Infectious morbidity in 18-month-old children with and without older siblings

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Background. Infections are the most commonly reported health problems in children. Younger age and day care outside the home are two factors of importance for infectious morbidity. The influence of siblings on infectious symptoms is not clear.

Objectives. To compare families with one child and families with more than one child in terms of reported infectious symptoms, physician consultations and antibiotic prescriptions.

Methods. A prospective population-based survey was performed. During 1 month, all infectious symptoms, physician consultations and antibiotic prescriptions for 18-month-old children were noted by the parents. The 789 families also answered questions about socio-economic factors, numbers of siblings in the family and type of day care.

Results. No difference in number of symptom days was found between children with and without older siblings. Neither could we find any significance in terms of having older siblings in relation to physician consultations and antibiotic prescriptions.

Conclusions. The results of our study indicate that having older siblings not was important in relation to number of symptoms days, physician consultations or antibiotic prescriptions for 18-month-old children in Sweden today. Changes in social activities and attitudes towards antibiotic prescription may explain our different findings as compared with previous Swedish studies and studies from other countries.

Keywords. Antibiotic prescription, child, infectious symptom, physician consultation, siblings.

Introduction

Infections are the most commonly reported health problems among children.\textsuperscript{1–3} Approximately 80\% of the days with reported health problems are attributable to infections.\textsuperscript{4} Among infections, respiratory tract infections (RTIs) are the most common cause of morbidity.\textsuperscript{2,3} Younger age has been found to increase the risk of RTIs\textsuperscript{5,6} as have day care outside the home\textsuperscript{7–9} and smoking in the family.\textsuperscript{10}

The influence of siblings on infectious symptoms is not clear. Siblings have been found not to influence infectious morbidity,\textsuperscript{7} as to increase\textsuperscript{11,12} and to decrease the risk of infectious morbidity.\textsuperscript{13} Physician consultations have been found to be lower with more children in the family,\textsuperscript{14,15} while others have not found any importance of number of siblings in the family.\textsuperscript{16} The relationship between the number of children in the family and antibiotic prescription rates is occasionally mentioned in articles focusing on infectious symptoms.

Thus, the influence of siblings on infectious symptoms and physician consultation has varied and the influence of siblings on antibiotic prescription has been studied very little. The aims of this study were to investigate the importance of having siblings in terms of infectious symptoms, physician consultations and antibiotic prescriptions.

Methods

Population

Seven municipalities, two urban and five rural, in southern and central Sweden took part. The number of inhabitants was between 54 600 and 118 000 in the urban and between 15 300 and 19 000 in the rural municipalities.
A total of 1185 families in the geographical areas studied had infants who reached the age of 18 months during the study period. All except seven families attended the health care clinic and were asked to participate there. Thirty-eight families were excluded from participation because of language difficulties, in accordance with the exclusion criteria described below.

Thus, 1140 families were asked to take part in the study. Of these, 154 declined without stating any reason, 30 because of difficulties in their social situations and another 2 moved away during the month of registration. Thus, a total of 84% (954/1140) of the invited families were included. Of those who agreed to take part in the study, 87% (831/954) completed the logbook registration. Of the 1140 families, then, 831 (73%) participated in the study. Eight hundred and forty-eight 18-month-old infants were included in the study.

The nurses working at the child health clinic consecutively informed all parents who came for routine check-ups with an 18-month-old infant about the study in writing and orally and the families who agreed to participate were asked to give their written informed consent. The infants were included consecutively from 1 October 2002 until the 11 April 2003, and thus, the inclusion was related to the child’s date of birth. Families who did not master the Swedish language in the judgement of the nurses at the child health clinic were excluded.

Questionnaire
All participating families answered a self-administered questionnaire given to them by the nurses, regarding socio-economic status, number of siblings, ethnicity, smoking in the family and occupation. Other questions were whether the infants had asthma/allergies, if the parents thought the infant was prone to infections and if the infant was in day care outside the home.

Four questions about concerns about infectious illness, each with four response alternatives were given. The answers on each statement were scored from 1 to 4 and then summarized, giving possible scores of between 4 and 16. According to the answers, three levels of concern about infectious illness were determined—low concern (scores 13–16), medium concern (scores 8–12) and high concern (scores 4–7). To be able to compare families with low concern about infectious illness with all others, the medium and high levels of concern about infectious illness were then grouped together as ‘high level’.

The statements were

1. ‘Your child’s infections worry you a lot’.
2. ‘Each time your child is ill, you are afraid it is something serious’.
3. ‘Your child becomes ill more frequently than other children of the same age’.
4. ‘You are often afraid that your child may become seriously ill’.

The response alternatives were

1. Score 1: agree fully,
2. Score 2: agree partly,
3. Score 3: disagree partly,

The parents also answered two simple questions about RTIs and antibiotic treatment. If their answers to both questions were correct, their knowledge was classified as ‘adequate’, otherwise ‘inadequate’.

The statements were

1. ‘Most RTIs in children go away without antibiotics’.
2. ‘Most RTIs in adults go away without antibiotics’.

The response alternatives were the same as those given above.

Logbook
The parents were asked to note all their infant’s infectious symptoms during 1 month, according to preset alternatives in a logbook. The symptom alternatives were runny nose, cough, earache, sore throat, temperature >38°C, diarrhoea/vomiting, tiredness and other symptoms. The symptoms were noted day by day. In the logbook, the parents were also asked to note if the parents had consulted a physician and/or been prescribed antibiotics for their child.

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

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. Day care outside the home was defined as the child being registered at a day care centre or in family day care.

Statistical analysis
The statistical analyses were performed with SPSS software (Version 14.0). The partial non-response rate (missing data) on the variables was <5% except for asthma, where 12.6% of the data were missing.

The chi-square 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 (ORs) and their 95% confidence intervals in both univariate and multiple variable analyses. Backward elimination of non-significant exposure variables was performed until all remaining variables were significantly related to the outcome (P-removal 10%), except for presence of siblings, which was kept in the model irrespective of significance level. A P-value of 0.05 was regarded as statistically significant.

To begin with, crude ORs were drawn up for all variables given in Table 1. We then adjusted for background variables, which included all the variables in Table 1 with the exception of expectation of effect of antibiotics, perceived infection proneness and level of concern about infectious illness (Model 1). In Model 2, expectation about antibiotic effects, perceived infection proneness and concern about infectious illness were added, and in Model 3, infectious symptoms were also included.

Results

Among the participating 18-month-old children, 25 had younger siblings. There were 17 pairs of twins and these two groups were excluded from further analyses. Of the remaining 789 18-month-old children, 42.6% had no siblings, 37.8% had one older sibling with a median age of 50 months and 19.6% had two or more older siblings. In this last group, there were 364 siblings with a median age of 96 months.

Among 18-month-old children without siblings, more children were living in rental flats and living with a single parent and more families reported medium or high levels of concern about infectious illness. In this group, asthma and mothers with post-upper secondary education were also less frequent (Table 1).

Of the children included, 13% were included in November, 19% in December, 12% in January, 15% in February, 17% in March and 5% in April. No difference in number of symptom days was found between children with and without older siblings (chi-square = 1.35, P = 0.97) (Table 2), nor did we find any significant differences in symptom days among children with day care outside the home with and without siblings (Mann–Whitney U-test P = 0.89) or among children being cared for at home with or without older siblings (Mann–Whitney U-test P = 0.140).

The distribution of symptom days is shown in Table 3. Twenty-one point four per cent (72/336) of the children without older siblings and 17.2% (78/453) of the children with siblings (chi-square = 2.22, P = 0.136) had a consultation with a physician. Even after adjustment for socio-economic factors, concern about infectious illness and infectious symptoms for >7 days, the number of physician consultations was similar (Table 4). Antibiotics were prescribed to 8.3% (28/336) of the children without siblings and to 9.9% (45/453) of the children with older siblings (chi-square = 0.59, P = 0.443). Also after adjustment for socio-economic factors, concern about infectious illness and infectious symptoms for >7 days, the number of antibiotic prescriptions was similar (Table 4).

Discussion

In this prospective population-based logbook study, we found that >90% of the children had at least one

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>Background data for 18-month-old children with and without older siblings</th>
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<tbody>
<tr>
<td>Per cent</td>
<td>Siblings, n = 453</td>
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<tr>
<td>---------</td>
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</tr>
<tr>
<td>Boys</td>
<td>51.0</td>
</tr>
<tr>
<td>Asthma</td>
<td>12.8</td>
</tr>
<tr>
<td>Other chronic illness</td>
<td>2.1</td>
</tr>
<tr>
<td>Day care outside the home</td>
<td>32.2</td>
</tr>
<tr>
<td>Living in rental flat</td>
<td>18.4</td>
</tr>
<tr>
<td>Smoker in the family</td>
<td>14.5</td>
</tr>
<tr>
<td>Single parent</td>
<td>3.1</td>
</tr>
<tr>
<td>Mother without post-upper secondary education</td>
<td>61.2</td>
</tr>
<tr>
<td>Father without post-upper secondary education</td>
<td>69.7</td>
</tr>
<tr>
<td>Either parent unemployed</td>
<td>6.7</td>
</tr>
<tr>
<td>Health care education in the family</td>
<td>39.5</td>
</tr>
<tr>
<td>Both parents born outside the Nordic countries</td>
<td>7.1</td>
</tr>
<tr>
<td>Perceived as infection prone</td>
<td>19.8</td>
</tr>
<tr>
<td>High or medium level of concern about infectious illness</td>
<td>37.0</td>
</tr>
<tr>
<td>Inappropriate expectations of antibiotics effect</td>
<td>43.9</td>
</tr>
<tr>
<td>High prescription area</td>
<td>65.6</td>
</tr>
</tbody>
</table>
infectious symptom during a month. We did not find any significance of having older siblings in terms of reported infectious symptoms, physician consultations or antibiotic prescriptions.

The dropout rate was limited despite the logbook method used, which demands a great deal of work. One explanation for the good compliance and for the accurately and completely filled in logbooks might be that the nurses at the child health centres reminded the family twice during the month. Another explanation might be that 1 month is a period short enough for the families to cope with having to do daily registration. Since it is common for the children to have symptoms, even in such a short time period, a great deal of information is collected. In logbooks, symptoms are registered along with experience of symptoms/illness and actions taken day by day, without the risk of recall bias, which is a clear weakness in all retrospective studies.18 Logbooks have previously been used to study morbidity in children with and without siblings. Prospective diary registration was used in an Australian study conducted in 1994 and in a Canadian study conducted in 2004.11,13 In the Canadian study, only 185 children were included.13 In the Tecumseh study from the 1970s, weekly telephone interviews were made.19 Most other studies have used retrospective registration of infectious symptoms.7,12,15,16 One prospective Scottish study conducted in 1985 focused not only on infectious symptoms but also on all health problems.14 The age of 18 months was chosen because at that age, all children have a routine check-up at the child health clinic. Thus, this was a suitable opportunity to ask the parents for permission to include their children in the study. At 18 months, some children are still being cared for at home while others are in day care outside the home. At this age, if the child has siblings, they are almost always older siblings.

Infectious symptoms

In our study, no correlation was found between having older siblings and the occurrence of infectious symptoms. This is in concordance with an American study conducted in 1987, which found no importance as regards number of children younger than five in relation to the occurrence of upper RTIs.7

In the older Tecumseh study, conducted in the late 1960s, it was found that a children with no older siblings in the family had a lower rate of infectious illness up to the age of 3 years than children of the same age who had older siblings.19 A Norwegian study conducted in 1996 also found an increased risk of RTIs among children aged 4–5 years with at least one sibling.12

Among younger children, ages 0–2 years, an Australian study conducted in 1987 also found an increased risk of RTIs among children with older siblings.11 Recently published papers from a Danish prospective birth cohort study found that having older siblings ages 1–3 years (all in day care) was significantly associated with increased risk of acute RTIs during the first year of life.20 They also found that having older siblings was significantly associated with detectable anti-hMPV IgG (human metapneumovirus) at age 12 months.21 The age of the children in these studies and time when the studies were conducted varied. Thus, it is difficult to compare the results, but the studies indicate that older siblings may introduce infections into the family and increase the risk of RTIs as also shown in older studies.22 Changes in behaviour over time may explain the differences. For example, it is more common today that parents in Sweden take part in group activities outside the home with their small children. This may expose even children without older sibling to infectious agents, thus increasing the risk of infectious symptoms. Thus, the exposure to infectious agents probably starts earlier in life today, and at 18 months of age as in our study, there may no longer be a major difference between children with and without older siblings.

In the background data, there were differences between the groups regarding level of concern about infectious illness, although the level of concern did not influence the results in this study. Concern about illness is of importance for how the families report symptoms and deal with problems.23
In our study, we found no correlation between having older siblings with or without day care outside the home and the occurrence of infectious symptoms. For children up to the age of 2 years who were in day care, a prospective Canadian study conducted in 1997 found that each sibling increased the risk of respiratory illness in all children by 25%. Day care attendance approximately tripled the risk among children without siblings, whereas only a 30% increase was observed for children with siblings. The study concluded that children in day care with older siblings had fewer respiratory illnesses than children in day care without siblings. An increased risk of respiratory illness was also seen in an American study conducted in 1987 where children ages 18–35 months in day care with no older siblings were compared with children in day care of the same age with older siblings. These studies thus indicate that in terms of RTIs for children older siblings seem to be protective for small children entering day care. Perhaps different settings and that the American and Canadian children are younger when they start day care may explain why the results in these studies are not in agreement with ours. When children in Sweden start day care, the differences between children with and without siblings may already have been capped.

**Physician consultations**
Number of children in the family in relation to physician consultations has also been investigated and the results vary. After our multiple logistic analysis, we did not find any differences among children with and without siblings. This is in agreement with another Swedish study, which also found no correlation between siblings and physician consultations. However, an earlier Swedish study found more physician consultations during the first 18 months for children without siblings. This is also in line with the findings from an English and a Scottish study. The results in our recent study might be explained by a general decrease in the number of physician consultations and increased support and information given by the child health clinics in Sweden during the last 10 years.

**Antibiotic prescription**
The relationship between the number of children in the family and antibiotic prescription rates is occasionally mentioned in articles focusing on infectious symptoms. One Swedish study found no correlation between the number of siblings in the family and antibiotic prescription. The results from our study are in agreement. In contrast, greater use of antibiotics in children with older siblings was seen in an older Swedish study, but at that time the number of physician consultations was also higher.

The antibiotic prescription rate among children in Sweden has been reduced by half since 1994. Our findings may thus be a result of greater knowledge about common infections both among health care personnel and the general public, resulting in changing attitudes towards antibiotic prescription and a decrease in number of physician consultations. This might be interpreted as a result of information from the child health clinics as well as campaigns directed both towards health care personnel and the general public. This may have led to our findings of no differences in antibiotic prescription rates in children with and without siblings.

**Conclusions**
The results of our study indicate that having older siblings does not have any significance for number of

### Table 4: Physician consultations and antibiotic prescriptions in 18-month-old children with and without older siblings in the family

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<thead>
<tr>
<th></th>
<th>Physician consultations</th>
<th>Antibiotic prescriptions</th>
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<tbody>
<tr>
<td></td>
<td>Crude</td>
<td>Adjusted</td>
</tr>
<tr>
<td></td>
<td>OR 95% CI</td>
<td>OR 95% CI</td>
</tr>
<tr>
<td>Older sibling</td>
<td>0.77 0.53–1.09</td>
<td>0.68 0.43–1.02</td>
</tr>
<tr>
<td>Antibiotic prescriptions</td>
<td>1.21 0.74–1.99</td>
<td>1.27 0.73–2.21</td>
</tr>
</tbody>
</table>

CI, confidence interval. Crude OR and adjusted ORs with 95% CIs. The variables in the last step are shown in the models. Adjusted ORs were calculated using multiple logistic regressions with backward elimination of all variables except for siblings. Model 1 adjusted for social variables. Model 2 adjusted for variables in Model 1 plus antibiotic knowledge and concern about infectious illness. Model 3 adjusted for variables in Model 2 plus infectious symptoms lasting >7 days.
symptoms days, physician consultations or antibiotic prescriptions for 18-month-old children in Sweden today. Probably changes in social activities, health care seeking behaviour and attitudes towards antibiotic prescription may explain these differences in comparison with older Swedish studies and studies from other countries.

Declaration

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Ethical approval: Committees on research ethics at Linköping (Dnr 02-147) and Lund and Uppsala Universities.

Conflicts of interest: none.

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