

## Bed Sharing and the Risk of Sudden Infant Death Syndrome: Can We Resolve the Debate?

Mechtild M. Vennemann, MD, MPH<sup>1</sup>, Hans-Werner Hense, MD<sup>2</sup>, Thomas Bajanowski, MD, PhD<sup>3</sup>, Peter S. Blair, PhD<sup>4</sup>,  
Christina Compojer<sup>1</sup>, Rachel Y. Moon, MD<sup>5</sup>, and Ursula Kiechl-Kohlendorfer, MD, MSc<sup>6</sup>

**Objective** To conduct a meta-analysis on the relationship between bed sharing and sudden infant death syndrome (SIDS) risk.

**Study design** Data from PubMed and Medline were searched for studies published after Jan 1, 1970. The search strategy included articles with the terms “sudden infant death syndrome,” “sudden unexpected death,” and “cot death” with “bed sharing” or “co-sleeping.” To further specify the potential risk of bed sharing and SIDS, subgroup analyses were performed.

**Results** Eleven studies met inclusion criteria and were included in the final meta-analysis. The combined OR for SIDS in all bed sharing versus non-bed sharing infants was 2.89 (95% CI, 1.99-4.18). The risk was highest for infants of smoking mothers (OR, 6.27; 95% CI, 3.94-9.99), and infants <12 weeks old (OR, 10.37; 95% CI, 4.44-24.21).

**Conclusions** Bed sharing is a risk factor for SIDS and is especially enhanced in smoking parents and in very young infants. (*J Pediatr* 2012;160:44-8).

The sudden and unexplained death of a seemingly healthy infant is still the leading cause of post-neonatal mortality in most developed countries. Most of these infant deaths are certified as sudden infant death syndrome (SIDS). A number of case-control studies in the late 1980s and early 1990s identified the prone sleeping position as a main risk factor for SIDS.<sup>1-3</sup> This finding resulted in a widespread recommendation to avoid the prone sleeping position (“Back to Sleep” campaigns), which was followed by a substantial drop in the SIDS mortality rate in many countries.<sup>4-6</sup> After this success, advice on other infant care practices has been given to reduce further the risk of SIDS, although specific recommendations vary from country to country.<sup>7-10</sup> There is ongoing debate and controversy about bed sharing recommendations, especially because some studies suggest that bed sharing does not increase SIDS risk for infants of non-smoking parents.<sup>11</sup> Some countries advise parents simply not to bed share,<sup>8,12</sup> and some countries advise not to bed share in certain circumstances.<sup>10</sup>

The purpose of this study was to conduct a meta-analysis of all case-control studies that provide data on bed sharing and SIDS to provide a thorough quantitative review of the current evidence about SIDS risk associated with bed sharing. Our hypotheses were: (1) bed sharing increases the risk for SIDS; and (2) the risk is highest for young infants.

Our methods follow the guidelines for reporting meta-analyses of observational studies, proposed by Stroup et al.<sup>13</sup>

### Methods

In the search for all relevant studies, two of the authors (M.V., C.C.) independently searched PubMed and Medline for these subjects: “sudden infant death syndrome,” “sudden unexpected death,” and “cot death” with “bed sharing” or “co-sleeping.” In addition, all reference lists of the relevant studies were checked to find additional studies that may have been overlooked. Finally, participants at the “Epidemiology Working Group” of the International Society for the Study and Prevention of Perinatal and Infant Death and the SIDS International Conference in 2008 were asked whether there were other studies on bed sharing that were not yet published. Bed sharing was defined as the practice of sharing a sleep surface between adults and young children.

#### Selection Criteria for Studies Included in the Meta-Analysis

Only studies analyzing the influence of bed sharing on the risk of SIDS were included. All case-control studies about SIDS and bed sharing were considered. These selection criteria were set before reviewing the papers: (1) an adequate definition for SIDS; (2) autopsies performed in >95% of cases; (3) an appropriate description of SIDS ascertainment in the study population; (4) a clear description of the process of control selection; and (5) sufficient data to calculate ORs and

From the <sup>1</sup>Institute of Legal Medicine, University of Münster, Münster, Germany; <sup>2</sup>Institute of Epidemiology and Social Medicine, Münster, Germany; <sup>3</sup>Institute of Legal Medicine, University of Essen, Essen, Germany; <sup>4</sup>School of Social and Community Medicine, University of Bristol, St Michael's Hospital, Bristol, United Kingdom; <sup>5</sup>Children's National Medical Center and Department of Pediatrics, George Washington University School of Medicine and Health Sciences, Washington, DC; and <sup>6</sup>Department of Pediatrics, Division of Neonatology, Neuropaediatrics and Metabolic Diseases, Innsbruck Medical University, Innsbruck, Austria

The authors declare no conflicts of interest.

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SIDS Sudden infant death syndrome

95% CIs, or the actual ORs and 95% CIs were provided. When there were multiple publications from one study, only the publication with the most relevant information on bed sharing was used. The search included publications from Jan 1, 1970, to December 2009. There was no restriction on language.

### Exclusion of Studies

The New Zealand Cot Death Study (1991-1993) was excluded because no multivariate ORs were reported for bed sharing.<sup>14</sup> The European Concerted Action on SIDS<sup>15</sup> study pooled data from case-control studies in 20 different regions in Europe. However, because some of these nation-wide studies were already included in the meta-analysis,<sup>16,17</sup> we excluded the European Concerted Action on SIDS study to avoid including some studies twice. The Confidential Enquiry into Stillbirths and Deaths in Infancy study (1993-1995)<sup>11</sup> was excluded because results of the same research group with an extended period (1993-1996) were included in the current meta-analysis.<sup>16</sup> Three additional studies were not considered because of the small numbers of bed sharing infants in cases and controls.<sup>18-20</sup>

### Statistical Methods

We calculated the summary ORs from the published univariate and multivariate ORs, with the Mantel-Haenszel fixed effect model (Comprehensive Meta Analysis, version 2; BioStat, Englewood, New Jersey).

We then stratified studies containing the pertinent data according to parental smoking status (mother smoking, father smoking, or both versus non-smoking parents), age of infant at the time of last sleep regardless of smoking status (<12 weeks versus  $\geq$ 12 weeks), and bed sharing as a usual habit versus bed sharing not usual but in the last night.

## Results

Eleven case-control studies were included in the meta-analysis.<sup>3,16,17,21-28</sup> First author, country, number of cases and controls, the total number of subjects in each study, and univariate and multivariate ORs with 95% CI for the risk of SIDS are shown in the [Table](#). The flow diagram

describing inclusion and exclusion of studies is shown in [Figure 1](#) (available at [www.jpeds.com](http://www.jpeds.com)). The forest plot for the multivariate ORs with the random effect model is shown in [Figure 2](#).

The summary OR for bed sharing and SIDS was 2.89 (95% CI, 1.99-4.18). In the combined calculation, 2464 cases and 6495 controls were included, of which 710 cases (28.8%) and 863 controls (13.3%) bed shared. There was some heterogeneity in the analysis (degrees of freedom: 10;  $P = .009$ ; I-squared: 57.3). When the Blair et al<sup>22</sup> paper with an OR of 21.8 was excluded, I-squared was 48.5 ( $P = .04$ ).

### Smoking versus Non-Smoking Parents

The risk of SIDS and bed sharing with smoking mothers was reported in detail in 4 studies. The subgroup analysis for maternal smoking and bed sharing<sup>11,28-30</sup> found an OR of 6.27 (95% CI, 3.94-9.99), and the risk for non-smoking mothers<sup>11,28,29</sup> was 1.66 (95% CI, 0.91-3.01; [Figure 3](#)).

### Infant's Age Regardless of Smoking Status

Bed sharing with infants <12 weeks old was reported by 3 studies,<sup>17,28,30</sup> with an OR of 10.37 (95% CI, 4.44-24.21), and the OR for older infants was 1.02 (95% CI, 0.49-2.12; [Figure 4](#); available at [www.jpeds.com](http://www.jpeds.com)).

### Routine Sleep Location

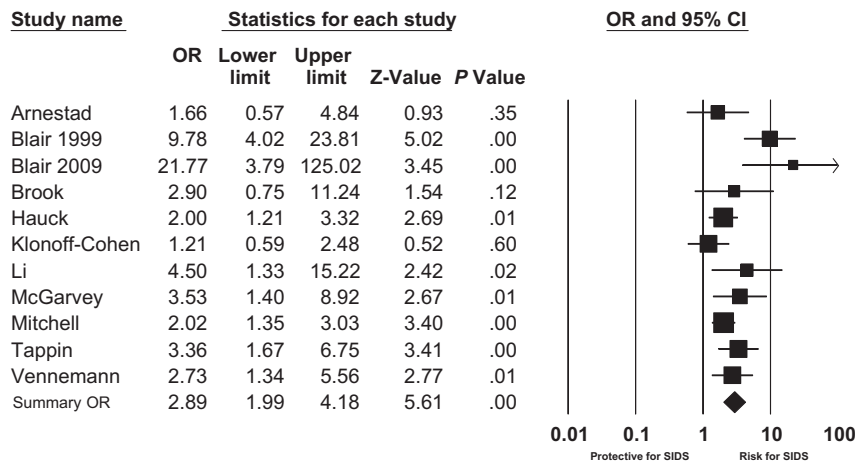
Routine bed sharing<sup>28,29</sup> was not significantly associated with SIDS, with an OR of 1.42 (95% CI, 0.85-2.38), but the risk for those reporting bed sharing on the last night when bed sharing was not routine<sup>17,29-31</sup> had a statistically significant OR of 2.18 (95% CI, 1.45-3.28; [Figure 5](#); available at [www.jpeds.com](http://www.jpeds.com)).

## Discussion

In our meta-analysis we included 2464 cases and 6495 controls. When the study-specific multivariable ORs were combined, the summary OR for SIDS was 2.89 (95% CI, 1.99-4.18). Despite indications of heterogeneity, there was not a single study showing a reduced risk of SIDS in bed-sharing infants; all studies found an increased risk.

**Table.** Studies reporting bed sharing and the risk of SIDS

First author (reference number)	Country	Years of study	n of cases bed sharing/total n of cases	n of controls bed sharing/total n of controls	Univariate OR	95% CI	Multivariate OR	95% CI	Failed criteria
Mitchell EA <sup>3</sup>	New Zealand	1987-1990	94/391	166/1584	2.70	2.02-3.62	2.02	1.35-3.04	None
Klonhoff-Cohen H <sup>25</sup>	US, California	1989-1992	60/200	52/200	1.28	0.81-2.03	1.21	0.59-2.48	None
Brooke H <sup>23</sup>	Scotland	1992-1995	11/146	6/276	3.92	1.35-11.37	2.90	0.75-11.26	None
Blair PS, 1999 <sup>16</sup>	United Kingdom	1993-1996	82/321	189/1299	2.75	1.85-4.08	9.78	4.02-23.83	None
Hauck FR <sup>24</sup>	US, Chicago	1993-1996	131/260	79/260	2.70	1.80-4.20	2.00	1.21-3.32	None
Arnestad M <sup>21</sup>	Norway	1984-1998	15/174	24/375	1.37	0.68-2.77	1.66	0.57-4.85	None
Li DK <sup>26</sup>	US	1997-2000	68/169	114/309			4.50	1.30-15.10	None
Tappin D <sup>27</sup>	Scotland	1996-2000	30/131	25/278	5.76	2.86-11.57	3.36	1.67-6.73	None
McGarvey C <sup>17</sup>	Ireland	1994-2001	128/260	101/829	5.30	2.29-12.24	3.53	1.40-8.93	None
Vennemann MM <sup>28</sup>	Germany	1998-2001	48/333	89/998	1.8	1.21-2.66	2.73	1.34-5.55	None
Blair PS, 2009 <sup>22</sup>	England	2003-2006	43/79	18/87			21.77	3.79-125.00	None



**Figure 2.** Forest plot and ORs for the association of bed sharing and risk of SIDS, all studies.

In the studies that presented data on maternal smoking, the risk associated with bed sharing increased even further. The 4 studies considered here all reported on maternal smoking because this is proposed to be the more prominent risk factor than paternal smoking.<sup>11,28-30</sup> However, it is difficult to separate maternal smoking from in utero exposure to tobacco smoke, which also increases SIDS risk<sup>4,24,31</sup> and may further increase the infant's susceptibility to SIDS while bed sharing. The 3 papers that reported the risk of bed sharing in non-smoking parents found the risk to be only slightly and not significantly increased (OR, 1.66; 95% CI, 0.91-3.01).

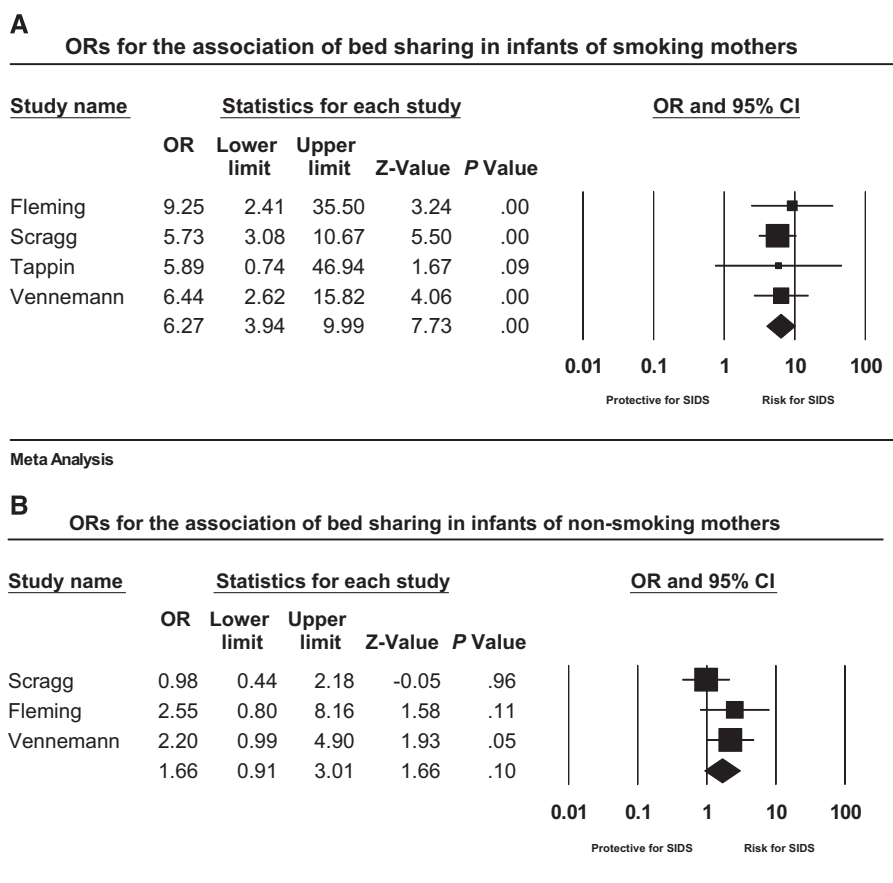
In addition, in 3 studies reporting on infant's age, the risk was 10 times higher in infants <12 weeks old, and the risk for infants  $\geq$ 12 weeks old was not elevated. Other studies have demonstrated that this risk persists even when the parents do not smoke.<sup>15,16,30,32</sup> When the risk of bed sharing is in part caused by overlaying and thermal stress, these findings suggest that older infants may be better able to free themselves from unsafe situations or are more likely to wake up and alarm their parents when they are too hot or covered accidentally by duvets (comforters). Indeed, Baddock reported that bed sharing infants have more bedding and have a higher skin temperature than cot-sleeping babies.<sup>33</sup> Moreover, younger infants may be more vulnerable to potential stressors associated with bed sharing, suggesting that any form of bed sharing may be dangerous for them.<sup>15</sup>

Only two studies examined the effect of routine bed sharing versus bed sharing during the last night when bed sharing was not the routine.<sup>28,29</sup> Routine bed sharing did not increase the risk of SIDS. However, bed sharing during the last night when bed sharing was not routine increased the risk two-fold. It has been suggested that this category largely comprises sick infants, who may be more likely to be taken to bed for comfort and that the disease status rather than the bed sharing itself increases the risk of SIDS. However, one study has shown

that infection is only a risk when infants are placed prone.<sup>34</sup> Furthermore, infants who are returned to their own cot during the middle of the night are not at an increased risk of SIDS.<sup>24</sup> This indicates that temporary bed sharing for the purposes of feeding and comforting does not bring added risk.

Whether bed sharing with an infant is a risk factor or a beneficial factor for SIDS remains a controversial topic in SIDS research. The benefits of bed sharing include prolonged and easier feeding (both breast and formula)<sup>35</sup> and better parent-child bonding.<sup>36</sup> In addition, bed sharing promotes infant arousals,<sup>37</sup> which may be protective against SIDS. Horsley performed a systematic review on this topic, including papers published between 1993 and 2005, and concluded that there was an association between bed sharing and SIDS risk for younger infants and infants whose parents smoked.<sup>38</sup> Since then, a number of additional case-control studies about the possible association between bed sharing and the risk of SIDS has been published. Whereas earlier studies suggested that the risk is only increased when the mother smokes,<sup>39</sup> more recent case-control studies have indicated that it might be increased independently of the mother's smoking status.<sup>15,28</sup> The risk of infant death may also be increased when there are multiple bed sharers<sup>24</sup> or when the bed sharer has consumed alcohol or is overtired.<sup>15,29</sup>

Sharing a sofa with an infant, which is becoming increasingly frequent in some countries,<sup>22,30</sup> is associated with a high risk of SIDS.<sup>11,30</sup> The proportion of infants who die of SIDS found while sleeping with an adult on a sofa increased from 6% in 1993 to 1996 to 16% in 2003 to 2006 in the southwest region of England,<sup>22</sup> with approximately one-sixth of infants who died of SIDS found sleeping with an adult on a sofa. Similar proportions have been reported in Scotland<sup>27</sup> and Northern Ireland,<sup>40</sup> but were not found in a recent German study, in which the number of infants



**Figure 3.** Forest plot and ORs for the association of bed sharing and the risk of SIDS. **A**, In infants of smoking parents; **B**, In infants of non-smoking parents.

exposed to this risk was small,<sup>28</sup> suggesting that sleeping with an infant on a sofa is a culture-specific practice.

The strength of this meta-analysis is that it includes all major studies addressing the risk of SIDS and bed sharing in the last 20 years. However, some potential limitations of this meta-analysis merit attention. First, the studies were undertaken both before and after the “back to sleep” campaigns, which have resulted in substantial changes in SIDS epidemiology during the survey period. Second, there was methodological diversity. The studies were conducted in different countries and at different times. However, all recent studies have controlled for the same set of confounders in their multivariate models, including socioeconomic status, sleeping position, and maternal age. In recently published studies, there are additional data on the specific environment and the circumstances of bed sharing that are not present in earlier studies. Only recent studies have disentangled infants sleeping with adults in a parental bed from infants sleeping with an adult on a sofa. This is certainly a limitation of the individual studies and hence of the meta-analysis. In addition, there were interactions that we were unable to analyze because of the lack of data. For instance, although it would be helpful to study the interaction of breastfeeding and bed sharing, these data were not available. Additionally, in most

studies, bed sharing parents were not asked whether they were overtired, although this might be difficult to assess objectively, or had taken drugs or consumed alcohol during the night the baby died. There is also the question of publication bias. There is a possibility that negative results were not reported. However, the first report about smoking and bed sharing is from 1993, and after that all large case control studies have analyzed the risk of SIDS with bed sharing, although not all in the same way.

In conclusion, bed sharing strongly increases the risk of SIDS. This risk is greatest when parents smoke and in infants who are <12 weeks of age. Although we could not examine these interactions in this meta-analysis, emerging evidence suggests there is also a significant interaction between bed sharing and parental use of alcohol and drugs, and there is an excess of SIDS bed sharing deaths on sofas. For public health advice, it is not clear whether a strategy to advise against bed sharing in general or just particular hazardous circumstances in which bed sharing occurs would be more prudent. However, at a minimum, families should be warned against bed sharing when either parent smokes or when the parent has consumed alcohol or drugs and against inappropriate sleeping surfaces such as sofas. They should also be made aware that the risk is particularly high in

very young infants, regardless of whether either parent smokes. ■

Submitted for publication Mar 11, 2011; last revision received Jun 9, 2011; accepted Jun 28, 2011.

Reprint requests: Ursula Kiechl-Kohlendorfer, Innsbruck Medical University, Department of Pediatrics, Division of Neonatology, Neuropediatrics and Metabolic Diseases, Anichstraße 35, A-6020 Innsbruck, Austria. E-mail: Ursula.Kohlendorfer@i-med.ac.at

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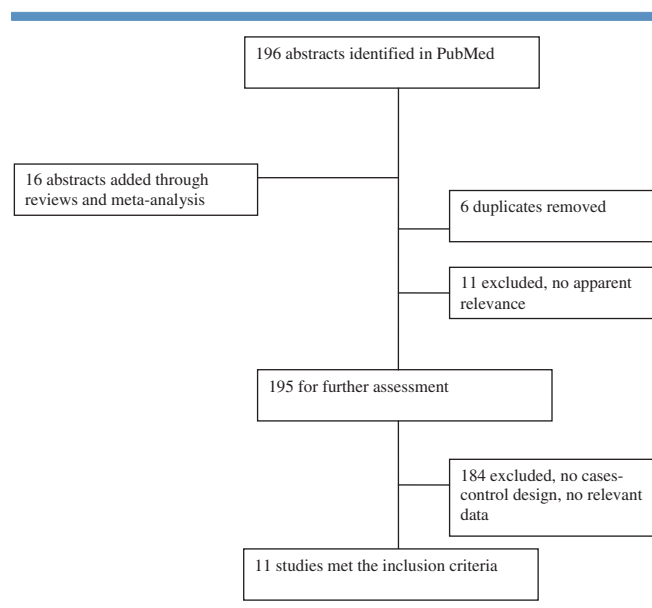


Figure 1. Flow diagram.

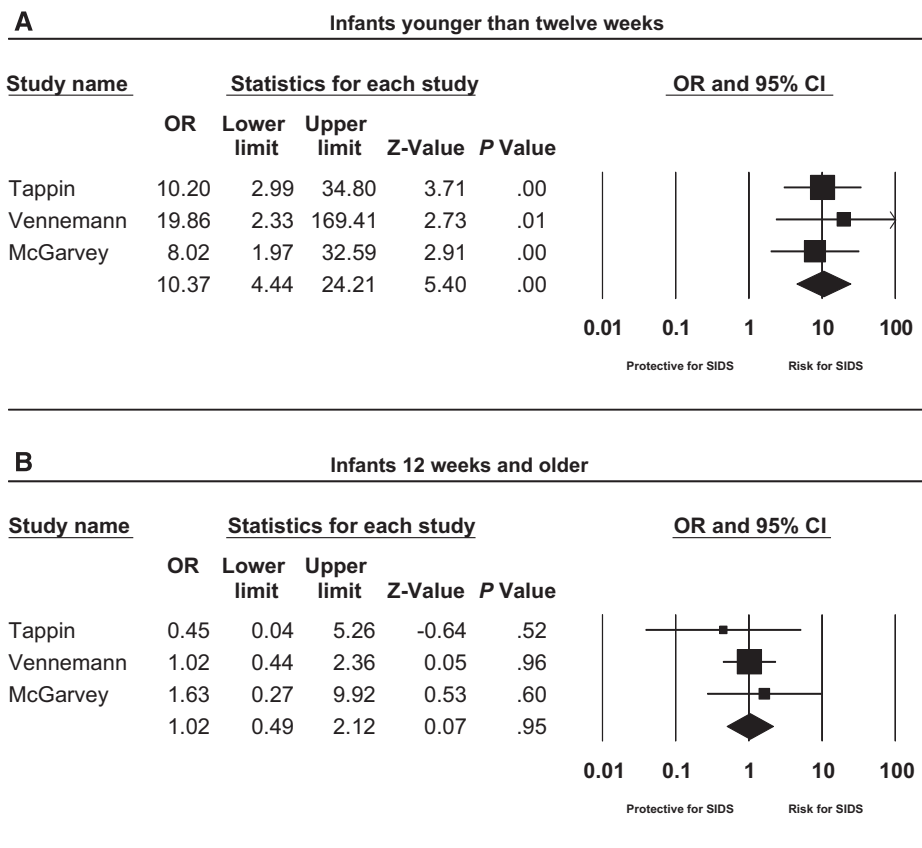
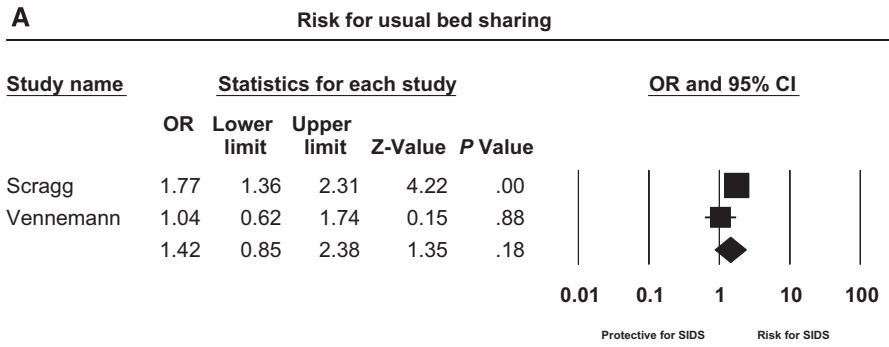
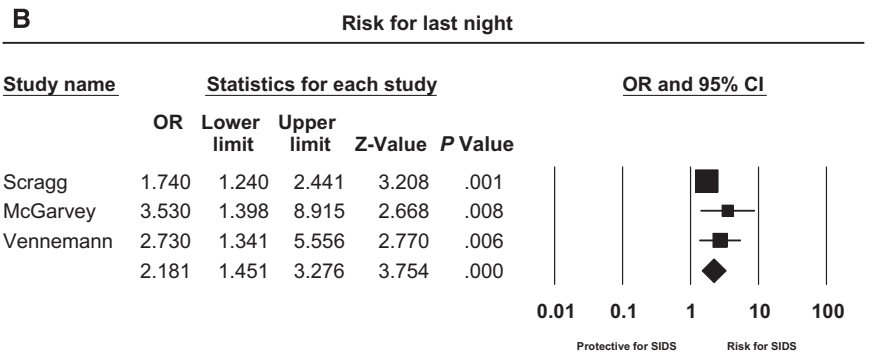


Figure 4. Forest plot and ORs for the association of bed sharing and the risk of SIDS. **A**, In infants <12 weeks old and **B**, ≥12 weeks old, regardless of smoking status.



Meta Analysis



Meta Analysis

**Figure 5.** Forest plot and ORs for the association of bed sharing and the risk of SIDS. **A**, In infants who are routinely bed sharing and **B**, those who bed shared only the last night.