Does the Supine Sleeping Position Have Any Adverse Effects on the Child?: I. Health in the First Six Months

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ABSTRACT. *Objective.* **To assess whether the recommendations that infants sleep supine could have adverse health consequences.**

Design. **A prospective study of infants, delivered before, during, and after the Back to Sleep Campaign in the United Kingdom (UK), followed to 6 months of age. The children were part of the Avon Longitudinal Study of Pregnancy and Childhood (ALSPAC).**

Subjects. **Singletons born to mothers resident in the three former Bristol-based health districts of Avon in the period June 1991 to December 1992, and for whom questionnaires were completed on sleeping position at 4 to 6 weeks of age (n = 9777); for these infants 8524 questionnaires were also completed at 6 to 8 months of age.**

Main Outcome Measures. **Subjective measures of health, the presence of specific signs and symptoms, duration of sleep at night, and calling the family doctor to the home.**

Results. **Of 43 outcomes considered, after adjustment for 12 factors using logistic regression only 2 were associated with raised risk among infants put to sleep on their back (diaper rash and cradle cap). Infants put to sleep prone had increased risk of a number of health outcomes, including cough and possibly pyrexia.**

Conclusions. **There is no evidence that putting infants to sleep in the supine position results in increased morbidity, although changes in prevalence of rare disorders would not have been identified.** *Pediatrics* **1997; 100(1). URL: http://www.pediatrics.org/cgi/content/full/100/1/e11;** ***sleeping position, infant morbidity, health.***

ABBREVIATIONS. UK, United Kingdom; SIDS, sudden infant death syndrome; ALSPAC, Avon Longitudinal Study of Pregnancy and Childhood; OR, odds ratio; CI, confidence interval.

In 1991, the United Kingdom (UK) Department of Health together with the Foundation for the Study of Infant Deaths and Cot Death Research initiated campaigns to persuade mothers to stop placing their infants to sleep in the prone position and to start putting them on their sides or on their backs.[1,2] As time went on the emphasis became more and more to put the infant on its back and indeed the Department of Health campaign was called Back to Sleep. The reasons for the campaign were set out in detail by the Chief Medical Officers Expert Group,[3] who found published evidence that the relative risk of cot death for infants sleeping prone was in the range 1.9 to 12.7. Decreases in the proportion of infants placed prone had been followed, in Avon and in New Zealand, with decreases in the incidence of cot death.[1,2,4] On the basis of these results, the Expert Group advised that mothers should not put infants to sleep prone. Whether the side was less safe than the back position was not clear, although there was some evidence to suggest that the back position was less likely to be associated with sudden infant death syndrome (SIDS) than the side position.[5] Since then, further studies have provided evidence to show that the back position is indeed less likely to be associated with SIDS than the side position.[6] From the temporal effect on SIDS rates within the UK, it is now clear that the change in sleeping position has been followed by a dramatic reduction in the incidence of SIDS.[2,6–8]

From monitoring trends in mortality, it has been shown that the change in sleeping position has not resulted in increases in other causes of death in infancy.[1,2,5,8,9] Nevertheless, there remains the suspicion that other features of the child's health may be affected. The American Academy of Pediatrics Task Force listed the following reasons why prone sleeping had been thought to be better for infants[10]: a decreased likelihood of aspiration, reduced gastroesophageal reflux, less colic, less head molding and, in children with specific abnormalities such as the Pierre Robin syndrome, the risk of airway obstruction when supine. Advantages of prone position were described as improved pulmonary function, sleeping and psychomotor development, and the possible prevention of infant scoliosis.[10,11] Consequently, the American Academy of Pediatrics Task Force was worried that encouraging parents to put the infants to sleep supine might affect the health of the child adversely though the evidence upon which some of the concerns were based was poorly documented.

The Back to Sleep Campaign in Britain fortuitously occurred during the time in which pregnant mothers were being enrolled into the Avon Longitudinal Study of Pregnancy and Childhood (ALSPAC). The opportunity was therefore taken to assess the consequences of changing sleeping position of the infant population over a defined time period. In this article we report on the relationship between the sleeping position of the child and the health outcomes in the first 6 to 8 months of the child's life. As far back as

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September 1989, health care professionals in Avon had been made aware of the potential risks associated with prone sleeping, and had been encouraged to recommend supine or side position. By 1991 the prevalence of prone sleeping among infants in Avon had decreased considerably from that observed 2 years earlier, and that in other areas of the UK, though no **public** campaign to change infant sleeping position was mounted until the end of October 1991.[1,2,7,8]

MATERIALS AND METHODS

The ALSPAC study is a longitudinal, population-based cohort study of mothers and infants in the county of Avon. It was designed to monitor features of the environment that affected the health and development of young children. The study started during pregnancy, and aimed to enroll all women who were resident in the three Bristol-based health districts of the county of Avon (population 940 000) and who had an expected date of delivery between April 1, 1991 and December 31, 1992. Approximately 85% of the eligible mothers in the study area have taken part. Information is obtained both from self-completion questionnaires with specific questions being asked of mothers at various time points during pregnancy and after the child is born, and from clinical records.[12] The information collected includes detailed assessments of the mother's social and environmental background, her lifestyle, her parenting attitudes, and medical problems experienced by both mothers and infants.

In a questionnaire administered 4 weeks after the infant's birth, the mother was asked: "in what position is your baby (i) when (s)he goes down for the night?; (ii) when (s)he wakes up?" She was given the options "(a) back, (b) side, (c) front, and (d) varies" for each of these categories. It has been assumed that the position at 4 weeks will be similar to that for the first 6 months of the child's life. The validity of this was shown in a separate study of 152 randomly selected children in Avon[8,13] which showed a slight decrease in prevalence of side sleeping between 1 and 3 months of age, with a corresponding rise in both supine and prone sleeping, but little change between 3 and 5 months of age.

The health outcomes were assessed from questions asked in two questionnaires, administered at 4 weeks and at 6 months. The health outcomes considered were mainly based on signs and symptoms of the child rather than diagnoses. This was thought to provide a far more objective assessment, and be relatively independent of maternal experience or educational ability. It also rested less upon whether a doctor had made a diagnosis or not. The health items considered are listed in Table 1.

In all there were 14 138 livebirths that survived the neonatal period. Of these, questionnaires administered at 4 weeks were completed for 12 348 children (an 87% response rate). Excluded from this analysis were all multiple births (n = 321), all whose mothers did not complete this questionnaire between June 1991 and February 1992 (n = 51), or between 4 and 6 weeks of the child's age (n = 2133). Thus for health outcomes at 4 to 6 weeks the study sample comprised 9777 infants. Questionnaires administered at 6 months were completed for 8852 of the 9777 children (91%). Of these, 328 who did not complete the second questionnaire between 6 and 8 months of the child's age were excluded.

There were slight biases in the proportion of the 9777 mothers who completed the 6-month questionnaire–they were more likely to be older, better educated, have breastfed, and lived in nonrented accommodation and were less likely to be smokers or to have had the infant admitted to the special care infant unit. All these variables have therefore been taken into account in the analyses.

Confounding factors likely to be related to the health outcomes were considered as follows:

1. The mother's highest educational level: (in five different groups: Certificate of Secondary Education or less; vocational qualification; O-level; A-level; degree);

TABLE 1. Health Outcomes Considered in the Study

Health of the infant now? (Very healthy vs other categories)	A
Health of the infant within past month? (Very healthy vs other categories)	B
Asked doctor to home because of problems with infant? (Yes vs no)	A, B
Ever had snuffles? (Yes vs no)	A
Ever had cough? (Yes vs no)	A, B
Ever had cough for at least 2 days? (Yes vs no)	B
Ever had earache? (Yes vs no)	B
Has anyone thought there may be a problem with hearing? (Yes vs no)	B
Is hearing worse than usual during/after a cold.	B
Ever had wheezing with whistling on chest when breathing? (Yes vs no)	B
Ever had attacks of breathlessness? (Yes vs no)	B
Ever had episodes of stopping breathing? (Yes vs no)	B
When asleep seems to stop breathing or hold breath for several seconds? (Often/sometimes vs rest)	B
Breathes through mouth rather than nose? (All/much of time vs rest)	B
Snores for more than a few minutes at a time? (Most nights/quite often vs rest)	B
Has regular sleeping? (Yes vs no)	B
Amount of sleep measured in hours–grouped as <14 hours, ≥14 hours.	B
Possets? (Often vs rest)	A, B
Has vomited? (Often vs rest)	A, B
Has ever been ill with diarrhea or gastroenteritis? (Yes vs no)	A, B
Has choked on feeding? (Yes vs no)*	A, B
Has ever had a lot of wind on feeding? (Yes vs no)	A
Ever had colic? (Yes vs no)	B
Has often had periods when in agony, screams, draws legs up and can't be calmed? (Yes vs no)	A
Feel that infant's crying is a problem? (Yes vs no)	A
Infant is happy (No vs yes)	A
Ever had jaundice? (Yes vs no)	A
Ever been jittery/twitching? (Yes vs no)	A
Ever had raised temperature? (Yes vs no)	A, B
Ever had convulsions/fits? (Yes vs no)	B
Has had rash in joints and creases (Yes vs no)	A, B
Has had a nappy rash? (Yes vs no)	A, B
Has had cradle cap? (Yes vs no)	A, B

* Question at 6 to 8 months worded slightly differently.
(A = 4-week questionnaire; B = 6-month questionnaire).

2. Mother's age: (<25; 25 to 29; 30+);
3. Housing circumstances: (owned/mortgaged; housing association or private rented accommodation; council accommodation);
4. Parity: (0 or 1+);
5. Maternal postnatal smoking: (yes or no);
6. Breastfeeding: (no; yes but stopped by 4 to 6 weeks; yes still breastfeeding at 4 to 6 weeks);
7. Admission to special care infant unit: (yes vs no);
8. Sex of child;
9. Mother's ethnic origin: (white; African/Caribbean/other black; Indian/Pakistani/Bangladeshi; Chinese; other);
10. Month of completion of the questionnaire (to allow for seasonal effects in morbidity);
11. Age at completion of questionnaire (for the 4-week questionnaire this was classified as 4, 5, or 6 weeks of age; for the 6-month questionnaire it was classified as 6, 7, or 8 months);
12. Whether the child had been vaccinated against pertussis by the 6-month questionnaire completion date (yes vs no).

A variety of different logistic regression analyses were used to ensure that the data had been fully investigated. First, in the tables the unadjusted odds ratio (OR) for each sleeping position relative to the back is shown, and second, the adjusted OR allowing for the 12 items above and, where relevant, the month the questionnaire was completed and/or the age at completion. The adjustment used 85% to 89% of cases, (the differences being due to missing data). Not shown in the tables were the results of further logistic regression analyses using a stepwise process and allowing only those items that were statistically significantly associated with the particular outcome. These made little difference to the overall conclusions.

RESULTS

Sleeping Position on Being Put Down and Waking Up

The question concerning sleeping position distinguished between the sleeping position on being put down to sleep and that on waking up. It can be seen from Table 2 that of those put on their back to sleep at 4 weeks of age, 97% were on their backs when they woke in the morning. Mothers who had put their children to sleep on their front almost invariably found them on their front in the morning. Of those put on their side to sleep, however, only just over half were still on their side consistently on waking, and a third were on their back. The remainder largely varied, presumably sometimes being on their back and sometimes on their side. Only .5% of those put on their sides were found on their front. Mothers in Avon had been advised to put their infants on their sides with their lower arm forward to reduce the likelihood of rolling on to the front.[1,2,8] This differed from previous advice, in which mothers had been advised to put a roll of blanket down the side of the infant's back so that he could not roll on to his back. Of those who put their children to sleep in a variety of different ways, most were also found in an inconsistent position, although a quarter were said to always be on their back in the morning. In the analyses that follow, the position on going down will be the one that is always considered—we have shown that for back and front position this is almost synonymous with the sleeping position throughout the night, whereas the side position is likely to be a combination of side and back position in the morning.

TABLE 2. Stated *Sleeping Position* at 4–6 Weeks: "In What Position is Your Baby (i) When He Goes Down for the Night? (ii) When He Wakes Up?"

		Wakes Up			
	n = 100%	Back	Side	Front	Varies
Goes down					
Back	1716	*97.4%*	1.2%	0.1%	1.3%
Side	6669	*33.5%*	*51.4%*	0.5%	14.6%
Front	316	0.3%	1.9%	*95.6%*	2.2%
Varies	852	24.4%	0.7%	*1.1%*	*73.8%*
All	9553	43.1%	36.2%	3.6%	17.1%

TABLE 3. Factors Targeted or Mentioned in the Back to Sleep Campaign; Responses Grouped According to Relationship to Time of Campaign

	Before* (n = 2395)	During† (n = 2756)	After‡ (n = 4626)
Sleeping			
Back	2.8%	17.4%	25.8%
Side	81.6%	74.9%	61.2%
Front	9.4%	1.0%	1.4%
Smoking			
Mother (in third trimester of pregnancy)	19.3%	19.6%	19.0%
Mother postnatal	23.1%	22.0%	22.0%
Partner postnatal	27.1%	25.2%	25.1%
Quilt used (sometimes/always)			
At 4–6 weeks	19.0%	12.8%	10.9%
At 6–8 months	47.7%	33.8%	35.0%
Breastfeeding			
Yes–stopped <4–6 weeks	20.1%	24.0%	22.4%
Yes–still at 4–6 weeks	57.8%	54.0%	55.6%

* June 1991–October 1991; † November 1991–April 1992; ‡ May 1992–February 1993.

To evaluate the effectiveness of the campaign we first subdivided the infants according to when the question about sleeping position was answered. There were three time periods considered: before the public campaign (ie, between June 1991 and October 1991); during the campaign (ie, between November 1991 and April 1992); after the campaign (ie, May 1992 to February 1993). The way in which sleeping position changed over these time periods is shown in Table 3. Note the strong and dramatic increase in back sleeping over time and the diminution in front sleeping. Infants were more likely to have slept on their side before the campaign and least likely to after the campaign. Table 3 also shows that little else changed that had been emphasized in the campaign, apart from a reduction in the use of a quilt particularly for the 4-week-old child. There were no changes in other items mentioned in the campaign—(viz, mother's smoking habit, and that of the partner) or in breastfeeding rates.

The change in sleeping position over time was found in subgroups of mother's education and mother's age, housing type, parity, smoking habit, breastfed and bottle-fed infants, and whether or not they were admitted to special care infant unit. Nevertheless there were significant variations between sleeping position and demographic factors—before the public campaign sleeping position was associated with housing type (council housing associated with more prone and less back sleepers), parity (more prone among multiparae), and breastfeeding (more back sleepers); after the campaign sleeping position was associated with mother's education level (the

better educated had more back sleepers and more "varies"), housing (council more prone, owned/mortgaged more back), parity (more prone and side among multiparae), smoking (fewer back and more side sleeping among smokers), breastfeeding (those breastfeeding at 4 to 6 weeks were least likely to be prone and more likely to "vary") and the sex of the child (boys are more likely to "vary" and least likely to be on side). There were, however, no differences in the demographic variation in the mothers or children delivered before, during, or after the campaign; similar proportions of mothers were in each of the educational groups, maternal age groups, housing types, parity, admission to special care, and ethnic minority groups; similar proportions had had their child immunized against pertussis.

Health of the Child

A. Subjective Assessment

In Table 4A, the subjective assessment of the mother's description of the child as not very healthy is shown in relation to the sleeping position of the child. At 4 to 6 weeks, there were no significant differences with sleeping position, but by the time the children were 6 to 8 months of age, the children placed to sleep on their front were significantly less likely to have been described as "very healthy" by their mothers ($P < .001$); however, by the time adjustment was made for the 12 possible confounders, significance had reduced so that the OR for front sleeping, 1.34 [95% confidence interval (CI) .99, 1.81], was no longer statistically significantly different from the back position. Both the side sleeping and the "varied position" had adjusted ORs between those of the front and the back.

A less subjective measure of ill health is whether or not the doctor was called to the home because of a problem with the infant. Although this was more likely to occur with the 4- to 6-week-old infant who was placed prone, this was not statistically significant; however, adjustment increased the OR to 1.47 [95% CI .97, 2.21], which just failed to reach statistical significance.

Assessment as to whether the doctor had been called to the home for the ill infant by 6 to 8 months of age indicated that the infant put to sleep on the back was least likely to have such a history—and unadjusted rates showed high ORs both for side sleeping and front sleeping. On adjustment, these ORs were reduced, but the side sleeping was significantly elevated in comparison with back sleeping with OR 1.17 [95% CI 1.01, 1.35] after adjustment for all factors. The OR for front sleeping after adjustment for all factors was 1.15 [95% CI .82, 1.60].

B. Respiratory Symptoms

At 4 weeks the mother was asked whether the child had ever had snuffles; more children placed to sleep on their sides were reported to have this and less of those on their fronts. Adjustment for all variables showed that children placed to sleep on their side had a significantly greater risk of being reported to have snuffles with OR 1.20 [95% CI 1.06, 1.35].

At the same age the mothers were asked whether the children had ever had a cough. Again there was a significant variation, this time however it was the children placed to sleep on their fronts who had the highest risk. After adjustment, the OR increased to 1.53 [95% CI 1.08, 2.17] statistically significantly greater than the back sleeping position. A similar question asked at 6 months of age also showed a greatly elevated risk for front sleeping—even after adjustment for all potential confounders, the OR for front sleeping was 1.52 [95% CI 1.07, 2.16]. However, when the data were confined to the response to the question at 6 months that the child had coughed for a period of at least 2 days, the statistical significance of the association with prone sleeping position disappeared.

Data regarding earache at 6 months showed a significant association with sleeping position when the data were unadjusted, with prone sleepers having the highest risk of earache, but after adjustment, the OR decreased from 1.71 to 1.33, and was no longer statistically significantly associated [95% CI .84, 2.09]. Other aspects of ear problems were addressed through a number of different questions such as "has anyone thought there might be a problem with hearing." This showed a significant unadjusted association, with children placed on their fronts being more likely to be reported to have a problem with hearing—however on adjustment this was no longer statistically significant, and the children whose sleeping position was said to vary were those who had the greatest OR 1.53 [95% CI .90, 2.61]. In relation to whether the child had worse hearing during or after a cold, there was no significant association with sleeping position, nor was there any significant relationship with wheezing or breathlessness, episodes of stopping breathing or holding breath when asleep. Interestingly, in relation to the claims for prone sleeping in regard to respiratory function and apnea in preterm infants,[14] after adjustment the prone sleepers were less likely to be reported as having had episodes of stopping breathing when asleep with an OR of .78 [95% CI .51, 1.20], but this was not statistically significant.

Children sleeping prone were reported to breath through their mouths more often than through their nose, but after adjustment this ceased to be statistically significant with an OR of 1.17 [95% CI .79, 1.72]. In regard to snoring, however, after adjustment there was a significant association with sleeping position, children who were put to sleep on their sides were significantly less likely to snore than either those put to sleep on their back or on their front, with an OR of .76 [95% CI .63, .93].

C. Sleeping Characteristics

At 6 months the mother was asked whether the child had a regular sleeping pattern. There was no difference in response between back, side, and front sleeping positions. However, when the actual amount of time spent sleeping was considered, children who slept on their front were significantly more likely to sleep for at least 14 hours per night compared with those sleeping on their back. Even after

TABLE 4. Questionnaire Responses Grouped by Sleeping Position on Going Down at Night: Odds Ratio (OR) With Adjustments for Confounding Variables

	Back	Side	Front	Varies	n	*P*
A. Markers of Ill Health						
Health of the infant now (4–6 weeks)						
% not "very healthy"	18.4%	19.5%	21.8%	18.7%	9636	
OR unadjusted	1.00	1.08	1.24	1.02	9636	NS
OR adjusted	1.00	1.15	1.33	1.05	8214	NS
Health of the infant within past month (6–8 months)						
% not "very healthy"	36.1%	40.5%	51.4%	40.2%	8400	
OR unadjusted	1.00	1.20	1.87	1.19	8400	<.001
OR adjusted	1.00	1.10	1.34	1.14	7500	NS
Asked doctor to home because of problem with infant? (4–6 weeks)						
% home visit	11.4%	12.7%	14.9%	11.4%	9644	
OR unadjusted	1.00	1.14	1.37	1.01	9644	NS
OR adjusted	1.00	1.06	1.47	1.06	8222	NS
Has doctor been called to home for ill infant? (6–8 months)						
% home visit	24.8%	30.2%	30.4%	27.0%	8398	
OR unadjusted	1.00	1.31	1.32	1.12	8398	<.001
OR adjusted	1.00	1.17	1.15	1.11	7501	NS
B. Respiratory Symptoms						
Ever had snuffles? (4–6 weeks)						
% with snuffles	54.2%	56.0%	47.6%	53.0%	9669	
OR unadjusted	1.00	1.08	0.77	0.96	9669	.009
OR adjusted	1.00	1.20	0.97	1.14	8239	.017
Ever had cough? (4–6 weeks)						
% with cough	18.9%	19.1%	22.7%	18.3%	9669	
OR unadjusted	1.00	1.02	1.26	0.96	9669	NS
OR adjusted	1.00	1.03	1.53	1.13	8239	NS (.086)
Ever had cough? (6–8 months)						
% with cough	60.5%	64.9%	77.7%	64.3%	8445	
OR unadjusted	1.00	1.21	2.28	1.18	8445	<.001
OR adjusted	1.00	1.09	1.52	1.11	7543	NS
Ever coughed for at least 2 days? (6–8 months)						
% with cough 2 or more days	40.1%	44.1%	51.2%	42.9%	8379	
OR unadjusted	1.00	1.18	1.57	1.12	8379	.003
OR adjusted	1.00	1.07	1.07	1.04	7485	NS
Ever had earache? (6–8 months)						
% with earache	7.9%	9.9%	12.7%	8.2%	8445	
OR unadjusted	1.00	1.29	1.71	1.00	8445	.013
OR adjusted	1.00	1.21	1.33	0.92	7543	NS
Has anyone thought there might be a problem with hearing? (6–8 months)						
% with problem	2.2%	3.0%	6.2%	4.0%	8393	
OR unadjusted	1.00	1.34	2.88	1.81	8393	.006
OR adjusted	1.00	0.91	1.40	1.53	7504	NS (.091)
Is hearing worse than usual during/after a cold? (6–8 months)						
% worse	4.7%	5.5%	7.1%	5.9%	5433	
OR unadjusted	1.00	1.18	1.56	1.27	5433	NS
OR adjusted	1.00	1.02	0.90	1.16	4845	NS
Ever had episodes of wheezing with whistling on the chest? (6–8 months)						
% wheezed	18.3%	19.2%	25.8%	19.0%	8391	
OR unadjusted	1.00	1.06	1.55	1.05	8391	NS (.06)
OR adjusted	1.00	0.86	0.95	0.86	7497	NS
Ever been breathless? (6–8 months)						
% breathless	5.4%	5.8%	8.5%	4.5%	8445	
OR unadjusted	1.00	1.08	1.61	0.82	8445	NS
OR adjusted	1.00	0.95	1.05	0.75	7543	NS
Ever had episodes of stopping breathing? (6–8 months)						
% apnea	1.8%	2.1%	2.7%	2.0%	8445	
OR unadjusted	1.00	1.20	1.54	1.12	8445	NS
OR adjusted	1.00	1.13	1.14	1.01	7543	NS
When asleep, seems to stop breathing or hold breath for several seconds at a time? (6–8 months) (often/sometimes)						
% hold breath	18.0%	18.9%	17.8%	19.7%	7610	
OR unadjusted	1.00	1.06	0.98	1.12	7610	NS
OR adjusted	1.00	1.07	0.78	1.13	6803	NS
Currently breathes through mouth rather than nose? (6–8 months) (all or much of the time)						
% mouth breathe	16.6%	17.6%	24.7%	15.9%	7260	
OR unadjusted	1.00	1.07	1.64	0.95	7260	.024
OR adjusted	1.00	0.94	1.17	0.92	6515	NS
Snores for more than a few minutes at a time? (6–8 months) (most nights/quite often)						
% snore	14.9%	13.6%	18.3%	15.4%	7028	
OR unadjusted	1.00	0.90	1.28	1.04	7028	NS
OR adjusted	1.00	0.76	1.05	0.93	6284	.020

TABLE 4. *Continued*

	Back	Side	Front	Varies	n	*P*
C. Sleeping Characteristics						
Has regular sleeping? (6–8 months)						
% regular	86.0%	85.4%	82.2%	84.5%	8367	
OR unadjusted	1.00	0.95	0.75	0.88	8367	NS
OR adjusted	1.00	1.02	0.99	0.97	7453	NS
Amount of sleep >14 hours? (6–8 months)						
% lengthy sleep	31.9%	36.1%	49.6%	33.9%	8152	
OR unadjusted	1.00	1.20	2.10	1.10	8152	<.001
OR adjusted	1.00	1.14	1.69	1.04	7296	.007
D. Gastrointestinal Signs and Symptoms						
Possets Often? (4–6 weeks)						
% posset	23.4%	22.4%	18.1%	24.9%	9611	
OR unadjusted	1.00	0.94	0.72	1.08	9611	NS (.071)
OR adjusted	1.00	0.98	0.81	1.11	8195	NS
Possets often? (6–8 months)						
% posset	24.8%	26.8%	24.7%	26.1%	8420	
OR unadjusted	1.00	1.11	1.00	1.08	8420	NS
OR adjusted	1.00	1.10	1.00	1.08	7521	NS
Has vomited often? (4–6 weeks)						
% vomit	1.8%	2.4%	3.2%	2.6%	9518	
OR unadjusted	1.00	1.30	1.76	1.45	9518	NS
OR adjusted	1.00	1.07	1.43	1.20	8117	NS
Has vomited often? (6–8 months)						
% vomit	3.1%	4.2%	5.0%	4.8%	8417	
OR unadjusted	1.00	1.39	1.65	1.57	8417	NS
OR adjusted	1.00	1.17	1.10	1.43	7518	NS
Has ever had vomiting? (6–8 months)						
% vomit	29.3%	31.5%	34.2%	30.4%	8445	
OR unadjusted	1.00	1.11	1.26	1.06	8445	NS
OR adjusted	1.00	1.00	0.91	1.03	7543	NS
Has ever been ill with diarrhea or gastroenteritis? (4–6 weeks)						
% diarrhea	2.5%	2.6%	2.2%	2.5%	9618	
OR unadjusted	1.00	1.04	0.88	0.99	9618	NS
OR adjusted	1.00	0.90	0.78	0.88	8201	NS
Has ever had diarrhea or gastroenteritis? (6–8 months)						
% diarrhea	26.2%	27.9%	26.9%	25.3%	8424	
OR unadjusted	1.00	1.09	1.04	0.95	8424	NS
OR adjusted	1.00	0.94	0.76	0.92	7526	NS
Has choked on feeding? (4–6 weeks)						
% choked	55.4%	56.2%	53.6%	56.4%	9685	
OR unadjusted	1.00	1.03	0.93	1.04	9685	NS
OR adjusted	1.00	1.06	1.09	1.10	8249	NS
Has choked on feeding? (6–8 months)						
% choked	19.4%	21.9%	18.5%	19.8%	8445	
OR unadjusted	1.00	1.17	0.94	1.03	8445	NS (.077)
OR adjusted	1.00	1.10	0.86	0.98	7543	NS
Has ever had a lot of wind on feeding? (4–6 weeks)						
% with wind	88.3%	88.0%	90.5%	88.4%	9685	
OR unadjusted	1.00	0.97	1.26	1.01	9685	NS
OR adjusted	1.00	0.98	1.58	1.07	8249	NS
E. Crying and Colic						
Ever had colic? (6–8 months)						
% colic	39.6%	40.0%	32.3%	40.8%	8445	
OR unadjusted	1.00	1.02	0.73	1.05	8445	NS (.083)
OR adjusted	1.00	1.13	0.97	1.12	7543	NS
Has often had periods when in agony, screams, draws legs up, and can't be calmed? (4–6 weeks)						
% colic symptoms	10.3%	11.5%	12.1%	14.2%	9522	
OR unadjusted	1.00	1.13	1.20	1.45	9522	.038
OR adjusted	1.00	1.22	1.48	1.57	8132	.010
Feel that infant's crying is a problem? (4–6 weeks)						
% with crying problem	4.5%	4.4%	7.6%	5.9%	9590	
OR unadjusted	1.00	0.97	1.75	1.33	9590	.028
OR adjusted	1.00	1.02	1.69	1.46	8173	NS (.065)
Infant is happy? = NO (4–6 weeks)						
% not happy	7.9%	9.0%	9.8%	11.7%	9685	
OR unadjusted	1.00	1.15	1.27	1.55	9685	.018
OR adjusted	1.00	1.08	1.21	1.53	8249	.036
F. Miscellaneous Signs and Symptoms						
Ever had jaundice? (4–6 weeks)						
% jaundice	45.4%	46.5%	42.0%	43.8%	9669	
OR unadjusted	1.00	1.05	0.87	0.94	9669	NS
OR adjusted	1.00	1.13	1.04	1.02	8239	NS

TABLE 4. *Continued*

	Back	Side	Front	Varies	n	*P*
Ever been jittery/twitching? (4–6 weeks)						
% jittery/twitching	11.7%	10.2%	8.8%	12.0%	9669	
OR unadjusted	1.00	0.86	0.73	1.02	9669	NS
OR adjusted	1.00	0.93	0.84	0.97	8239	NS
Ever had high temperature? (4–6 weeks)						
% with pyrexia	3.3%	4.8%	6.0%	5.6%	9669	
OR unadjusted	1.00	1.49	1.90	1.76	9669	.010
OR adjusted	1.00	1.44	1.82	1.64	8239	NS (.071)
Ever had raised temperature? (6–8 months)						
% with pyrexia	34.3%	39.4%	43.8%	37.4%	8445	
OR unadjusted	1.00	1.25	1.50	1.15	8445	<.001
OR adjusted	1.00	1.18	1.16	1.14	7890	NS
Ever had convulsions/fits? (6–8 months)						
% convulsions/fits	0.4%	0.7%	1.2%	0.8%	8445	
OR unadjusted	1.00	1.69	2.96	2.02	8445	NS
OR adjusted	1.00	1.57	3.04	1.60	7543	NS
G. Skin Conditions						
Has had rash in the joints and creases of body? (4–6 weeks)						
% rash	5.1%	5.9%	10.2%	7.3%	9603	
OR unadjusted	1.00	1.15	2.10	1.45	9603	.004
OR adjusted	1.00	1.03	1.72	1.41	8184	.040
Has had rash in the joints and creases of body? (6–8 months)						
% rash	25.2%	22.3%	18.8%	22.4%	8389	
OR unadjusted	1.00	0.85	0.69	0.85	8389	.042
OR adjusted	1.00	0.89	0.72	0.92	7495	NS
Has had a nappy rash? (4–6 weeks)						
% nappy rash	28.6%	23.6%	19.6%	25.2%	9622	
OR unadjusted	1.00	0.77	0.61	0.84	9622	<.001
OR adjusted	1.00	0.81	0.66	0.86	8202	.014
Has had nappy rash? (6–8 months)						
% nappy rash	56.6%	54.3%	52.7%	54.1%	8416	
OR unadjusted	1.00	0.91	0.86	0.91	8416	NS
OR adjusted	1.00	0.88	0.83	0.94	7520	NS
Has had cradle cap? (4–6 weeks)						
% cradle cap	12.4%	10.9%	10.5%	11.7%	9563	
OR unadjusted	1.00	0.87	0.83	0.94	9563	NS
OR adjusted	1.00	0.92	0.73	0.92	8156	NS
Has had cradle cap? (6–8 months)						
% cradle cap	77.6%	74.8%	66.7%	75.0%	8420	
OR unadjusted	1.00	0.86	0.58	0.87	8420	.002
OR adjusted	1.00	0.82	0.55	0.92	7522	.002

Adjusted for mother's education, mother's age, housing, parity, maternal smoking, admission to SCBU, pertussis vaccination, breast feeding, sex and ethnic group, and where relevant month questionnaire completed and/or age of child at completion.

adjustment for all potential confounders, the relationship was highly significant, with front sleepers having an OR of 1.69 [95% CI 1.24, 2.30] compared with those sleeping on their back. Side sleepers also were more likely to have periods of prolonged sleep with OR 1.14, which just failed to reach statistical significance [95% CI .99, 1.30].

D. Gastrointestinal Disorders

Posseting, or frequent vomiting, can be signs of gastroesophageal reflux. It was therefore of interest that the unadjusted figures for "posseting often" at 4 to 6 weeks of age showed a significant relationship with prone sleeping such that these infants were less likely to posset with an OR of .72 [95% CI .53, .98]. On adjustment however this ceased to be statistically significant with an OR of .81 [95% CI .57, 1.15]. By the time the child was 6 to 8 months of age, there were no negative relationships with prone sleeping, and a suggestion of increased posseting with side sleeping. This, however, was slight and nonsignificant after adjustment. Frequent vomiting was more likely to occur by 6 months in infants on their sides [OR 1.39, 95% CI 1.01, 1.91], prone [OR 1.65, 95% CI .88, 3.10] and in varying position [OR 1.57, 95% CI 1.01, 2.45]. After adjustment there was no significant relationship with any sleeping position, nor was there any relationship with diarrhea or gastroenteritis.

In regard to choking with feeds, there was slightly increased risk associated with side sleeping at 6 to 8 months, OR 1.17 [95% CI 1.01, 1.34], but this became nonsignificant after adjustment. Infants who were put prone were more likely after adjustment to have been reported as having a lot of wind (ie, burping) on feeding, although this was not statistically significant; OR 1.58 [95% CI .96, 2.60].

E. Crying and Colic

There was some suggestion that at 6 to 8 months, the proportion of infants who were reported as having had colic was lower for children put on their front, but this was accounted for on adjustment for all other factors. A far more objective picture occurs with the description of the infant being "in agony, screaming, drawing legs up and cannot be calmed" which was a description of more severe colic used by the study. Here it can be seen that the infants put to sleep on their back appeared less likely to have such

symptoms, and those in other sleeping positions more likely to do so. At 4 to 6 weeks, this relationship was statistically significant even on adjustment. The increase in colic described in this way was of borderline significance for side sleeping OR 1.22 [95% CI 1.00, 1.49], but just failed to reach significance for prone sleeping OR 1.48 [95% CI .97, 2.26], and was most significant for position varying, OR 1.57 [95% CI 1.20, 2.06].

At 4 to 6 weeks the mother was asked whether she felt that the infant's crying was a problem—although infants put prone were more likely to have such a description, this was not statistically significant on adjustment; OR 1.69 [95% CI .94, 3.04]. There were significant relationships with unhappiness, however (Table 4E). Infants who were put to sleep prone at 4 to 6 weeks and particularly those put in varying positions were significantly less likely to be reported as happy by their mothers. The adjusted OR for varied sleeping position was 1.53 [95% CI 1.13, 2.07].

F. Miscellaneous Signs and Symptoms

In Table 4F it can be seen that there were no significant differences between the proportions of children in each of the various sleeping positions who had ever had jaundice, been jittery, or twitching in the first month or so of life. There were significant relationships however with pyrexia in the first 4 to 6 weeks—with children put to sleep on their backs being least likely to have had a high temperature, and those put prone most likely to do so; after adjustment for all factors, in relation to back sleeping, the side sleeping position had an OR of 1.44 [95% CI 1.04, 2.00], the front sleeping position an OR of 1.82 [95% CI .97, 3.45], and the varied sleeping position OR 1.64 [95% CI 1.06, 2.54]. At 6 to 8 months, although unadjusted relationships were highly significant, by the time adjustment for all factors had been taken into account, the overall relationship was nonsignificant. Nevertheless, side sleeping was significantly more likely to be associated with a raised temperature than back sleeping (OR 1.18 [95% CI 1.04, 1.35]) and prone sleeping also had an elevated OR 1.16 ([95% CI .86, 1.57].

Data for convulsions are also shown in Table 4F. Here it can be seen that although there were strikingly elevated ORs that changed little with adjustment, overall statistical significance was not reached, probably because the incidence is so small. However, because at this age at least half of all convulsions are related to febrile fits, it is feasible that prone sleeping could be associated with such convulsions.

G. Rashes

In Table 4G it can be seen that there were significant associations between sleeping position and eczema (defined as rashes in the joints and creases of the body) at 4 to 6 weeks of age, with children placed prone being significantly more likely to have such a history (adjusted OR 1.72 [95% CI 1.04, 2.86]). This association was no longer present or significant at 6 to 8 months of age—and indeed children placed prone appeared to be less likely at this age to have had such a rash, although this was not statistically significantly different from back sleeping; OR .72 [95% CI .49, 1.04]. However, there were significant relationships with nappy (diaper) rash such that the child who had been placed side or prone, even after adjustment, was significantly less likely to have had such a rash; for side sleeping the OR was .81 [95% CI .71, .93] and for prone sleeping it was .66 [95% CI .47, .94]. At 6 to 8 months there were similar relationships, but statistical significance was not reached—OR side sleeping .88, [95% CI .77, 1.00], OR front sleeping .83 [95% CI .61, 1.12]. Children placed prone were also significantly less likely to have developed cradle cap in the period up to 8 months—with adjusted ORs .55 [95% CI .40, .77] for prone sleeping and .82 [95% CI .71, .95], for side sleeping.

DISCUSSION

Although when the ALSPAC study was being planned it seemed likely that there would be up to 40 sudden infant deaths, the change in sleeping position in the population of Avon was already far advanced, and there were only 5 such deaths among the 14,138 infants. The study consequently did not have the statistical power to consider the etiology of SIDS. Nevertheless, it was important to ensure that in reducing the incidence of SIDS, prevalence of other conditions was not being increased. This study was therefore undertaken with the remit of ensuring that infants put to sleep on their backs were not at increased risk of any common adverse health outcome. In this study we have looked at 43 different health outcomes, and shown only 2 to be significantly associated with an increase in risk for back sleepers compared with sleepers in other positions. These relationships are for an increase in nappy (diaper) rash at 4 weeks and cradle cap at 6 months of age. Neither are likely to cause major concerns to health professionals. Thus we have not shown any significant adverse health outcomes related to the advice to choose the supine as opposed to side or prone sleeping position.

There remain methodological questions concerning this study. First, it is feasible that taking the information on sleeping position when the children were 4 weeks of age is not necessarily an accurate reflection of sleeping position throughout the first 6 months of life. Unfortunately, details of sleeping position were not again requested until the child was 30 months of age. At this stage the usual sleeping position of the child was related to (but not synonymous with) that found when the child was 4 weeks of age in relation to going down to sleep. As noted above, in a separate study of child care practices in a group of 152 Avon families randomly selected from the birth register in 1990 to 1991, no significant changes in routine sleeping position for infants were identified between 1 and 5 months of age, suggesting that the sleeping position at 4 weeks was a good proxy for usual practice throughout the first 6 months.[8,13]

There are also the questions that must always arise in any study concerning the representative nature of the sample under scrutiny. The ALSPAC study achieved a high response rate, and covered over 85% of the eligible population. Nevertheless, there were certain groups that were underrepresented in this

study—these particularly involved mothers who were teenagers, those from the ethnic minority groups, and unsupported mothers. Nevertheless, the analysis showed similar time trends in sleeping position within strata of education, ethnic group, and education background. The message concerning sleeping position of the child appears to have reached all members of the community. It is unlikely that any systematic bias in response could therefore change our results.

A secondary hypothesis of this study was to see whether information on other conditions in these young infants would actually help inform the debate as to why front sleeping position should be associated with increased risk of SIDS. Whereas we only showed significant increases of two conditions among back sleepers, there were a large number of conditions where the front sleeper showed an elevated OR in comparison with the back sleeper. There were relatively small numbers of front sleepers, and consequently these elevated ORs rarely reached statistical significance. The front sleepers were significantly more likely to be reported as having had a cough (although not more likely to be reported as coughing for at least 2 days), both at 4 weeks and at 6 months of age, to have had episodes of pyrexia, and signs of eczema in the first weeks, compared with back sleepers. They were also significantly more likely to sleep for a prolonged length of time (in excess of 14 hours) at 6 months of age. Although not statistically significant at the 95% level, prone sleeping infants were also more likely to be reported as not very well, to have had the general practitioner called to the home, to have had earache and suspected hearing problems, colic, and crying problems.

These relationships may provide clues to the etiology of SIDS. Prolonged sleeping may be an indicator of an infant that was inappropriately difficult to arouse; increased risk of cough, pyrexia, earache and having to call the general practitioner to the home suggest that in the presence of an infection symptoms are worse for infants sleeping prone.

There remains the question as to whether the initial position of the infant on being put to sleep was actually a consequence of any of the symptoms that had occurred in the first 4 weeks rather than the symptom being initiated by the sleeping position. It may well be that children with wind were found to be more docile if put down on their fronts than if put in any other sleeping position. The relationship with colic may well be of similar origins–and the dramatic relationship shown with a varying sleep position was probably a direct consequence of trying to achieve a less unhappy infant by trying different sleeping positions.

In conclusion, this study has shown a variety of different relationships between sleeping position and morbidity–few are statistically strong, but the general tenor of the results indicate that infants put to sleep on their back were if anything at reduced risk of respiratory and gastrointestinal conditions, those put on their side were more likely to be visited at home by a doctor for health problem, to have colic, but also to sleep for a prolonged length of time and be at reduced risk of snoring. Front sleeping was associated with a wide range of different problems, mainly respiratory in origin.

Data from this study are reassuring in the light of the Back to Sleep Campaign, because they show no indications that this policy may be producing unwarranted adverse effects in the population of children born since the campaign. There are however a number of queries that should still be investigated—for example is there any effect on the subsequent temperament, behavior, and development of these children according to the sleeping position in which they were put, and is health after 6 months related in any way to the sleeping position of the child?

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