

## CURRENT TOPIC

## The changing epidemiology of SIDS

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Within the past five years, the number of deaths attributed to the sudden infant death syndrome (SIDS) has fallen dramatically in the UK,<sup>1,2</sup> New Zealand,<sup>3</sup> Australia,<sup>4</sup> the Netherlands,<sup>5</sup> Norway,<sup>6</sup> Denmark,<sup>7</sup> and Ireland.<sup>8</sup> In England and Wales, the number of SIDS victims has fallen by nearly 70% from 1593 in 1988 to 531 in 1992<sup>1</sup> (see table 1). The decline has coincided with public health advice to avoid the prone sleeping position but other risk factors may have also changed.

The contribution of any one risk factor to the fall in SIDS incidence depends on the associated relative risk for SIDS, the prevalence of the factor in the young infant population, and the change in prevalence. Consistent associations have been established between SIDS and male sex, intrauterine growth retardation, preterm birth, poor socioeconomic status, young maternal age, multiple birth, and short interpregnancy interval.<sup>9-11</sup> However, the prevalence of these factors changes little from year to year. The prevalence of some environmental factors is more variable. Of these, the prone sleeping position and maternal smoking have been most consistently associated with SIDS, whereas evidence for a role for heavy wrapping, infection, bottle feeding, or bed sharing is less clear. This paper examines the potential contribution of specific environmental risk factors to the fall in SIDS incidence.

### Risk factors for SIDS: evidence from case-control and cohort studies

#### PRONE SLEEPING POSITION

Nineteen case-control studies and one cohort study in eight different countries have shown a 3-9 fold increased risk of SIDS in babies who sleep prone compared with on their side or supine.<sup>12-27</sup> Criticisms of some but not all of these studies have included: use of inappropriate control babies; measurement of usual sleeping position rather than position put down or found; and recall bias.<sup>15 28-30</sup> Nevertheless, the size and consistency of the effect in many different settings, the suggestion of a dose effect with intermediate risk associated with side sleeping,<sup>30 31</sup> and the persistence of an effect after controlling for confounding factors<sup>23-25</sup> strongly suggest a causal relationship between prone sleeping and SIDS. Estimates of the prevalence of prone sleeping among young infants has ranged from 25-68% in different areas.<sup>15</sup> Assuming that the association between prone sleeping and SIDS is causal, estimations of the population attributable risk - the percentage reduction in SIDS incidence that could be achieved by avoidance of prone sleeping - have ranged from 38-82%.<sup>23-25 27</sup>

#### MATERNAL SMOKING

Maternal smoking has consistently been found to at least double the risk of SIDS in 14 studies conducted in eight different countries.<sup>24 30 32-42</sup> Of these, two prospective cohort studies<sup>34 35</sup> and four case-control studies<sup>24 32 33 38</sup> took some account of confounding due to social factors, preterm birth, and low birth weight. The risk of SIDS increased with the number of cigarettes smoked by the mother<sup>24 34 35 38 41</sup> and if both parents smoked.<sup>32 38</sup> The effect of maternal smoking appears to be highest in infants under 10 weeks of age.<sup>35 38</sup> The population attributable risk for maternal smoking has been estimated to be as high as 40%.<sup>24</sup>

#### INFECTION

No clear association has yet been established between SIDS and presence of bacterial or virus pathogens.<sup>32 43</sup> Findings from many case-control studies have been difficult to interpret partly due to possible selection bias of cases and controls, incomparability of microbiological samples, and lack of attention paid to potential confounding factors.<sup>44-47</sup> In a UK study,<sup>44</sup> differences in sampling techniques probably led to an overestimation of the difference in virus prevalence which was 16% and 8% respectively in SIDS and live control babies ( $p > 0.05$ ). However, even if this difference did represent a causal association, eradication of virus infections in infancy would lead only to an estimated 7% reduction in SIDS mortality.<sup>32</sup>

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Table 1 SIDS victims by age in England and Wales, 1987-92<sup>1 79</sup>

Year	No of SIDS victims (incidence*)	% Of all SIDS under 1 year (months)			SIDS as proportion of all postneonatal deaths (%)	Male: female ratio
		<1	1-5	6-11		
1987	1528 (2.24)	5.0	81.3	13.7	53	1.43
1988	1597 (2.30)	5.2	80.2	14.6	53	1.57
1989	1337 (1.93)	5.4	81.6	13.0	50	1.50
1990	1202 (1.70)	6.5	80.2	13.3	48	1.44
1991	1008 (1.44)	6.2	79.0	14.9	45	1.60
1992	531 (0.77)	11.3	72.7	16.0	30	1.68
Decline 1988-92 (%)	67	23	70	63		

\*SIDS deaths under 1 year of age/1000 live births recorded as principal cause of death or mentioned anywhere on death certificate.

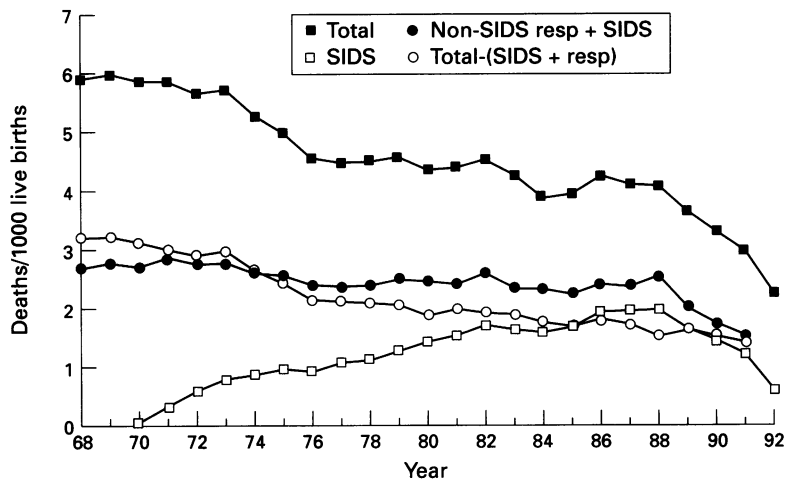


Figure 1 Postneonatal deaths by cause: England and Wales, 1968–92.<sup>1 30</sup> Total postneonatal deaths, postneonatal SIDS, postneonatal non-SIDS respiratory deaths and SIDS combined, all postneonatal deaths excluding SIDS and non-SIDS respiratory deaths (resp). SIDS recorded as main underlying cause.

#### BOTTLE FEEDING

Overall, there is suggestive but inconsistent evidence for an increased risk of SIDS in bottle fed babies. Of 11 studies<sup>24 37 40 42 48–54</sup> which found a 2–3 fold increased risk of SIDS in bottle fed babies, only three took account of confounding due to social factors, preterm birth, low birth weight, and maternal smoking.<sup>24 37 48</sup> Seven case-control studies found no association.<sup>23 25 55–59</sup> In New Zealand, the population attributable risk for not being breast fed at hospital discharge has been estimated to be 22%.<sup>24</sup>

#### HEAVY WRAPPING

Only three case-control studies have investigated the association between the thermal insulation of clothing and bedding and SIDS<sup>26 60</sup> (personal communication, R E Wigfield). Overall, the evidence for an effect is inconclusive. One study found an increased risk of SIDS in babies over 10 weeks of age who were heavily wrapped.<sup>26</sup> The effect of heavy wrapping was further increased in babies who were found prone<sup>26</sup> or had viruses identified in the upper respiratory tract or gastrointestinal tract.<sup>44</sup> A subsequent study in the same geographical area conducted after publicity about the risks associated with the prone position and heavy wrapping found no association (personal communication, R E Wigfield). In an Australian study, the risk of SIDS increased with the degree of wrapping for a given room temperature.<sup>60</sup>

One possible explanation for these inconsistent findings is that heavy wrapping is associated with an increased risk of SIDS only when other thermal stressors such as the prone position or infection are present. Heat loss is reduced in the prone compared with the supine position<sup>61</sup> and physiological studies have shown that nocturnal body temperature is higher in babies over 12 weeks old who are heavily wrapped and sleep prone.<sup>62</sup> However, detection of this 'interaction' between heavy wrapping and the prone position by epidemiological studies requires much larger sample sizes than have hitherto been studied.

#### BED SHARING

Evidence for an association between bed sharing and SIDS is weak. Laboratory studies have indicated possible advantages of mother-infant bed sharing for the development of respiratory and temperature rhythms but these have been based on infants least at risk of SIDS studied in an artificial environment.<sup>63</sup> The relevance of these findings for SIDS is unclear. In contrast, a recent epidemiological study showed an increased risk of SIDS in babies who shared their bed with another person, particularly if the mother smoked.<sup>64</sup> These results require cautious interpretation. As bed sharing is highly culturally determined,<sup>65</sup> an apparent association may be due to residual confounding by other social and cultural factors.<sup>66</sup> Furthermore, interactions such as that detected between maternal smoking and bed sharing<sup>64</sup> will arise by chance if enough interactions are examined.

#### Interpretation of changes in SIDS incidence

SIDS incidence rose steadily in England and Wales throughout the 1970s after SIDS became a registerable cause of death in 1971 (see fig 1). This rise in incidence was largely attributable to diagnostic transfer from respiratory causes to SIDS as these rates combined remained relatively constant. This change in certification practice makes it difficult to examine the effect of an increase in prone sleeping during the same period. Prone sleeping was promoted from the early 1970s in Europe and New Zealand principally because benefits observed for preterm babies were assumed to apply to term babies.<sup>67 68</sup> In the USA, prone had been the predominant infant sleeping position for most of the century (personal communication, H J Hoffman).

Evidence from some countries suggests that a rise in SIDS incidence similar to that observed in the UK, may have been partly due to an increase in infant prone sleeping. From 1970 onwards, the rise in SIDS incidence was associated with an increase in total 1–5 month mortality in New Zealand and Sweden which may have been due to an increase in unexplained deaths.<sup>69</sup> Furthermore, data from the Netherlands<sup>5</sup> and Norway<sup>6</sup> have shown a close correlation between the rise in prevalence of prone sleeping and increase in SIDS incidence from the early 1970s (table 2).

In England and Wales, SIDS incidence stabilised in the mid 1980s and has fallen steadily since 1988, predominantly in the postneonatal age group (see table 1). Postneonatal incidence plotted on a logarithmic scale (fig 2) shows a steady proportional decline between 1988 and 1991 in England and Wales of 14.5% year. This decline is unlikely to be explained by diagnostic transfer because postneonatal mortality from causes other than SIDS has also declined, albeit more slowly. Had the fall of 14.5% per year continued, the predicted incidence in 1992 would have been 1.16/1000 live births. The actual incidence was 0.68/1000 live births, 41% below predicted.

Table 2 SIDS incidence and prevalence of prone sleeping among young infants in different countries

Country	SIDS incidence (/1000 live births)	Prevalence of prone sleeping in infants (%)
Avon (UK)		
1987-9 <sup>27</sup>	3.5	59
1990-1	1.7	27
1992 <sup>30</sup>	0.3*	2
The Netherlands		
1969 <sup>25,68</sup>	0.4	10
1977	1.2	
1985 <sup>5</sup>	1.1	62 (1982-7)
1986	1.0	63 (1985-7)
1987	0.9	56
1988	0.6	27
1989	0.7	
1990	0.6	16
1991	0.4	9
New Zealand <sup>73</sup>		
1985	4.2	
1986	4.0	42
1987	4.3	
1988	3.7	
1989	3.9	
1990	3.1	2 (1989-90)
1991	2.1	
Norway <sup>64</sup>		
1970	1.1	10
1985	2.6	55
1989	2.5	54
1991-2	1.3	31

\*Personal communication, P J Fleming.

†Retrospective data based on 24 371 families.

This sharp fall in postneonatal SIDS incidence in 1992 was not evident in other causes of postneonatal mortality and is therefore likely to have been due to changes in risk factors specific for SIDS.

In Scotland, postneonatal SIDS incidence declined slightly in 1990 but dropped substantially in 1991 and in 1992 in contrast to the gradual decline in other causes of postneonatal mortality over the same period (fig 2).

From 1988 onwards, information about the risks associated with the prone position was published in the medical journals (fig 2) but whether health professionals in the UK changed their advice to parents as a result is not known. The official government 'back to sleep' campaign probably had a stronger effect on infant care practices and coincided with a sharp

decline in the number of cases of SIDS. However, it is difficult to infer how much this publicity influenced the decline in SIDS incidence. Firstly, underlying trends in incidence are partly obscured by random year to year variation. This is particularly true of the rates for Scotland which are based on fewer deaths, and could explain the apparent departure of SIDS incidence from pre-existing trends one year earlier in Scotland than in England and Wales. Secondly, it may not be possible to date precisely the onset of effective publicity. A recent retrospective study showed that health visitors in Scotland started to advise avoidance of the prone position long before the official government 'back to sleep' campaign.<sup>70</sup>

A further problem is the identification of the effective component of advice about risk factors. Although avoidance of the prone sleeping position has been the main advice in all recent risk reduction campaigns, some have also included advice about parental smoking, breast feeding, or heavy wrapping.<sup>7 30 71</sup> In several countries a substantial fall in SIDS incidence has occurred subsequent to all publicity campaigns that included advice about sleeping position.<sup>5-8 13 27</sup> This decline is unlikely to be due just to increased parental vigilance as a previous intervention study to improve infant care by parents did not alter pre-existing trends in SIDS incidence.<sup>72</sup>

Stronger evidence for a link between risk factor publicity and the decline in SIDS incidence comes from studies in New Zealand, the Netherlands and Avon, UK where data on the prevalence of environmental risk factors were collected before and after the decline in SIDS incidence (table 2).<sup>5 28 72</sup> Only the reduction in the prevalence of prone sleeping has been shown to be of sufficient magnitude to account for the fall in SIDS incidence (personal communication, R E Wigfield).<sup>73</sup> In the Netherlands, a slight fall in maternal smoking may have had a marginal effect on SIDS incidence,<sup>68</sup> but in England the prevalence of smoking has remained static among women of childbearing age.<sup>74</sup> Despite this strong correlation between the fall in SIDS incidence and the prevalence of prone sleeping, such studies provide intrinsically weak evidence on which to base public health action. It is never possible to rule out some other 'cause' for the decline in incidence.

### Public health action

Irrefutable evidence that prone sleeping causes SIDS is not available. The mechanism is not understood and no intervention study has yet been conducted. Public health recommendations to avoid prone sleeping in young infants have been based largely on evidence from case-control and cohort studies: on balance, the potential benefits of supine sleeping for SIDS prevention have been considered to outweigh possible adverse effects, except for babies with severe mandibular hypoplasia or severe symptomatic gastro-oesophageal reflux.<sup>30</sup> In many countries, recommendations in favour of supine sleeping have been widely publicised. A

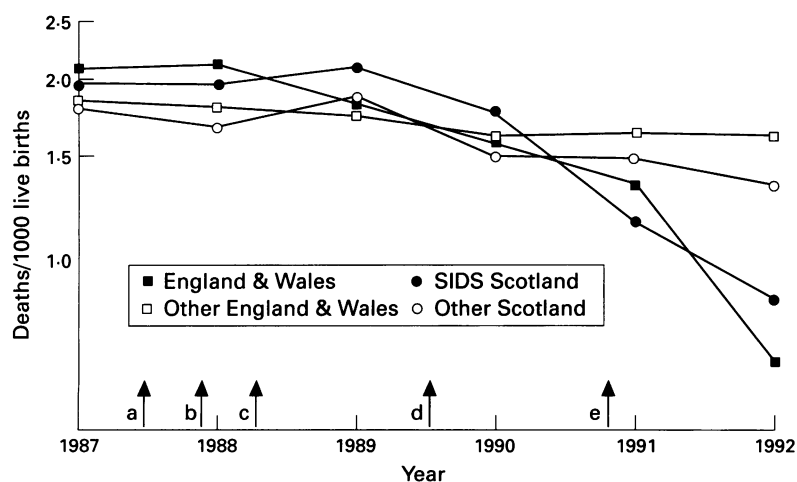


Figure 2 Postneonatal mortality trends and publicity about sleeping position<sup>1 2 30</sup> (personal communication H Brooke, A A M Gibson, The Scottish Cot Death Trust). SIDS recorded as main underlying cause or mentioned anywhere on death certificate. Key: a=Hong Kong experience reported, June 1988<sup>60</sup>; b=anecdotal findings in Australia reported, November 1988<sup>13</sup>; c=Dutch case-control study published, March 1989<sup>81</sup>; d=Avon case-control study published, July 1990<sup>26</sup>; e=National 'back to sleep' campaign launched by chief medical officer, November 1991.<sup>30</sup>

notable exception is the USA, where although the majority of young infants sleep prone (personal communication, H J Hoffman), advice issued to paediatricians<sup>75</sup> has not yet received general publicity.<sup>29</sup>

In the UK, there is undoubtedly scope for further public health action to reduce environmental risk factors for SIDS. Many infants still sleep prone and there has been little change in parental smoking habits. The justification for public health advice about other environmental risk factors should be kept under review. Excessive wrapping should be discouraged in older babies who are unwell, although there may be dangers in recommendations that increase the proportion of infants who are lightly wrapped.<sup>44 76 77</sup> Further evidence is required before recommendations can be made about breast feeding and bed sharing.<sup>78</sup>

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