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

C McGarvey, M McDonnell, K Hamilton, M O'Regan and T Matthews

Arch. Dis. Child. 2006;91;318-323; originally published online 21 Oct 2005;
doi:10.1136/adc.2005.074674

ORIGINAL ARTICLE

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

Arch Dis Child 2006;**91**:318–323. doi: 10.1136/adc.2005.074674

See end of article for authors' affiliations

Correspondence to: Cliona McGarvey, National Sudden Infant Death Register, George's Hall, The Children's University Hospital, Temple St, Dublin 1, Ireland; cliona.mcgarvey@tsch.ie

Accepted 25 September 2005
Published Online First 21 October 2005

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.

Epidemiological studies indicating some forms of infant-parent co-sleeping as a risk factor for sudden infant death syndrome (SIDS) have initiated much debate as to whether or not it is safe for babies to co-sleep with adults in adult beds.[1–6] While there is agreement regarding the dangers of co-sleeping on sofas and armchairs, details regarding the risks and/or benefits of bed-sharing remain unclear. Variations in the use and interpretation of terminology and definitions for bed-sharing (infant sharing an adult bed) and co-sleeping (which may refer to sharing any type of sleep surface or simply room sharing without bed-sharing) add to the confusion. The practice of bed-sharing is increasing in some countries and in Ireland, where the SIDS rate is currently 0.7 per 1000 live births, a large proportion of SIDS cases every year occur while the infant is sharing a sleep surface with an adult(s), highlighting the need for further investigation of this issue.[6–8]

Thermal stress is a known risk factor for SIDS and is thought to be one mechanism by which bed-sharing may put infants at increased risk, particularly if the infants are sleeping prone.[9–12] Other factors associated with bed-sharing include the additional body heat of adjacent adults sharing the bed, the possibility of the infants' head covering with bedding, and use of soft bedding. These factors might contribute to an increased risk of SIDS through overheating or rebreathing of expired air.[9 10 13–16] Several studies have indicated that the associated risk applies only to younger babies and babies whose parents smoke.[1 3–5] However, recent studies have shown that even among non-smokers, bed-sharing increases the SIDS risk in younger infants, suggesting that all forms of bed-sharing should be avoided for these infants.[17 18] In countries with low SIDS rates where bed-sharing is the common method of sleeping arrangement, maternal smoking rates are also low and sleep surfaces are firm.[19] In general, it is agreed that bed-sharing should be avoided if parents are smokers, have consumed alcohol or other drugs, or are ill or excessively tired. So while there are some situations where bed-sharing is clearly dangerous, whether bed-sharing per se poses a risk remains to be determined.

Previous investigations from our group demonstrated that infants who are placed back in their own cots/beds to sleep or are ⩾20 weeks of age are not at increased risk.[1] This would indicate that temporary bed-sharing for the purpose of feeding, for example, does not bring added risk. We also found that the risk associated with co-sleeping was influenced by maternal smoking status. However, a limitation of this analysis was that a distinction was not made between infants co-sleeping on couches or armchairs and those co-sleeping in beds. Co-sleeping on sofas is considered a particularly dangerous practice and should be excluded from analyses aiming to establish whether there are risks associated specifically with bed-sharing. The current study is an extension of our previous work, includes additional data for the years 1999–2001, and has enabled us to conduct a more detailed examination of the profile of risk factors for SIDS among both bed-sharing infants and those sleeping in cots.

METHODOLOGY

This study was part of an ongoing, nationwide case control study of SIDS in the Republic of Ireland. The National SIDS Register is notified of all sudden unexpected deaths in infancy (SUDI) in Ireland and all cases occurring between the 1st January 1994 and 31st December, 2001 with "SIDS" as the certified cause of death were included in the study. Controls were selected randomly for each case from the birth

Abbreviations: AOR, adjusted odds ratio; SIDS, sudden infant death syndrome; UOR, unadjusted odds ratio

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*.[20] 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.[20] 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.[21] 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 factors between cases and controls were estimated using χ^2 analysis. The population attributable risk for bed-sharing, adjusted for other variables in the multivariate model, was calculated as described by Bruzzi *et al*.[22]

RESULTS

During the time period of the study, 332 cases of SIDS were reported to the register and of these, a total of 287 families agreed to participate in the study, corresponding to a response rate of 86%. The response rate for control families was also 86% (831/966). Information on co-sleeping status during the last sleep period was available for 260 SIDS cases and 829 controls.

A total of 49% of SIDS infants were found while bed-sharing with an adult(s), in comparison with 12% of control infants bed-sharing during a corresponding reference sleep (table 1). An additional 4% of cases died while co-sleeping with an adult on a sofa or armchair. An estimated 50% (64/127) of SIDS cases who were bed-sharing on the night they died were unaccustomed to this type of sleeping arrangement.

Logistic regression analysis revealed an adjusted odds ratio (AOR) of 3.53 for bed-sharing indicating a fourfold increase in the SIDS risk for infants who bed-share. The estimated proportion attributable risk for the population was 37%. A comparison with non-co-sleeping infants revealed that the associated odds ratio was greater when the infant was found located between two adults than when found next to one adult (table 1).

SIDS cases found sharing a sleep surface were significantly younger than cases found sleeping in cots; 12.8 weeks (bed-sharers) and 8.3 weeks (sofa-sharers) *v* 21.0 weeks for infants not sharing a sleep surface ($p<0.001$). Categorisation of bed-sharing infants by age resulted in an unadjusted OR (UOR) of 8.07 for bed-sharing infants ⩽10 weeks of age and when adjusted for maternal smoking and social deprivation the OR remained statistically significant (table 1). Infants older than 20 weeks were not at significant risk compared with non-bed/sofa-sharers.

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

Table 1 Infant-parent bed-sharing and risk of SIDS

	Case		Control		Univariate		Multivariate	
	n	%	n	%	OR	95% CI	OR	95% CI
Usual pattern								
Not bed-sharing	188	71	780	94	Ref		Ref	
Bed-sharing	75	29	47	6	5.09	1.86 to 13.92	5.20	1.86 to 14.50
Last sleep period								
No sharing of sleep surface	121	47	728	88	Ref		Ref	
Bed-sharing	128	49	101	12	5.30	2.29 to 12.24	3.53	1.40 to 8.93
Co-sleeping on sofas/armchairs	11	4	0	0	*	*	*	*
Next to one adult in bed	76	29	60	7	4.94	1.89 to 12.91	3.29	1.05 to 10.26
Between two adults in bed	44	17	39	5	5.20	1.20 to 22.55	4.68	1.09 to 19.99
Other	8	4	2	0.2	*	*	*	*
Bed-sharing (0–10 weeks)	71	28	16	2	8.07	2.24 to 29.03	8.02†	1.97 to 32.54
Bed-sharing (10–20 weeks)	39	15	36	4	16.38	2.95 to 90.69	6.63†	0.95 to 45.81
Bed-sharing (21–52 weeks)	15	6	36	4	2.11	0.40 to 11.11	1.63†	0.27 to 10.00
Bed-sharing (>52 weeks)	2	1	13	2	0.78	0.45 to 0.59	0.42†	0.01 to 14.17

Multivariate analysis adjusted for maternal age, education, smoking, drinking, and occurrence of urinary tract infection during pregnancy, social disadvantage, ⩾3 previous live births, z scores for weight by gestation, resuscitation required at birth, male sex, whether breastfeeding was initiated at birth, any history of illness during infant's lifetime, baby prone to sweating, symptoms in 48 h prior to last/reference sleep, tog of clothing/bedding ⩾10, use of duvets, prone position, and absence of routine soother use during the last/reference sleep period. Odds ratios for all univariate analysis adjusted for infant age at death/interview.
''Other'' refers to cases found: ''between mother and other child'' (n = 3), ''at top of bed with older sibling, younger siblings at bottom'' (n = 1), ''baby down in middle/bottom of bed'' (n = 2), ''next to one sibling 13 years of age'' (n = 1), or no information on location (n = 1).
*Odds ratio not available due to the lack of any control infants who co-slept on sofas/armchairs; †adjusted for maternal smoking and social deprivation.

Table 2 Interaction of "bed-sharing" (±sofa-sharers) with other risk factors

Risk factor	Interaction with bed-sharing			
	UOR	95% CI	AOR	95% CI
Placed prone for last sleep	1.94	0.19 to 18.89	–	
Mother smoker	6.64	2.29 to 19.24	6.35	1.15 to 34.81
Social disadvantage (3–5)	0.95	0.34 to 2.67	–	
z Scores of weight for gestation at birth (cts variable)	0.55	0.35 to 0.88	0.37	0.14 to 0.97
Breastfeeding initiated at birth	0.42	0.17 to 1.02		
History of symptoms/illness since birth	0.46	0.20 to 1.06	–	–
Tog of clothing/bedding ⩾10	4.21	1.68 to 10.55	6.14	1.10 to 34.42
Duvets used for last sleep	2.34	0.89 to 6.18		
Pillows used for last sleep	0.39	0.09 to 1.72	–	
Parental alcohol consumption in last 24 h	3.39	1.00 to 11.51	0.39	0.02 to 8.71
Absence of routine soother use for last sleep	1.40	0.46 to 4.28	–	
	Interaction with co-sleeping			
	UOR	95% CI	AOR	95% CI
Placed prone for last sleep	2.38	0.25 to 22.76	–	
Mother smoker	7.56	2.62 to 21.8	8.50	1.57 to 45.99
Social disadvantage (3–5)	0.94	0.34 to 2.62	–	
z Scores of weight by gestation at birth (cts variable)	0.58	0.36 to 0.92	0.31	0.12 to 0.79
Breastfeeding initiated at birth	0.40	0.17 to 0.96	0.55	0.13 to 2.36
History of illness since birth	0.41	0.18 to 0.92	0.31	0.07 to 1.42
Tog of clothing/bedding ⩾10 for last sleep	2.23	0.97 to 5.13	3.17	0.64 to 15.79
Duvets used for last sleep	1.28	0.52 to 3.11		
Pillows used for last sleep	0.24	0.06 to 1.01		
Parental alcohol consumption in last 24 h	3.95	1.19 to 13.07	0.41	0.02 to 8.95
Absence of routine soother use for last sleep	1.69	0.56 to 5.04	–	

Odds ratios adjusted for maternal age, education, smoking and drinking during pregnancy, social disadvantage, occurrence of a urinary tract infection during pregnancy, infant z scores at birth, resuscitation at birth, male sex, breastfeeding initiated at birth, history of illness since birth, baby prone to sweating, symptoms/problems in 48 h prior to death and tog value of clothing and bedding ⩾10, use of duvets, absence of routine soother use, placed prone during the last sleep period. cts, continuous.

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 for 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 of scores 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

Table 3 Infant z scores of weight for gestation at birth and combined tog value of clothing and bedding, stratified by bed-sharing status during the last/reference sleep

	Cases			Controls		
	Mean	SD	n	Mean	SD	n
z Scores of weight for gestation at birth						
Non-co-sleepers	−0.31	1.07	108	0.02	1.0	649
Bed-sharers	−0.78*	1.12	113	0.10	0.9	89
Sofa-sharers	−0.51*	1.11	10	–	–	–
Tog of clothing+bedding for last sleep						
Non-co-sleepers	9.76	4.49	118	9.41	4	724
Bed-sharers	13.34*	5.18	126	10.86*	3.82	100
Sofa-sharers	6.27	4.56	11	–	–	–

*p<0.01 *v* non-co-sleepers.

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

Group	Cases		Controls		OR for bed-sharing	95% CI
	n	%	n	%		
Mother smoker	109	42	17	2	13.87	9.58 to 20.09
Mother non-smoker	17	7	83	10	2.09	0.98 to 4.39
Tog ⩾10	102	40	57	7	9.68	8.24 to 11.36
Tog <10	24	9	44	5	2.34	1.12 to 4.95
z Scores < −0.81	57	25	17	2	16.28	14.15 to 19.10
z Scores ⩾ −0.81	56	24	72	10	4.90	2.88 to 8.41

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.

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).

Bed-sharing and prone sleeping

More case than control infants were placed and found in the prone position (table 5). No significant difference was observed between the proportion of bed-sharers and non-bed-sharers *placed* prone. However, the proportion of SIDS cases *found* prone while bed-sharing was significantly less than for non-bed-sharers.

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.[5 17 18]

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.[4 5 18] 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.[1] 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.[4 5 17 18] 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.[23] When adjusted for maternal smoking, bed-sharing infants ⩽10 weeks of age remained 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.[17] Unfortunately more precise analysis of

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

	Bed-sharing		Sleeping alone			
	n	%	n	%	$\chi 2$	p value
Placed prone						
Cases						
Yes	10/126	8	14/120	12		
No	116/126	92	106/120	88	1.76	0.41
Controls						
Yes	1/101	1	17/725	2		
No	100/101	99	708/725	98	0.76	0.38
Found prone						
Cases						
Yes	19/128	15	39/121	32		
No	109/128	85	82/121	68	10.52	0.001
Controls						
Yes	9/101	9	39/728	5		
No	92/101	91	689/728	95	2.04	0.15

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

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.[15 18] 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. The effects were greatly increased, however, when the infant was also bed-sharing.

Bed-sharing posed a greater risk for infants born with low birth weight for gestation and it is possible that the lower birth weight observed for bed-sharing infants may account for at least some of the effects of maternal smoking since studies have shown that infants of smokers are more likely to be born prematurely and to be of low birth weight.[24 25] 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.[11 26–28] 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.[27] 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.[9 27]

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.[9 11 29–31]

We reported previously that more co-sleeping (all surfaces) than non-co-sleeping infants were placed and found in the prone position.[1] 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.[27 32 33] 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.[34–36] 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.

Authors' affiliations
C McGarvey, M McDonnell, K Hamilton, National Sudden Infant Death Register, George's Hall, The Children's University Hospital, Temple St, Dublin 1, Ireland
M O'Regan, Department of Statistics, Trinity College Dublin, Dublin, Ireland
T Matthews, University College Dublin, Department of Paediatrics, The Children's University Hospital, Temple St, Dublin 1, Ireland

Competing interests: none declared

REFERENCES

1 **McGarvey C**, McDonnell M, Chong A, *et al*. Factors relating to the infant's last sleep environment in sudden infant death syndrome in the Republic of Ireland. *Arch Dis Child*, 2003;**88**:1058–64.
2 **Brooke H**, Gibson A, Tappin D, *et al*. Case-control study of sudden infant death syndrome in Scotland. *BMJ* 1997;**314**:1516–20.
3 **Fleming PJ**, Blair PS, Bacon C, *et al*. Environment of infants during sleep and risk of sudden infant death syndrome: results of 1993-5 case-control study for confidential inquiry into stillbirths and deaths in infancy. *BMJ* 1996;**313**:191–5.
4 **Blair PS**, Fleming PJ, Smith IJ, *et al*. Babies sleeping with parents: case-control study of factors influencing the risk of sudden infant death syndrome. *BMJ* 1999;**319**:1457–62.
5 **Scragg RKR**, Mitchell EA, Taylor BJ, *et al*. Bed sharing, smoking, and alcohol in the sudden infant death syndrome. *BMJ* 1993;**307**:1312–18.
6 **Arnestad M**, Andersen M, Vege Å, *et al*. Changes in the epidemiological pattern of sudden infant death syndrome in southeast Norway, 1984–1998: implications for future prevention and research. *Arch Dis Child* 2001;**85**:108–15.
7 **Willinger M**, Ko C, Hoffman HJ, *et al*. Trends in infant bedsharing in the United States, 1993–2000. *Arch Paediatr Adolesc Med* 2003;**157**:43–7.
8 **deJonge GA**, Hoogenbozezem J. Epidemiology of 25 yrs of cot death (sudden infant death syndrome) in the Netherlands; incidence of cot death and prevalence of risk factors in 1980–2004. *Ned Tijdschr Geneeskd* 2005;**149**:1273–8.
9 **Fleming PJ**, Gilbert R, Azaz Y, *et al*. Interaction between bedding and sleeping position in the sudden infant death syndrome: a population based case-control study. *BMJ* 1990;**301**:85–9.
10 **Ponsonby AL**, Dwyer T, Gibbons LE, *et al*. Thermal environment and sudden infant death syndrome: case-control study. *BMJ* 1992;**304**:277–82.
11 **Tuffnell CS**, Petersen SA, Wailoo MP. Higher rectal temperatures in co-sleeping infants. *Arch Dis Child* 1996;**75**:249–50.

12 **Williams SM**, Taylor BJ, Mitchell EA. Sudden infant death syndrome: insulation from bedding and clothing and its effect modifiers. *Int J Epidemiol* 1996;**25**:366–75.
13 **Flick L**, White DK, Vemulapalli C, *et al*. Sleep position and the use of soft bedding during bed-sharing among Africa American infants at increased risk for sudden infant death syndrome. *J Paediatr* 2001;**111**:1207–14.
14 **L'Hoir MP**, Engelberts AC, van Well GThJ, et al. Risk and preventive factors for cot death in the Netherlands, a low incidence country. *Eur J Pediatr* 1998;**157**:681–8.
15 **Hauck FR**, Herman SM, Donovan M, *et al*. Sleep environment and the risk of sudden infant death syndrome in an urban population: The Chicago Infant Mortality Study. *Pediatrics* 2003;**111**:1207–14.
16 **Kemp JS**, Unger B, Wilkins D, *et al*. Unsafe sleep practices and an analysis of bed-sharing among infants dying suddenly and unexpectedly: results of a four year population based, death-scene investigation study of sudden infant death syndrome and related deaths. *Pediatrics* 2000;**106**:e41.
17 **Carpenter RG**, Irgens LM, Blair PS, *et al*. Sudden unexplained infant death in 20 regions in Europe: case control study. *Lancet* 2004;**363**:185–91.
18 **Tappin D**, Ecob R, Brooke H. Bed-sharing, room-sharing and sudden infant death syndrome in Scotland: a case control study. *J Pediatr* 2005;**147**:32–7.
19 **Nelson EA**, Taylor BJ, Jenik A, *et al*. International Child Care Practices Study: infant sleeping environment. *Early Hum Dev* 2001;**62**:43–55.
20 **Matthews T**, McDonnell M, McGarvey C, *et al*. A multivariate ''time based'' analysis of SIDS risk factors. *Arch Dis Child* 2004;**89**:267–71.
21 **Tin W**, Wariyar UK, Hey EN. Selection biases invalidate current low birthweight weight-for-gestation standards. The Northern Neonatal Network. *Br J Obstet Gynaecol* 1997;**100**:835–40.
22 **Bruzzi P**, Green SB, Byar DP, *et al*. Estimating the population attributable risk for multiple risk factors using case-control data. *Am J Epidemiol* 1985;**122**:904–14.
23 **Altman DG**, Bland, JM. Absence of evidence is not evidence of absence. *BMJ* 1995;**311**:485.
24 **Davies DP**, Abernethy M. Cigarette smoke in pregnancy: associations with maternal weight gain and fetal growth. *Lancet* 1976;**1**:385–7.
25 **England LJ**, Kendrick JS, Gargiullo PM, *et al*. Measures of maternal tobacco exposure and infant birthweight at term. *Am J Epidemiol* 2001;**53**:954–60.
26 **Watson L**, Potter A, Galluci R, *et al*. Is baby too warm? The use of infant clothing, bedding and home heating in Victoria, Australia. *Early Hum Dev* 1998;**51**:93–107.
27 **Baddock SA**, Galland BC, Beckers MGS, *et al*. Bed-sharing and the infant's thermal environment in the home setting. *Arch Dis Child* 2004;**89**:1111–16.
28 **Ball HL**. Triadic bed-sharing and infant temperature. *Child Care Health Dev* 2002;**28**:55–8.
29 **Galland BC**, Taylor BJ, Bolton DPG. Prone versus supine sleep position: a review of the physiological studies in SIDS research. *J Paediatr Child Health* 2002;**38**:332–8.
30 **Byard RW**. Is breastfeeding in bed always a safe practice? *J Paediatr Child Health* 1998;**34**:418–19.
31 **Ponsonby A-L**, Dwyer T, Gibbons LE, *et al*. Factors potentiating the risk of sudden infant death syndrome associated with the prone position. *N Engl J Med* 1993;**329**:377–82.
32 **Richard C**, Mosko S, McKenna J, *et al*. Sleep position, orientation and proximity in bed sharing infants and mothers. *Sleep* 1996;**19**:685–90.
33 **Wailoo M**, Ball H, Fleming P, *et al*. Infants bedsharing with mothers. *Arch Dis Child* 2004;**89**:1082–1083.
34 **Ball HL**. Breastfeeding, bed-sharing and infant sleep. *Birth* 2003;**30**:181–88.
35 **Blair PS**, Ball HL. The prevalence and characteristics associated with parent-infant bed-sharing in England. *Arch Dis Child* 2004;**89**:1106–10.
36 **McCoy RC**, Hunt CE, Lesko SM, *et al*. Frequency of bed sharing and its relationship to breastfeeding. *J Dev Behav Pediatr* 2004;**25**:141–9.