Does the Supine Sleeping Position Have Any Adverse Effects on the Child? II. Development in the First 18 Months

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ABSTRACT. *Objective.* **To assess whether the recommendations that infants sleep supine could have adverse consequences on their motor and mental development.**

Design. **A prospective study of infants, delivered before, during, and after the Back to Sleep Campaign in the United Kingdom, followed to 18 months of age.**

Subjects. **The children were participants of the Avon Longitudinal Study of Pregnancy and Childhood born to mothers resident in the three former Bristol-based health districts of Avon, with expected date of delivery from April 1, 1991 to December 31, 1992. Questionnaires were completed on sleeping position at 4 to 6 weeks of age and sets of standardized questions on development at 6 and 18 months.**

Main Outcome Measures. **Social, communication, fine and gross motor, and total developmental scales based on the Denver Developmental Screening Test at 6 and 18 months.**

Results. **After adjustment for 27 factors using multiple regression, 3 of the 10 scales and subscales significantly distinguished between front and back sleeping position. At 6 months of age, infants put to sleep on their front had a mean score 0.38 SD (95% confidence interval [CI]: 0.28, 0.49) higher on the gross motor scale, 0.11 SD (95% CI: 0.00, 0.23) higher in the social skills scale, and a total development score 0.20 SD (95% CI: 0.10, 0.30) higher than those on their backs. These differences were no longer apparent at 18 months.**

Conclusions. **There is some evidence that putting infants to sleep in the supine position results in a reduced developmental score at 6 months of age, but this disadvantage appears to be transient. Weighing this against the adverse health effects demonstrated with the prone sleeping position, these results should not change the message of the Back to Sleep Campaign.** *Pediatrics* **1998; 101(1). URL: http://www.pediatrics.org/cgi/content/full/101/1/e5;** ***sleeping position, infant development, motor development.***

ABBREVIATIONS. SIDS, sudden infant death syndrome; ALSPAC, Avon Longitudinal Study of Pregnancy and Childhood; OR, odds ratio.

While acknowledging the dramatic reduction in sudden infant death syndrome (SIDS) in many countries accompanying a change from prone to supine sleeping position, it is important to ensure that the recommended position has no adverse effects on the child. We have already shown[1] that there appear to be no adverse effects on the health of the child in the first 6 months of life. The American Academy of Pediatrics Task Force, however, stated that prone sleeping had been thought to be better for infants because of improved psychomotor development, among other factors.[2]

From 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 fallen considerably from that observed 2 years earlier and contrasted with that in other areas of the United Kingdom, although no public campaign to change infant sleeping position was mounted until the end of October 1991.[3–5]

The Avon Longitudinal Study of Pregnancy and Childhood (ALSPAC) was designed to identify ways in which the environment affected the health and development of the child,[6] and therefore has monitored the consequences of changing sleeping position of an infant population that was born in 1991 and 1992.

MATERIAL AND METHODS

Participants

The ALSPAC 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.

Procedure

Information was obtained both from self-completion questionnaires with specific questions being asked of mothers and their partners at various times during pregnancy and after the birth of the child and from clinical records.[6] In all, there were 14 138 live births that survived the neonatal period. Of these, questionnaires administered at 4 weeks were completed with details of sleeping position for 12 208 children (86% response rate). Questionnaires administered at 6 and 18 months were completed for 10 579 of these children at age 25 to 42 weeks inclusive, and 10 183 at between 18 and 22 months of age, respectively The questionnaire-based information included detailed assessments of the mother's social and environmental background, her lifestyle, her parenting attitudes, and medical problems experienced by both mothers and infants. To provide information on validity and fine scale measurements, a randomly selected 10% sample of the ALSPAC study have been examined at periodic intervals. The present study, however, is of the whole dataset.

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Measures

In a questionnaire administered 4 weeks after the infant's birth, the mother was asked what position the infant is in when 1) (s)he goes down for the night?; 2) (s)he wakes up? The mother was given the options: (a) back, (b) side, (c) front, and (d) varies for each of these categories.

The developmental outcomes were assessed from sets of questions asked in two questionnaires, administered when the children were 6 and 18 months of age. These questions were derived from the Denver Developmental Screening Test,[7] each item having the options "yes can do well"; "yes, has only done once or twice"; and "no has not started yet." Scores of 2, 1, and 0, respectively, were given to the responses and the scores summed for each item in a particular subscale. The total development score was the sum of the subscale scores. If there was an item missing, the modal value for that item was used, unless all items were missing.

Total scores and all of the subscale scores except that for gross motor at 18 months were distributed normally. We have shown elsewhere that the total score obtained from maternal questionnaire responses at 18 months was correlated highly with results of hands-on testing of the children at 18 months by trained observers using the Griffiths test.[8]

For statistical analysis, the development scores were transformed to have a mean of zero and an SD unit of 1. The effect of sleeping position on the normally distributed scales was estimated using multiple linear regression models that included the statistically significant ($P < .05$) confounding factors from those listed below.

The gross motor scale at 18 months exhibited a ceiling effect and was therefore dichotomized using a −0.5 SD cutpoint. Logistic regression was used to estimate the effects of sleeping position on the binary outcome. To compare the effect at the two ages, the procedure was repeated for the gross motor scale at 6 months.

The confounding factors considered in the multiple regression analyses were as follows: age of the child when the questionnaire was completed; the mother's highest educational level (categorized into five groups of increasing achievement according to types of examination passed; A denotes minimal qualifications and E university degree); the partner's highest educational level (in five groups as for mothers); mother's age (<20, 20 to 24, 25 to 29, 30 to 34, ≥35); housing circumstances (owned/mortgaged; rented); whether the home suffered from damp as reported by the mother (yes/no); number of children in household; ethnic origin of child; social support received by mother (measured using 10 questions developed specifically for this study); postnatal depression (using the Edinburgh Postnatal Depression Scale[9] administered at 8 weeks' postpartum); parenting score (based on a series of 10 questions derived from the Home Observation for Measurement of the Environment [10]); duration of breastfeeding; number of life events experienced between midpregnancy and eight weeks' postpartum; hospitalization of the child before age 6 months; sex of child; birth weight; mother's smoking habit at conception and midpregnancy; mother's alcohol exposure at conception and midpregnancy; binge drinking experiences midpregnancy; caffeine intake midpregnancy; cannabis and hard drug habits; paracetamol (acetaminophen) and other medication midpregnancy; and environmental tobacco smoke exposures during pregnancy.

RESULTS

The number of children who were included in each follow-up are shown according to sleeping position in Table 1. It can be seen that there were only slight differences at each follow-up in the proportion of children who had been prone, side, or supine sleepers. The majority had been put on their sides and <4% on their fronts.

The ways in which the various demographic and other variables are associated with sleeping position are shown in Table 2. Arbitrarily, we show the unadjusted odds ratio (OR) values for the prone/supine ratio. It can be seen that the prone position was particularly favored by the ethnic minorities, those living in rented accommodation, those with other children, those with high levels of social support, mothers who smoked during pregnancy, mothers who took paracetamol during pregnancy, those who were hospitalized, and those with fewer life events. Conversely, there was an excess of infants put in the supine position if mothers had low social support or drank alcohol postnatally. There was no significant difference in the OR values of prone to supine sleeping position by maternal education, but there was a lower proportion of side sleepers and a higher proportion reporting varied sleeping positions ($P <.00001$). Similar associations were observed with higher parenting scores ($P = .041$); longer duration of breastfeeding ($P = .00003$); smoking cannabis ($P <.00001$), and daily alcohol consumption during pregnancy ($P = .0003$). Low birth weight children were more likely to have varied or side sleeping position compared with heavier infants ($P < .00001$), and girls were more likely to be in a side sleeping position than were boys ($P = .011$). There were no significant associations with maternal age, damp housing, caffeine consumption, or postnatal depression.

Table 3 shows the way in which the 6-month developmental scores vary with the sleeping position of the child. The first column shows the effect adjusted only for age; the second column shows the full adjustment. The results of the F tests indicate that sleeping position explained a significant proportion of the variation in gross motor, fine motor, and total scores. Inspection of the coefficients shows that none of the developmental scores revealed any significant difference between the side and back sleeping positions, once fully adjusted. However, there were significant differences for children who slept prone, with increased ability on the gross motor scale ($P < .0001$), the social scale ($P <.05$), and the total score ($P < .0001$) when compared with back sleepers. Children for whom mothers reported varying the sleeping position also had significantly increased ability on the gross motor scale ($P = .0002$) and total score ($P = .02$). Varied sleeping position was marginally significant for fine motor skills ($P = .066$).

TABLE 1. The Numbers of Children Included in Each Data Sweep According to the Position on Going Down at Night at 4 Weeks

Follow-up	Sleeping Position				
	Prone	Side	Supine	Varies	All
At 4 weeks	466 (3.8%)	8316 (68.1%)	2381 (19.5%)	1045 (8.6%)	12 208 (100%)
At 6 months	382 (3.6%)	7212 (65.1%)	2069 (18.7%)	916 (8.7%)	10 579 (100%)
At 18 months	384 (3.8%)	7032 (69.1%)	1915 (18.8%)	852 (8.4%)	10 183 (100%)

TABLE 2. OR With 95% CI of Prone to Supine Sleeping Position for Various Potentially Confounding Variables

Variable		OR	[95% CI]
Ethnic origin	White	1.00	Ref
	Nonwhite	3.88	[2.59, 5.80]
	Unknown	0.79	[0.38, 1.68]
Tenure	Owned	1.00	Ref
	Rented	1.59	[1.24, 2.05]
Number of children	1 (ie, study child)	1.00	Ref
	2+	4.64	[3.51, 6.14]
Social support	A (low)	0.23	[0.08, 0.63]
	B	0.47	[0.20, 1.12]
	C	0.70	[0.56, 0.89]
	D (high)	1.00	Ref
Smoking midpregnancy	No	1.00	Ref
	Yes	1.59	[1.20, 2.09]
Paracetamol use midpregnancy	No	0.68	[0.54, 0.85]
	Yes	1.00	Ref
Child hospitalized before 6 months	No	1.00	Ref
	Yes	1.47	[1.06, 2.04]
Postnatal alcohol consumption	None	1.00	Ref
	<1/week	0.69	[0.51, 0.92]
	≥1/week	0.55	[0.40, 0.75]
	≥1/day	0.56	[0.33, 0.94]
Life events	0	1.86	[1.41, 2.45]
	1	1.16	[0.89, 1.52]
	≥2	1.00	Ref

The results of the regressions on those 18-month scales of development that were distributed normally are shown in Table 4. There was one significant coefficient indicating a difference between back and side sleeping with increased communication score for the side sleepers of 0.07 SD units, but no significant differences between back and front or back and varies, on any of the scales, including the total score (which includes the gross motor component), when fully adjusted.

For gross motor development, logistic regression was used to assess whether there was any indication of delayed development, especially among the group of back and side sleepers compared with front sleepers. The result (Table 5) indicates that although front (and varied position) sleepers were significantly less likely to be in the lower tail of the gross motor distribution at 6 months, these effects were much reduced in size and no longer statistically significant at 18 months.

DISCUSSION

We have shown that one of the many arguments against the nonprone sleeping position has some justification. Children put to sleep prone had an increased gross motor score (of the order of 0.38 SD units) at 6 months of age, which was highly statistically significant, and an increase in social skills score of 0.11 SD units. Because these scores are components of the total score, it is not surprising that for this, there was a significant increase of 0.20 SD units for prone sleeping.

Interestingly, the group described as having a variable sleeping position showed a pattern of development at 6 months that showed a significant advance in both gross motor and total score, perhaps indicating that many of these children often slept on their fronts.

These findings would be disturbing for the Back to Sleep Campaigns around the world were it not for the findings at 18 months, by which time there were no statistically significant advantages for the prone (or varied) sleeper.

It is important to ensure that artifacts have not been responsible for either the significant findings at 6 months or the nonsignificant results at 18 months. There are no obvious candidates other than a possible artefact introduced by the age of the children when the 6-month questionnaire was administered. A short-term financial crisis in the ALSPAC study resulted in a delay in sending out the questionnaires to the children born before June 1991; consequently, the questions were not answered for this group until they were 7 to 8 months of age. This group of the cohort, however, contained proportionately more prone sleepers (because they had been born before the national campaign). However, repeating the analysis for only the children whose mothers had completed the questionnaire before the children were 30 weeks old (n = 9398) resulted in essentially the same results, although there was now a significant difference in the communication score, with side sleepers having a significantly lower score (0.08 SD units) than back sleepers ($P < .0001$) and a slight reduction in the effect of prone sleeping on the motor development score from 0.38 to 0.30 SD units. However, this was still highly statistically significant ($P = .0001$). There was no similar problem at 18 months, with the questionnaire sent out as scheduled to the whole cohort.

Despite controlling for a wide variety of social, environmental, and lifestyle variables, there is no obvious way of controlling for a mother's innate desire to exaggerate the ability of her child. Nevertheless, it is difficult to understand why such an effect might operate at 6 months but not at 18 months and among mothers with prone sleeping infants rather than those with infants sleeping in other positions.

Finally, assuming that children placed prone are, as a result, able to develop faster in the first 6 months, there are two important questions: 1) what might the mechanism be and 2) what are the likely consequences? Before performing this set of analyses, we postulated that the child placed prone might be more advanced in regard to gross motor development, because he/she would have more opportunity to start moving on hands and knees, for example, but we assumed that the child placed supine would have had more opportunity to develop fine motor coordination, playing with his/her hands and toes and more likely to interact and develop social skills. Although our predictions about gross motor skills were correct, we found no evidence here of any compensatory beneficial developmental effect with nonprone sleeping. It is conceivable that the prone sleeper is stimulated to move and explore because the position itself is inherently boring and the child must do something

TABLE 3. Age-adjusted and Fully Adjusted Effects (β) of Sleeping Position in SD Units on Development at 6 Months (With Significance Level of F Test for Improvement in Model Fit When Term Was Added)

Sleeping Position	n	Age-adjusted β [95% CI]	Fully Adjusted[a] β [95% CI]
Gross motor			
Back	1777	0.00 Ref	0.00 Ref
Side	6235	−0.02 [−0.07, 0.02]	0.02 [−0.02, 0.07]
Front	320	0.31 [0.20, 0.41]	0.38 [0.28, 0.49]
Varies	774	0.13 [0.06, 0.21]	0.14 [0.06, 0.21]
F test significance level		****	****
Fine motor			
Back	1774	0.00 Ref	0.00 Ref
Side	6223	−0.06 [−0.11, −0.01]	−0.02 [−0.06, 0.03]
Front	318	−0.02 [−0.14, 0.09]	0.09 [−0.02, 0.20]
Varies	771	0.05 [−0.03, 0.13]	0.07 [0.00, 0.15]
F test significance level		***	**
Communication			
Back	1772	0.00 Ref	0.00 Ref
Side	6222	−0.04 [−0.09, 0.01]	−0.04 [−0.09, 0.01]
Front	318	−0.07 [−0.18, 0.05]	−0.08 [−0.20, 0.03]
Varies	772	0.02 [−0.06, 0.10]	0.02 [−0.05, 0.10]
F test significance level		NS	NS
Social skills			
Back	1773	0.00 Ref	0.00 Ref
Side	6220	−0.02 [−0.07, 0.03]	0.02 [−0.03, 0.07]
Front	318	0.07 [−0.05, 0.18]	0.11 [0.00, 0.23]
Varies	771	0.01 [−0.07, 0.09]	0.02 [−0.06, 0.09]
F test significance level		NS	NS
Total score			
Back	1772	0.00 Ref	0.00 Ref
Side	6218	−0.05 [−0.09, 0.00]	0.00 [−0.05, 0.04]
Front	318	0.11 [0.01, 0.22]	0.20 [0.10, 0.30]
Varies	771	0.08 [0.00, 0.15]	0.09 [0.02, 0.16]
F test significance level		*	*

[a] Adjusted for significant factors from the 27 described in "Methods." NS indicates nonsignificant; **** $P < .0001$; *** $P < .01$; ** $P < .001$; * $P < .05$.

TABLE 4. Age-adjusted and Fully Adjusted Effects (β) of Sleeping Position in SD Units on Development at 18 Months (With Significance Level of F Test for Improvement in Model Fit When Term Was Added)

Sleeping Position	n	Age-adjusted β [95% CI]	Fully Adjusted[a] β [95% CI]
Fine motor			
Back	1612	0.00 Ref	0.00 Ref
Side	5892	−0.02 [−0.07, 0.04]	0.00 [−0.05, 0.06]
Front	308	−0.03 [−0.15, 0.08]	−0.02 [−0.14, 0.09]
Varies	715	−0.01 [−0.10, 0.07]	−0.01 [−0.09, 0.07]
F test significance level		NS	NS
Communication			
Back	1614	0.00 Ref	0.00 Ref
Side	5898	0.07 [0.02, 0.12]	0.07 [0.01, 0.12]
Front	308	0.03 [−0.09, 0.15]	0.07 [−0.05, 0.18]
Varies	714	0.06 [−0.02, 0.15]	0.07 [−0.02, 0.15]
F test significance level		NS	NS
Social skills			
Back	1612	0.00 Ref	0.00 Ref
Side	5890	0.03 [−0.02, 0.09]	0.02 [−0.03, 0.08]
Front	308	0.12 [0.00, 0.24]	0.09 [−0.03, 0.20]
Varies	715	0.04 [−0.05, 0.12]	0.05 [−0.04, 0.13]
F test significance level		NS	NS
Total score			
Back	1609	0.00 Ref	0.00 Ref
Side	5883	0.04 [−0.01, 0.10]	0.04 [−0.01, 0.09]
Front	308	0.04 [−0.07, 0.16]	0.07 [−0.05, 0.18]
Varies	714	0.05 [−0.03, 0.14]	0.07 [−0.02, 0.15]
F test significance level	NS	NS	

[a] Adjusted for significant factors from the 27 described in "Methods." NS indicates nonsignificant.

to change his/her circumstances. Conversely many nonprone sleepers have many stimulating features to watch and be distracted by, so that movement is not a necessity.

In interpreting our findings, it is important to emphasize the importance of balancing the transient developmental advantage we have shown with the negative effects on health outcomes[1] and the now-certain increase in SIDS risk with prone sleeping.[3] There is no convincing reason therefore to change the current advice on sleeping position.

TABLE 5. Age-adjusted and Fully Adjusted Odds of Being 0.5 SD Unit Below the Mean on the Gross Motor Scale at 6 and 18 Months for Sleeping Position Compared With Supine Position (With Significance Level of χ^2 Test for Improvement in Model Fit When Term Was Added).

Sleeping Position	n	Age Adjusted β [95% CI]	Fully Adjusted[a] β [95% CI]
At 6 months			
Back	1777	1.00 Ref	1.00 Ref
Side	6235	1.06 [0.95, 1.19]	0.98 [0.87, 1.10]
Front	320	0.71 [0.52, 0.97]	0.60 [0.44, 0.82]
Varies	774	0.80 [0.66, 0.97]	0.78 [0.64, 0.95]
χ^2 test significance level		***	****
At 18 months			
Back	1611	1.00 Ref	1.00 Ref
Side	5892	1.17 [0.90, 1.51]	1.12 [0.86, 1.45]
Front	308	0.88 [0.72, 1.06]	0.86 [0.70, 1.04]
Varies	715	0.95 [0.84, 1.06]	0.94 [0.84, 1.07]
χ^2 test significance level		NS	NS

[a] Adjusted for significant factors from the 27 described in "Methods." NS indicates nonsignificant; *** $P < .001$; **** $P < .0001$.

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