Infection, health problems, and health care utilisation, and the risk of sudden infant death syndrome

M M T Vennemann, M Findeisen, T Butterfaß-Bahloul, G Jorch, B Brinkmann, W Köpcke, T Bajanowski, A Richter, E A Mitchell, the GeSID Group

**ORIGINAL ARTICLE**

A structured questionnaire was administered to parents by trained interviewers. Information was obtained on symptoms during the last day and the previous seven days by parental interview. In addition, whether the parent had measured the child’s temperature, and whether it was greater than 38°C was recorded. The infant’s paediatrician completed an extensive questionnaire which also contained questions on illnesses in the last four weeks and specific health problems at any stage of life. Immunisations will be reported in detail separately. Hospital records were also examined to determine whether or not the infant had been admitted to hospital, and if so, whether it was for a respiratory infection.

This analysis used 333 SIDS infants and 998 matched control infants. Univariate analysis and multivariate analysis were performed using conditional logistic regression. Each variable that was statistically significant (p < 0.05) in the univariate analysis was included separately in a multivariate model that adjusted for maternal factors (age, family status, smoking in pregnancy, parity, and socioeconomic status), infant factors (birth weight), and postnatal factors (breastfeeding for >2 weeks, sleep position, pacifier, and infant sharing a bed with an adult). The definitions of these variables have been described previously.

All 18 centres had the approval of their local medical ethics committees, and the state data protection officer gave permission to recruit controls in each federal state.

**RESULTS**

Symptoms during the last day and in the previous seven days were common in both cases and controls (table 1). Respiratory symptoms did not increase the risk of SIDS; diarrhoea and vomiting (during the last day) and vomiting (during the last seven days) increased the risk of SIDS in the univariate analysis, but after adjustment for potential confounders were not associated with a statistically significant increased risk of SIDS. Documented fever (>38°C) did not differ between cases and controls during the last day or the last seven days. Attendance at the doctor’s surgery during...
In the previous seven days did not differ between cases and controls. Illness in the last four weeks as reported by the paediatrician did not differ between cases and controls. Developmental problems at any stage of life significantly increased the risk of SIDS (adjusted OR = 2.14). Having had a special investigation, such as x-ray examination or electrocardiogram, was associated with an increased risk (adjusted OR = 2.07).

Admission to hospital at any stage of life was associated with an increased risk of SIDS in the univariate analysis only, and this appeared to be predominantly after the first week of life (adjusted OR = 1.88).

DISCUSSION

This study is the first to report detailed analysis of symptoms and healthcare utilisation in the post “Back to Sleep” era. In this study just 4% of the control population sleep prone. Parental reported symptoms were common in cases and controls, and no symptom was associated with an increased risk of SIDS after adjustment for potential confounders. Paediatrician reported illness in the previous four weeks was not associated with SIDS. It has been reported that although the prevalence of respiratory symptoms does not differ, SIDS infants are sicker than the controls. The presence of documented fever is a good marker for severity of illness, but this did not differ between cases and controls.

Having had a special investigation was associated with SIDS, and this may reflect the fact that SIDS cases were more likely to have been admitted to hospital than controls. There were many different causes for the admission to hospital, and no specific causes, such as infection of the respiratory tract, appeared different.

These findings tend to support our hypothesis that symptoms of infection as a risk factor for SIDS are much less important now that few infants sleep prone.

Of interest was the observation that paediatrician reported presence of developmental problems was a risk factor for SIDS. This provides support for the contention that infants which subsequently succumb to SIDS may be abnormal or vulnerable in some way. However, it should be noted that the number of SIDS cases with developmental problems is only 22%, and thus this is not a useful screening test for infants at risk of SIDS.

Limitations with this study should be recognised. Data obtained from the parents are subject to recall bias. However, it can reasonably be assumed that parents of cases might over-report symptoms, which would tend to increase the risk associated with symptoms. The fact that symptoms did not differ markedly between cases and controls provides support for our contention that symptoms of infection are no longer important as a risk factor for SIDS.

The second limitation is that standardised definitions for illness and health problems were not used by paediatricians, so that different criteria would have been used or the number of SIDS cases with developmental problems is only 22%, and thus this is not a useful screening test for infants at risk of SIDS.

**Table 1** Symptoms, illnesses, health problems, and hospitalisation, and risk of SIDS

<table>
<thead>
<tr>
<th>Variable</th>
<th>Case, n (%)</th>
<th>Control, n (%)</th>
<th>Univariate OR (95% CI)</th>
<th>Multivariate* OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured temperature and fever &gt;38°C (n=0)</td>
<td>25 (7.5)</td>
<td>68 (6.8)</td>
<td>1.11 (0.69 to 1.80)</td>
<td></td>
</tr>
<tr>
<td>Attended doctor (n=47)</td>
<td>102 (32.2)</td>
<td>323 (33.3)</td>
<td>0.90 (0.69 to 1.19)</td>
<td></td>
</tr>
<tr>
<td>In the last day</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Runny nose (n=4)</td>
<td>115 (34.7)</td>
<td>334 (33.5)</td>
<td>1.07 (0.81 to 1.39)</td>
<td></td>
</tr>
<tr>
<td>Cough (n=4)</td>
<td>60 (18.2)</td>
<td>173 (17.4)</td>
<td>1.07 (0.77 to 1.50)</td>
<td></td>
</tr>
<tr>
<td>Diarrhoea (n=8)</td>
<td>28 (8.6)</td>
<td>65 (6.5)</td>
<td>1.37 (0.86 to 2.10)</td>
<td></td>
</tr>
<tr>
<td>Vomiting (n=4)</td>
<td>53 (16.1)</td>
<td>92 (9.2)</td>
<td>1.90 (1.31 to 2.74)</td>
<td>1.55 (0.78 to 3.03)</td>
</tr>
<tr>
<td>Measured temperature and fever &gt;38°C (n=0)</td>
<td>25 (7.5)</td>
<td>68 (6.8)</td>
<td>1.11 (0.69 to 1.80)</td>
<td></td>
</tr>
<tr>
<td>In the last 4 weeks (from paediatrician)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common childhood infectious illnesses (n=96)</td>
<td>4 (1.3)</td>
<td>10 (1.1)</td>
<td>1.03 (0.32 to 3.33)</td>
<td></td>
</tr>
<tr>
<td>URI or bronchitis (n=99)</td>
<td>65 (21.7)</td>
<td>187 (20.1)</td>
<td>1.09 (0.78 to 1.51)</td>
<td></td>
</tr>
<tr>
<td>Any other infection (n=97)</td>
<td>49 (16.3)</td>
<td>116 (12.4)</td>
<td>1.40 (0.97 to 2.03)</td>
<td></td>
</tr>
<tr>
<td>Any illness (n=95)</td>
<td>117 (39.0)</td>
<td>353 (37.7)</td>
<td>1.10 (0.84 to 1.44)</td>
<td></td>
</tr>
<tr>
<td>Ever had the following (from paediatrician)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Developmental problems (n=96)</td>
<td>65 (21.7)</td>
<td>78 (8.3)</td>
<td>3.35 (2.25 to 4.97)</td>
<td>2.14 (1.04 to 4.39)</td>
</tr>
<tr>
<td>Accident (n=95)</td>
<td>9 (3.0)</td>
<td>22 (2.4)</td>
<td>1.11 (0.51 to 2.43)</td>
<td></td>
</tr>
<tr>
<td>Neglect (n=104)</td>
<td>18 (6.1)</td>
<td>7 (0.8)</td>
<td>7.49 (3.12 to 17.93)</td>
<td>0.79 (0.21 to 2.98)</td>
</tr>
<tr>
<td>Abuse suspected (n=102)</td>
<td>3 (1.0)</td>
<td>1 (0.1)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Special investigations (e.g. x ray, ECG) (n=108)</td>
<td>72 (24.6)</td>
<td>180 (19.4)</td>
<td>1.41 (1.02 to 1.95)</td>
<td>2.07 (1.18 to 3.64)</td>
</tr>
<tr>
<td>Laboratory test (n=114)</td>
<td>63 (21.2)</td>
<td>170 (18.5)</td>
<td>0.83 (0.59 to 1.15)</td>
<td></td>
</tr>
<tr>
<td>Referred to other specialist (n=97)</td>
<td>93 (31.1)</td>
<td>274 (29.3)</td>
<td>1.17 (0.87 to 1.57)</td>
<td></td>
</tr>
<tr>
<td>Hospital admission and outpatient clinic (OPC) data</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Admitted to hospital at any stage of life (n=36)</td>
<td>113 (34.7)</td>
<td>157 (16.2)</td>
<td>2.88 (2.12 to 3.90)</td>
<td>1.26 (0.52 to 3.03)</td>
</tr>
<tr>
<td>Admitted neonatal unit/hospital in first 7 days of life (n=36)</td>
<td>77 (23.6)</td>
<td>96 (9.9)</td>
<td>2.89 (2.05 to 4.08)</td>
<td>1.77 (0.87 to 3.62)</td>
</tr>
<tr>
<td>Admitted to hospital, excluding admissions in first 7 days of life (n=36)</td>
<td>53 (16.3)</td>
<td>75 (7.7)</td>
<td>2.31 (1.57 to 3.41)</td>
<td>1.88 (1.16 to 3.03)</td>
</tr>
<tr>
<td>OPC or specialist clinic attendance (n=0)</td>
<td>28 (8.4)</td>
<td>52 (5.2)</td>
<td>1.72 (1.05 to 2.82)</td>
<td></td>
</tr>
<tr>
<td>Admitted to hospital for respiratory infection after the first 7 days of life (n=0)</td>
<td>16 (4.8)</td>
<td>19 (1.9)</td>
<td>1.95 (0.49 to 7.69)</td>
<td></td>
</tr>
</tbody>
</table>

*Adjusting for maternal age (<20, 20-24, 25-29, 30+), family status (living alone/living with a partner), smoking in pregnancy (yes/no), parity (0/1 or more), socioeconomic status (low, middle, upper class), birth weight (in 500 g categories), breast feeding for >2 weeks (yes/no), sleep position, pacifier (yes/no), and infant sharing a bed with an adult (yes/no).
questionnaire could possibly be influenced by their knowledge of whether the subject was a case or control. Again this is more likely to increase the “identification” of illnesses and health problems among the cases. However, any such effect was likely to be small as only developmental problems were associated with an increased risk.

We conclude that symptoms of infection and illnesses are no longer risk factors for SIDS in communities such as Germany where few infants sleep prone, although admission to hospital for any cause was greater in cases than controls.

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