parents recorded all infectious symptoms, physician consultations and antibiotic treatments, from 848 18-month-old children in a log book. The parents also answered a questionnaire about socioeconomic factors and concern about infectious diseases.

Results

Antibiotics were prescribed to 11.6% of the children in the high prescription area and 4.7% in the low prescription area during the study month (crude odds ratio [OR] = 2.67; 95% confidence interval [CI] = 1.45 to 4.93). After multiple logistic regression analyses taking account of socioeconomic factors, concern about infectious illness, number of symptom days and physician consultations, differences in antibiotic prescription rates remained (adjusted OR = 2.61; 95% CI = 1.14 to 5.98). The variable that impacted most on antibiotic prescription rates, although it was not relevant to the geographical differences, was a high level of concern about infectious illness in the family.

Conclusions

The differences in antibiotic prescription rates could not be explained by socioeconomic factors, concern about infectious illness, number of symptom days and physician consultations. The differences may be attributable to different prescription behaviour.

Keywords

anti-bacterial agents; cohort study; communicable diseases.

INTRODUCTION

Antibiotic prescription rates vary markedly among European countries.[1–3] Sweden is one of the countries with the lowest prescription rates.[1,2]

Respiratory tract infection (RTI) is the most common reason for antibiotic prescription.[4] However, most patients with RTIs do not benefit from antibiotic treatment.[5] A correlation between antibiotic use and resistance has been shown at both individual and population levels.[6,7] This indicates that antibiotics should be prescribed with caution.

In Sweden there is great variation in the numbers of antibiotic prescriptions as well as in prescriptions of different kinds of antibiotics in different counties and municipalities according to official statistics from the National Corporation of Swedish Pharmacies, especially for children aged 0–6 years.[8,9] There is no clear explanation of these differences, which have been quite stable over time.

We therefore chose to study children living in municipalities with low antibiotic prescription rates and in municipalities with high antibiotic prescription rates, according to official statistics. Our aim was to find possible explanations for the different antibiotic prescribing patterns by studying socioeconomic factors, concern about infectious illness, infectious symptoms and physician consultations.

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How this fits in

Prescription rates differ when countries, counties and municipalities are compared. This population-based cohort study in children showed that the differences could not be explained by differences in infectious symptoms, socioeconomic factors, concern about infectious illness in the family or number of physician consultations. The differences in antibiotic prescription rates may be attributable to different prescription behaviour or patient expectations, in which case physicians´ prescription patterns are not always rational.

METHOD

Municipalities

We chose municipalities that had had either high or low antibiotic prescriptions rates during 2000 and 2001, in terms of prescriptions for children. These municipalities were similar in socioeconomic structure according to the Swedish association of municipalities. A convenient sample of seven municipalities was chosen, three among those in the highest quartile of antibiotic prescription rates and four among those in the lowest quartile of antibiotic prescription rates for children aged 0–6.

According to official statistics from the National Corporation of Swedish Pharmacies, antibiotic prescription rates for children aged 1–2 years from 1 July 2002 until 30 June 2003 in the municipalities in the two groups were 1073 prescriptions/100 000 inhabitants and 615 prescriptions/100 000 inhabitants, respectively. In other words, the differences in the prescription rates remained during the study period.

Population

In Sweden 99% of all preschool children come for routine checkups at child health clinics.[10] The nurses working at the 30 child health clinics in the seven municipalities studied informed the parents (who brought their children to these routine checkups at 18 months) about the study in writing and orally, and the families who agreed to participate were asked to give their written informed consent. The children were included consecutively from 1 October 2002 until the 11 April 2003. Families that had not mastered the Swedish language, in the judgement of the nurses at child health clinic, were excluded.

Questionnaire

All participating families answered a questionnaire, given to them by the nurses, regarding socioeconomic status, ethnicity, smoking status in the family and occupation. The questionnaire also asked whether the children had asthma/allergies and if they were in day care outside the home.

Four questions were asked about concern about illness, each with four alternative answers. According to the answers three levels of concern about illness were determined: low, medium and high concern.[11]

The parents also answered two general questions about respiratory tract infections and antibiotic treatment. If their answers to both questions were correct their knowledge was classified as ‘adequate’ otherwise ‘inadequate’.

Log book

The parents were asked to note all their child’s infectious symptoms during one month, according to preset alternatives, in a log book. The symptom alternatives were: runny nose, cough, earache, sore throat, temperature over 38°C, diarrhoea/vomiting, tiredness and other symptoms. The symptoms were noted day by day. In the log book they were also asked to note if the child had consulted a physician and/or been prescribed antibiotics.

Each family was given both the log book and a fridge magnet with a spring clip to attach it to the fridge. Nurses from the child health clinic phoned the family twice during the month to remind them about the registration and that the log book should be sent at the end of the month, in the envelope with prepaid postage.

Definitions

A symptom day was defined as a day when one or more symptoms occurred. Respiratory tract symptoms were defined as at least one of the following: runny nose, cough, earache, sore throat with or without tiredness and fever. Gastroenteritis was defined as diarrhoea or vomiting with or without tiredness and fever and without the occurrence of other symptoms. Mixed symptoms were defined as a combination of respiratory and gastroenteric symptoms on the same day, and other symptoms were defined as other symptoms with or without tiredness and fever.

Statistics

Statistical analyses were performed with the SPSS for Windows (Version 12.0.1).

The partial non-response rate (missing data) on the variables was less than 5% except for the question about asthma, where 12.6% of the data was missing.

The χ^2 test was used to compare categorical variables in two independent groups, and the Mann–Whitney U-test to compare numerical variables in two independent groups.

Logistic regression analysis was used to compute odds ratios (OR) and their 95% confidence intervals (95% CIs) in both univariate and multiple variable

Table 1. Background data according to questionnaire for the 18-month-old children.

	High prescription area % (*n* = 570)	Low prescription area % (*n* = 278)	*P*
Boys	49.8	56.1	0.08
Any siblings	56.7	59.4	0.46
Asthma	9.9	14.3	0.08
Day-care outside the home	70.7	60.1	0.002
Living in rental flat	24.4	21.5	0.35
Smoker in the family	15.0	8.8	0.012
Single parent	4.7	4.0	0.61
Mother without post-upper secondary	59.0	60.0	0.98
Father without post-upper secondary	68.7	68.6	0.69
Either parent unemployed	5.4	8.1	0.13
No health care education in the family	60.3	59.6	0.93
Both parents born outside the Nordic countries	4.0	2.5	0.26
Perceived as infection prone	17.5	17.0	0.88
High or medium level of concern about infectious illness	45.0	39.6	0.14
Inadequate expectations of antibiotics effects	58.1	57.2	0.80

analyses. Backward elimination of nonsignificant exposure variables was performed until all remaining variables were significantly related to the outcome (*P*-removal 10%), except for prescription area, which was kept in the model irrespective of significance level. A *P*-value of 0.05 was regarded as statistically significant.

At first, crude ORs were drawn up. Then we adjusted for background variables (Model 1). In Model 2, knowledge about antibiotics, perceived infection proneness and concern about infectious illness were added. In Model 3 infectious symptoms were also included and at last physician consultations were taken into concern together with all other variables (Model 4).

RESULTS

A total of 1185 families in the geographical areas studied had children who reached the age of 18 months during the study period. Seven families did not attend the child health clinic and 38 families were excluded from participation because of language difficulties, in accordance with the exclusion criteria.

Thus, 1140 families were asked to take part in the study. Of them 154 declined without stating any reason, 30 because of a difficult social situation and two moved during the month of registration. Thus a total of 84% (954/1140) of the invited families were included, 638/761 (84%) of those from the high prescribing area and 316/379 (83%) from the low prescribing area. Of those who agreed to take part in the study, 87% (555/638 and 276/316, respectively) completed the log book registration. Of the 1140 families then, 73% (555/761 and 276/379, respectively), participated in the study.

Eight hundred and forty-eight 18-month-old children were included in the study (17 pair of twins), 570 from the high prescription area and 278 from the low prescription area. The parents reported that 1.3% and 2.3% of the children in the respective group had chronic illnesses. The two groups were similar in their characteristics although there were some differences in the numbers of smokers and numbers of children who were in day care outside the home (Table 1).

There were no differences in percentage of children (7%) who did not report any symptoms during the registration month in the two groups (Table 2). The median number of symptom days were 11.0 (interquartile range [IQR] = 6–17) and 10.0 (IQR = 5–17), respectively, Mann–Whitney U-test *P* = 0.38. The distribution of symptom days is shown in Table 3.

In the high prescription area, 20.5% (117/570) of the children consulted a physician. The corresponding figure in the low prescription area was 15.8% (44/278); OR = 1.37; 95% CI = 0.94 to 2.01. The consultation rates were not significantly different even after adjustment for socioeconomic factors, concern about infectious illness and infectious symptoms more than 7 days, adjusted OR = 1.40 (95% CI = 0.88 to 2.23). During the study months 3.9 % of the children in the high prescription area and 1.8% in the low prescription area made more than one physician consultation.

During the studied months 11.6% (66/570) of the children in the high prescription area and 4.7% (13/278) of the children in the low prescription area were prescribed antibiotics (χ^2 = 10.54, *P* = 0.001). Among the children who consulted a physician, 46.2% (54/117) of the children in the high prescription area and 27.3% (12/44) of the children in the low prescription area were prescribed antibiotics at least once (χ^2 = 4.71, *P* = 0.03). The

Table 2. Distribution of 18-month-old children by per cent according to symptom days.

Days with symptoms (*n*)	High prescription area % (*n* = 570)	Low prescription area % (*n* = 278)
0	6.7	7.2
1–7	27.5	30.6
8–14	30.9	29.1
≥15	34.9	33.1
Total	100.0	100.0

χ^2 = 1.4. P = 0.79.

antibiotic prescription rate per consultation was 0.50 in the high prescription area and 0.30 in the low prescription area. In both groups some children received antibiotic prescriptions without a prior physician consultation, 12 children in the high prescription area and one in the low prescription area. Of the children in the high prescription area, 0.90% received more than one antibiotic prescription, compared with 0.40% in the low prescription area.

The crude OR for antibiotic use is shown in Table 4. When controlling for background variables (Model 1) as well as knowledge of antibiotics, perceived infection proneness and concern about infectious illness, the adjusted OR (aOR), still remained significant (Model 2). When symptoms lasting more than 7 days were added, the aOR did not change significantly (Model 3). Nor did it change appreciably when physician consultations were taken into account (Model 4). Thus, irrespective of which model we used, the differences in antibiotic prescription between the areas remained.

One variable of importance in relation to antibiotic prescriptions in all models was a high level of concern about infectious illness in the family (Table 4). This variable was evenly distributed between the groups.

Table 3. Symptom days distributed according to reported symptoms.

Symptoms	High prescription area % (*n* = 6837)	Low prescription area % (*n* = 3232)
Respiratory tract	80.8	83.4
coryza only	[27.4]	[30.7]
RTI with fever	[10.6]	[8.0]
Gastroenteric	4.1	4.1
Mixed respiratory and gastroenteric	10.5	9.7
Other	4.6	2.8
Total	100.0	100.0

DISCUSSION

Summary of main findings

The differences between the high and low prescription areas in terms of antibiotic prescription rates could not be explained by differences in reported infectious symptoms, differences in socioeconomic factors, day care, concern about infectious illness in the family or (number of) physician consultations.

Almost every child studied had some infectious symptoms during the study month, and in about 33% of the observed days infectious symptoms were reported. Nearly 20% of the children consulted a physician and approximately 8% of the children were prescribed antibiotics.

Table 4. Antibiotic treatment for 18-month-old children.

	Crude		Adjusted							
			Model 1		Model 2		Model 3		Model 4	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
High prescription area	**2.67**	**1.45 to 4.93**	**2.50**	**1.27 to 4.95**	**2.44**	**1.19 to 4.99**	**2.55**	**1.23 to 5.32**	**2.61**	**1.14 to 5.98**
Being a boy	1.49	0.93 to 2.39								
Any sibling	1.23	0.76 to 2.00							2.21	1.06 to 4.41
Asthma	**2.28**	**1.20 to 4.32**	**2.62**	**1.35 to 5.07**			1.96	0.92 to 4.16		
Day care outside the home	**2.43**	**1.34 to 4.41**	1.85	0.98 to 3.50						
Living in rental flat	1.44	0.86 to 2.41								
Smoker in the family	1.24	0.65 to 2.39								
Single parent	1.15	0.40 to 3.33								
Mother without post-upper secondary	1.13	0.70 to 1.82								
Father without post-upper secondary	0.90	0.55 to 1.49								
Either parent unemployed	0.81	0.28 to 2.32								
No health care education in the family	1.51	0.92 to 2.51								
Both parents born outside the Nordic countries	1.98	0.93 to 4.20	**2.59**	**1.07 to 6.28**						
Perceived as infection prone	**3.60**	**2.18 to 5.93**			**2.79**	**1.52 to 5.11**	**2.00**	**1.04 to 3.83**		
High or medium level of concern about infectious illness	**4.26**	**2.51 to 7.23**			**3.76**	**2.00 to 7.07**	**3.71**	**1.96 to 7.04**	**4.01**	**1.97 to 7.97**
Inadequate antibiotics knowledge	**1.82**	**1.08 to 3.05**								
Symptoms lasting more than 7 days	**5.43**	**2.58 to 11.5**					**4.40**	**1.93 to 10.07**		
Physician consultation	36.0	19.1 to 67.8							38.2	18.0 to 81.2

Crude (univariate) odds ratio (OR) and adjusted odds ratios with 95% confidence intervals. The variables in the last step are shown in the adjusted models. Adjusted odds ratios were calculated using multiple logistic regressions with backward elimination of all variables except prescription area. Model 1 adjusting for social variables. Model 2 adjusting for variables in Model 1 and antibiotic knowledge and concern about infectious illness. Model 3 adjusting for variables in Model 2 and infectious symptoms lasting more than 7 days. Model 4 adjusting for variables in Model 3 and physician consultations.

Strengths and limitations of the study

We have not found any other population based studies that relate infectious symptoms in a cohort of children to reported use of antibiotics. Antibiotic prescription rates in Sweden fell between the planning and the carrying out of this study. Therefore there were fewer antibiotic prescriptions than expected, but the differences between the groups still remained.

The dropout rate was limited despite the log book method used, which demands a great deal of work. The reasons for declining to participate were equally distributed between the groups. One explanation for the good compliance might be that the nurses reminded the family twice during the study month.

Log books have previously been used to study morbidity and health care utilisation. They give a more precise picture of daily symptoms and treatment, than retrospective interviews, above all when it comes to minor and mundane events.[12] With a log book it is possible to note the symptoms day by day, and a large amount of information can be obtained at a low price.[13]

We asked the parents to report every infectious symptom, even if it was of minor concern. The questionnaires and log books were well filled in, but we did not further validate whether the families actually reported according to the instructions. Neither did we validate the reported contacts with the health care services.

Since we wanted to include all families with an 18-month-old child in the geographical areas studied, the study groups ended up being of different sizes. The size of the municipality had no impact on the results in this study.

Comparisons with existing literature

Infectious symptoms and physician consultations. Infectious symptoms and symptom days were evenly distributed between the groups during the month. The high frequency of symptoms may be due to the fact that 18-month-old children are quite infection prone, and that the study took part during the winter season.

An earlier Swedish study with a comparable method showed that 26% of all days in the age group 0–6 years were days with reported infectious symptoms.[14] In our study the proportion of days with symptoms was 38%. This could be explained by the fact that our children were younger and that more children are in day-care outside the home today than in the early 1980s.

The physician consultation frequency was about the same as in an earlier log book study from the Netherlands[15] and in a recent retrospective English study[16] despite the differences in the health care systems.

Antibiotics prescription. The geographical differences in antibiotic prescription rates according to official statistics (from the National Corporation of Swedish Pharmacies) for children 0–6 years were also clear for the 18-month-old children in our study. One possible explanation of the different prescription rates is that the physicians handle infections and antibiotic prescriptions in different ways.

The factor that impacted most on antibiotic prescription rates, although it was not relevant to the geographical differences, was high concern about infectious illness in the family. It is important for physicians to be attentive to the parents' concern. Some of the perceived concern may be handled during the consultation and the more time a physician spends on listening, the less time will be spent on prescribing antibiotics.[17]

We were not able to show that the parents' knowledge about antibiotics was of importance, but studies from Israel and Trinidad have found that if the parents believe that antibiotics will be helpful in respiratory tract infections, the likelihood that the child will have antibiotics prescribed increases.[18,19]

Previous Swedish studies have shown that low socioeconomic status and low level of parental education were related to lower use of antibiotics,[20,21] which contradicted a Canadian study that found that families with higher incomes consumed less antibiotics.[22] In this study we did not find any socioeconomic variable of importance to antibiotic prescription although we did not record family income. It should also be noted that the influence of socioeconomic variables might not be generalisable from one country to another.[23]

Implications for future research and clinical practice

Recent studies indicate that if there is a reduction in antibiotic prescriptions for infectious diseases there is also a reduction in the numbers of consultations for those diagnosed.[24,25] However, in this study differences in antibiotic prescription rates for children could not be explained by differences in infectious symptoms or consultation rates. Studies have shown that the prescription patterns vary between different physicians[26] and that the physician's prescription behaviour, more than the clinical picture, determines whether or not antibiotics are prescribed.[27] Cultural differences may influence the antibiotic prescription patterns in different countries[28] and it is possible that there may be 'cultural' differences, in antibiotic prescription rates even among different counties and municipalities.

Other studies have found that the working style of

the physician is of importance for prescribing[29] and a positive approach in the consultation results in fewer referrals.[30] Also 'rules of thumb' may correlate to physician behaviour.[31] This indicates that behaviour of the physician may explain the differences in antibiotic prescription.

Concern about infectious illness in the family was a strong predictor for antibiotic prescription; this means that this topic should be carefully explained when meeting these families.

Further studies comparing different areas, focusing on the interaction between patients and physicians and their respective beliefs and knowledge are needed to explain geographical differences in antibiotic prescription rates.

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Ethics

The study has been approved by the committees on research ethics in Linköping, Lund and Uppsala (Drn 02-147)

Competing interests

The authors have stated that there are none

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