An 8 year study of risk factors for SIDS: bed-sharing versus non-bed-sharing

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An 8 year study of risk factors for SIDS: bed-sharing versus non-bed-sharing

C McGarvey, M McDonnell, K Hamilton, M O’Regan, T Matthews

Background: It is unclear if it is safe for babies to bed share with adults. In Ireland 49% of sudden infant death syndrome (SIDS) cases occur when the infant is bed-sharing with an adult.

Objective: To evaluate the effect of bed-sharing during the last sleep period on risk factors for SIDS in Irish infants.

Design: An 8 year (1994–2001) population based case control study of 287 SIDS cases and 831 controls matched for date, place of birth, and sleep period. Odds ratios and 95% confidence intervals were calculated by conditional logistic regression.

Results: The risk associated with bed-sharing was three times greater for infants with low birth weight for gestation (UOR 16.28 v 4.90) and increased fourfold if the combined tog value of clothing and bedding was >10 (UOR 9.68 v 2.34). The unadjusted odds ratio for bed-sharing was 13.87 (95% CI 9.58 to 20.09) for infants whose mothers smoked and 2.09 (95% CI 0.98 to 4.39) for non-smokers. Age of death for bed-sharing and sofa-sharing infants (12.8 and 8.3 weeks, respectively) was less than for infants not sharing a sleep surface (21.0 weeks, p<0.001) and fewer bed-sharing cases were found prone (5% v 32%; p=0.001).

Conclusion: Risk factors for SIDS vary according to the infant’s sleeping environment. The increased risk associated with maternal smoking, high tog value of clothing and bedding, and low z scores of weight for gestation at birth is augmented further by bed-sharing. These factors should be taken into account when considering sleeping arrangements for young infants.
register and matched for date of birth and the same community care area as the index case. Both case and control families were invited by letter to participate in a home interview which was conducted within 6 weeks of the index case's death. A detailed account of recruitment and interview processes has previously been described by Matthews et al. The study was approved by the Department of Health and Children and informed consent obtained from parents.

The average age of cases at time of death was 16.4 weeks and average age of control infants at interview was 21.8 weeks. Univariate analysis of variables related to the infants' last sleep was adjusted for this age difference. All multivariate analysis included a social disadvantage index, scoring 0–5 (5, most disadvantaged) as described previously. A variable was created for z scores of weight by gestation (multiples of standard deviations from the normal mean) by relating the birth weight of each baby to controls of similar gestation. These scores were adjusted for the effects of gender and parity on birth weight. The variable “parental alcohol consumption in last sleep” referred to any quantity of alcohol, and “history of illness since birth” referred to any symptoms or illness experienced by the infant during his/her lifetime. A continuous variable for “combined tog value of infant clothing and bedding during the last sleep period” was modified to derive a binary variable where 0 = tog <10 and 1 = tog ≥10. The variable “co-sleeping during the last sleep” was defined as any shared sleeping arrangement of an infant with an adult in or on a bed/sofa/armchair, while “bed-sharing” refers to infants sharing an adult bed with one or more adults. Infants who were room-sharing but not bed- or sofa-sharing were not included in the definition for co-sleeping.

Statistical analysis of data was conducted using Stata 8. The data were analysed by multiple conditional logistic regression allowing for matching and differences between cases and controls were expressed using odds ratios and 95% confidence intervals. Effect modifiers of “bed-sharing” were identified by examining interactions of the variable “infant found bed-sharing with adult(s)” with other variables studied. Mean values for continuous variables were compared using t tests and one way analysis of variance. Differences in distribution of risk factor between cases and controls were estimated using $\chi^2$ analysis.

### TABLE 1: Infant-parent bed-sharing and risk of SIDS

<table>
<thead>
<tr>
<th>Case</th>
<th>Control</th>
<th>Univariate</th>
<th>Multivariate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usual pattern</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not bed-sharing</td>
<td>188</td>
<td>71</td>
<td>780</td>
</tr>
<tr>
<td>Bed-sharing</td>
<td>75</td>
<td>29</td>
<td>47</td>
</tr>
<tr>
<td>Last sleep period</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No sharing of sleep surface</td>
<td>121</td>
<td>47</td>
<td>728</td>
</tr>
<tr>
<td>Bed-sharing</td>
<td>128</td>
<td>49</td>
<td>101</td>
</tr>
<tr>
<td>Co-sleeping on sofas/armchairs</td>
<td>11</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Next to one adult in bed</td>
<td>76</td>
<td>29</td>
<td>60</td>
</tr>
<tr>
<td>Between two adults in bed</td>
<td>44</td>
<td>17</td>
<td>39</td>
</tr>
<tr>
<td>Other</td>
<td>8</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

#### Risk factor interactions

Potential interactions of “bed-sharing” and “co-sleeping” with other variables in the study were examined and results are outlined in table 2. Significant interactions were observed for:

- **Bed-sharing:**
  - Bed-sharing (21–52 weeks) | OR: 3.53, 95% CI: 1.40 to 8.93
  - Bed-sharing (0–10 weeks) | OR: 8.07, 95% CI: 2.24 to 29.03
  - Bed-sharing (10–20 weeks) | OR: 16.38, 95% CI: 2.95 to 90.69
  - Bed-sharing (21–52 weeks) | OR: 2.11, 95% CI: 0.40 to 11.11
  - Bed-sharing (≥52 weeks) | OR: 0.78, 95% CI: 0.45 to 0.99

- **Risk factor interactions:**
  - Use of duvets, prone position, and...
between “bed-sharing” and variables for “maternal smoking”, “z scores at birth”, and “tog value of clothing/bedding ≥10”. Additional interactions with variables for “breastfeeding initiated at birth”, “history of illness during baby’s lifetime”, and “parental alcohol consumption during the last sleep” became non-significant following multivariate analysis, or when sofa-sharers were excluded from the definition of co-sleeping.

z Scores of weight of gestation at birth
The mean z score for SIDS infants was significantly lower than for control infants (– 0.55 v 0.034; p< 0.001). Stratifying the SIDS group by co-sleeping status revealed that bed-sharing and sofa-sharing infants had significantly lower z scores than non-bed-sharers (table 3). In the control group, bed-sharing infants had higher mean scores than infants sleeping on their own but this difference was not significant.

A categorical variable was created where 1 = z score in the lowest quartile of range for all infants in the study and 0 = score in 2nd, 3rd, or 4th quartile of range. For infants with scores in the lowest quartile, the UOR for bed-sharing was three times greater than for infants with scores in 2nd, 3rd, or 4th quartiles (table 4).

**Tog value of infant clothing and bedding**
The mean tog value of infant clothing and bedding for the last sleep was significantly higher for bed-sharing infants than infants sleeping in cots and this was true for both SIDS cases and control infants (table 3). Stratification of the bed-sharing data by tog value resulted in an UOR of 9.68 for bed-sharing when the combined tog value of clothing and bedding was ≥10. A total of 81% (102/126) of cases that were bed-sharing had tog value ≥10 in comparison with 57% (57/100) of controls. When the tog value was <10, the UOR for bed-sharing was reduced by a factor of four but remained statistically significant (table 4).

**Bed-sharing and maternal smoking**
The majority (87%) of SIDS cases that were bed-sharing for the last sleep had mothers who smoked during pregnancy (109/126) compared with only 17% (17/101) of controls. Logistic regression analysis revealed a significant odds ratio.
of 13.87 for bed-sharing infants whose mothers smoked, which was 6.6 times greater than the odds ratio for bed-sharing among non-smokers (table 4).

The reverse relationship was also examined, that is, how the odds ratio for maternal smoking was affected by bed-sharing status. Maternal smoking during pregnancy increased the SIDS risk by a factor of four for infants who did not bed/sofa-share (OR 3.74, 95% CI 2.31 to 5.99), whereas for bed-sharing infants the risk associated with maternal smoking was increased to 25 (OR 24.78, 95% CI 15.79 to 38.86).

**DISCUSSION**

This study demonstrates a high prevalence of bed-sharing among SIDS infants in the Irish population. More than half of all cases occurred while sharing a sleep surface with an adult(s), the majority of whom had mothers who smoked during pregnancy and half of whom were unaccustomed to this type of sleeping arrangement. The theoretical proportion of cases that may have been prevented if bed-sharing was eliminated as a risk factor is 37%.

A primary objective of the study was the distinction of bed-sharing from other types of co-sleeping such as sofa-sharing and statistical analysis of the data indicates that bed-sharing increases the risk of SIDS by a factor of almost four, a figure similar to other published data on bed-sharing. The profile of bed-sharing infants differed from that of non-bed-sharers with respect to a number of risk factors and the estimate of the associated risk was modified by maternal smoking status, the combined tog value of clothing and bedding used, and weight for gestation at birth. Additional interactions with variables for parental alcohol consumption, breastfeeding, and history of illness, also observed in our previous study, became non-significant after adjustment in the multivariate analysis or when sofa-sharers were removed from the analysis.

Bed-sharing infants were significantly younger than non-bed-sharers, an observation also reported by others. The OR for bed-sharing was higher for younger infants and in keeping with our previous data was not significant for infants 20 weeks of age. Initial reports stated that bed-sharing increases the SIDS risk only for infants whose mothers smoke, whereas more recently studies have found an effect of bed-sharing independent of maternal smoking status. In our analysis the odds ratio for bed-sharing was seven times greater for infants whose mothers smoked than for non-smokers, although, as evident by the associated 95% CI (0.98 to 4.39), the UOR for bed-sharing in the non-smoking group was not quite statistically significant. However caution is required with the interpretation of these data as this was clearly a borderline case with a trend towards a risk and a statement of no effect for bed-sharing among non-smokers should not be made without further study.

In our analysis the odds ratio for bed-sharing was seven times greater for infants whose mothers smoked than for non-smokers, although, as evident by the associated 95% CI (0.98 to 4.39), the UOR for bed-sharing in the non-smoking group was not quite statistically significant. However caution is required with the interpretation of these data as this was clearly a borderline case with a trend towards a risk and a statement of no effect for bed-sharing among non-smokers should not be made without further study.

When adjusted for maternal smoking, bed-sharing infants were found to be at greater risk of SIDS than non-bed-sharers. This is in keeping with the results of Carpenter et al who demonstrated that even among non-smokers, bed-sharing increased the risk of SIDS in younger infants suggesting that any form of bed-sharing may be dangerous for younger infants. Unfortunately more precise analysis of

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**Table 4** Odds ratios for bed-sharing, stratified by maternal smoking status, tog value, and z scores at birth

<table>
<thead>
<tr>
<th>Group</th>
<th>Cases</th>
<th></th>
<th></th>
<th>Controls</th>
<th></th>
<th></th>
<th></th>
<th>OR for bed-sharing</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother smoker</td>
<td>109</td>
<td>42</td>
<td>17</td>
<td>2</td>
<td>13.87</td>
<td>9.58 to 20.09</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother non-smoker</td>
<td>17</td>
<td>7</td>
<td>83</td>
<td>10</td>
<td>2.09</td>
<td>0.98 to 4.39</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tog &gt;10</td>
<td>102</td>
<td>40</td>
<td>57</td>
<td>7</td>
<td>9.68</td>
<td>6.24 to 11.36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tog &lt;10</td>
<td>24</td>
<td>9</td>
<td>44</td>
<td>5</td>
<td>2.34</td>
<td>1.12 to 4.95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>z Scores &lt; -0.81</td>
<td>57</td>
<td>25</td>
<td>17</td>
<td>2</td>
<td>16.28</td>
<td>14.15 to 19.10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>z Scores &gt; -0.81</td>
<td>56</td>
<td>24</td>
<td>72</td>
<td>10</td>
<td>4.90</td>
<td>2.88 to 8.41</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data refer to proportions of all infants found bed-sharing and further categorised according to maternal smoking status, tog value during last sleep, and birth weight adjusted for gestation.

z Scores < -0.81: scores in lowest quartile of data range; scores > -0.81: scores in 2nd, 3rd, and 4th quartiles.

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**Table 5** Prevalence of prone sleeping among bed-sharing and non-bed-sharing infants

<table>
<thead>
<tr>
<th></th>
<th>Bed-sharing</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Placed prone</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cases</td>
<td>10/126</td>
<td>8</td>
<td>14/120</td>
<td>12</td>
<td>1.76</td>
<td>0.41</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>116/126</td>
<td>92</td>
<td>106/120</td>
<td>88</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Controls</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1/101</td>
<td>1</td>
<td>17/725</td>
<td>2</td>
<td>0.76</td>
<td>0.38</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>100/101</td>
<td>99</td>
<td>708/725</td>
<td>98</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Found prone</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cases</td>
<td>19/128</td>
<td>15</td>
<td>39/121</td>
<td>32</td>
<td>10.52</td>
<td>0.001</td>
<td></td>
<td></td>
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<tr>
<td>No</td>
<td>109/128</td>
<td>85</td>
<td>82/121</td>
<td>68</td>
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<tr>
<td>Controls</td>
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<td></td>
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<td></td>
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<tr>
<td>Yes</td>
<td>9/101</td>
<td>9</td>
<td>39/728</td>
<td>5</td>
<td>2.04</td>
<td>0.15</td>
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<tr>
<td>No</td>
<td>92/101</td>
<td>91</td>
<td>689/728</td>
<td>95</td>
<td></td>
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</tbody>
</table>
The relationship between bed-sharing and infant age among the non-smoking population in this study was not possible due to the age difference between cases and controls at time of interview and the small number of non-smokers in the bed-sharing SIDS group. These results indicate that additional studies employing larger sample sizes are now warranted which will increase statistical power sufficiently to demonstrate confidently whether there is a significant effect of bed-sharing for non-smokers. The variance of our results with others reporting no interaction with smoking might be accounted for by variations in the study populations, for example, ethnicity, the definitions used for bed-sharing and in the reference groups, and diagnostic criteria used. Importantly, maternal smoking was found to be a risk factor regardless of bed-sharing status, indicating that the risk associated with smoking is not mediated solely via bed-sharing. These babies may be more vulnerable and less capable of dealing with potential stressors associated with bed-sharing.

Infants who bed-shared had higher thermal insulation than non-bed-sharers. The higher Tog value observed for bed-sharers elevated the bed-sharing risk by a factor of four. Furthermore, infants found between two adults were at greater risk than those found next to one adult. Excess thermal insulation from bedding while bed-sharing has been reported previously and some, but not all, studies of overnight rectal temperatures have shown that bed-sharers have significantly higher temperatures than infants sleeping alone. However, a study of excess thermal insulation in healthy infants has shown that bed-sharers are capable of maintaining adequate thermoregulation and normal core temperature suggesting that the risk might only apply to vulnerable infants exposed to other risk factors such as maternal smoking. Unfortunately, we had insufficient data for assessment of the effect of head covering, another important factor in compromising thermoregulation which has been shown to be more common among bed-sharers than non-bed-sharers.

Modification of the effect of bed-sharing by these other factors, that is, increased Tog values, number and proximity of adjacent adults, low birth weight, and maternal smoking, suggests that the increased risk from bed-sharing may be mediated through other mechanisms such as overheating or hypoxia induced by rebreathing of expired parental air. These factors may exert stronger physiological demands on a vulnerable infant while bed-sharing, similar to the way that they do when infants are sleeping prone.

We reported previously that more co-sleeping (all surfaces) than non-co-sleeping infants were placed and found in the prone position. Restricting the analysis to bed-sharers only, we found that the proportion of cases found prone while bed-sharing was significantly less than those found prone in cots, while no significant difference was found for control infants. It has been suggested that infants who bed-share are less likely to be placed or found prone as a result of increased parental awareness from the close proximity of the infant while breastfeeding. However, while bed-sharing is associated with increased duration and prevalence of breastfeeding, there is no evidence to date that bed-sharing reduces the risk of SIDS. It remains to be determined whether bed-sharing arrangements for the primary purpose of breastfeeding differ from other forms of bed-sharing.

These results are not supportive of a protective role for bed-sharing. They reiterate that at least some arrangements of infant-parent bed-sharing are unsafe and that factors associated with bed-sharing increase the risk of SIDS for vulnerable infants. While it has not been demonstrated that bed-sharing is a risk factor in itself, clearly it interacts with other risk factors to increase the associated risks even further.

What is already known on this topic

- Infant-parent bed-sharing increases the risk of sudden infant death syndrome for infants whose parents smoke. A similar association among non-smokers has been reported only for younger infants (<8 and <11 weeks of age). Infants older than 20 weeks of age are not at increased risk
- Temporary bed-sharing does not present a risk when the infant is placed back in their own cot to sleep

What this study adds

- Bed-sharing poses a greater risk for infants born with low birth weight for gestation
- SIDS cases that were bed-sharing for the last sleep period were less likely to be found in the prone position

References


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