



## **Infant Sleep Position and Sudden Infant Death Syndrome (SIDS): A Selected Annotated Bibliography**

Price SK, Gardner P, Hillman L, Schenk K, Warren C.

**Changing hospital newborn nursery practice: results from a statewide “back to sleep” nurses training program.**

Matern Child Health J. 2007 Jun 15; [Epub ahead of print].

**OBJECTIVE:** In response to findings from a statewide survey of hospital nurses, the authors designed, conducted, and evaluated a "Back to Sleep" nursing curriculum and training program in Missouri hospitals using two distinct training formats. This article evaluates the initial and follow-up outcomes for training participants and assesses the impact of training format on participant outcomes.

**METHODS:** Participants selected training format by hospital site. In each training format, participants responded to a pre and post test questionnaire measuring knowledge, beliefs, and current infant care behaviors as well as satisfaction with the training. Three months after completion of all statewide trainings, the authors also conducted a follow-up survey. **RESULTS:** Nurses who participated in the training reported statistically significant improvements in knowledge and "Back to Sleep" adherent beliefs. Over 98% of participants (N = 515) intended to place infants in back-only sleep positions following the training. Knowledge, attitudes, and practice intentions were significantly improved across both training formats. Additionally, follow-up survey respondents statewide (N = 295) reported lasting improvements, including 63% of nurses reportedly using supine-only sleep position for infants after the first 24 h of life, compared to 28% in the original statewide survey. **CONCLUSIONS:** Further research is needed to determine the long-term impact of this intervention and assess its applicability beyond this initial implementation. Ultimately, the findings from the evaluation of this pilot intervention and nursing-specific "Back to Sleep" curriculum demonstrate that it has a promising effect on risk-reduction adherence in hospital settings where parent observations of safe sleep behavior first occur.

Full-text available at: <http://www.springerlink.com/> (not a U.S. Government site)

Mary Anne Tablizo, MD; Penny Jacinto, MD; Dawn Parsley, PNP; Maida Lynn Chen, MD; Rangasamy Ramanathan, MD; Thomas G. Keens, MD.

**Supine sleeping position does not cause clinical aspiration in neonates in hospital newborn nurseries.**

Arch Pediatr Adolesc Med. 2007 May; 161(5):507-510.

**Objectives:** To determine the frequency and severity of clinically significant events of spitting up in normal newborns during the first 24 hours of life and to correlate the events with sleeping position. **Design:** Prospective observational study. **Setting:** Children born between August 2003 and October 2004 in newborn nurseries at 2 hospitals. **Participants:** Healthy full-term newborns (n = 3240) ( 37 weeks estimated gestational age) during the first 24 hours of life. **Outcome Measures:** Frequency of,

and intervention required for, spitting up in supine, side-lying, and prone positions while asleep and awake. Results: Of the 3240 infants, 96.6% did not spit up during sleep. A total of 142 episodes of spitting up were documented in 111 newborns during sleep. While the newborns were supine and asleep, there were 130 episodes of spitting up. Of these episodes, 55% did not require any intervention, 37% only required brief suctioning with a bulb syringe, 6% required gentle stimulation, and 2% required wall suction. Both nurseries had a policy that newborns should sleep supine; therefore, only 6 newborns were noted to have spitting up episodes while lying on the side, with 66.7% requiring no intervention and 33.3% requiring bulb syringe. No episodes of apnea, cyanosis, documented aspirations, neonatal intensive care unit admissions, or deaths from spitting up were noted. Conclusions: We conclude that clinically significant spitting up occurs infrequently in hospital newborn nurseries while the newborns are asleep. Fewer than 4% of newborns spit up while sleeping in the supine position in the first 24 hours of life, and none required significant intervention or experienced serious sequelae.

Full text available at: [archpedi.ama-assn.org/](http://archpedi.ama-assn.org/) (not a U.S. Government site)

Hutchison L, Stewart A, Mitchell E.

**Infant sleep position, head shape concerns, and sleep positioning devices.**

J Paediatr Child Health. 2007 Apr;43(4):243-8.

Aim: The Back To Sleep campaign has successfully promoted the use of the supine sleep position for infants, with a corresponding decrease in sudden infant death syndrome death rates around the world. The aim of this study was to survey current infant sleep position practices, concerns about plagiocephaly, and the use of sleep positioning devices. Methods: A postal survey of 400 mothers of infants aged 6 weeks to 4 months was carried out in Auckland, New Zealand. Results: Of the 278 (69.5%) respondents, the supine position was usually used in 64.8%, the prone position in 2.9%, with 32.3% using the side position or a combination of side and back positions. Approximately one-third had a concern about their infant's head shape, and 80% described practices to help prevent head deformation. Thirty per cent reported they had changed their infant's sleep position because of head shape concerns. A third of the mothers used some sort of positioning system to maintain the infant's sleep position. Conclusions: Anxieties about plagiocephaly, aspiration of vomit, and poor quality sleep are the main concerns that parents have about sleeping their infants on their backs. Further education is needed to inform mothers about these issues and to alleviate their fears.

Full text available: [www.blackwell-synergy.com](http://www.blackwell-synergy.com) (not a U.S. Government site)

Krous HF, Masoumi H, Haas EA, Chadwick AE, Stanley C, Thach BT.

**Aspiration of gastric contents in sudden infant death syndrome without cardiopulmonary resuscitation.**

J Pediatr. 2007 Mar; 150(3):241-6.

Objectives: (1) To compare demographic profiles among sudden infant death syndrome (SIDS) infants with or without gastric aspiration, for whom cardiopulmonary resuscitation (CPR) had not been attempted; (2) to review the severity and potential significance of aspiration in those SIDS cases; and (3) to assess the risk of supine sleep position with regard to gastric aspiration. Study Design: Retrospective review of records and microscopic slides for all postneonatal SIDS cases (29 to 365 days

of age) accessioned by the San Diego County Medical Examiner from 1991 to 2004. Results: Ten (14%) of 69 cases of SIDS infants who had not undergone CPR before autopsy revealed microscopic evidence of gastric aspiration into the distal lung; this group was not otherwise clinically or pathologically different from cases of SIDS infants without aspiration. Similar proportions of infants were found supine or prone, regardless of gastric aspiration. Conclusions: Gastric aspiration is not uncommon in infants dying of SIDS, and supine sleep position does not increase its risk. Gastric aspiration may be a terminal event that some infants, representing a subset of SIDS cases, cannot overcome.

Full-text available at: <http://www.sciencedirect.com> (not a U.S. Government site)

Baddock SA, Galland BC, Taylor BJ, Bolton DP.

**Sleep arrangements and behavior of bed-sharing families in the home setting.**

Pediatrics. 2007 Jan; 119(1):e200-7.

Objectives: We aimed to provide a quantitative analysis of the sleep arrangements and behaviors of bed-sharing families to further understand the risks and benefits as well as the effects of infant age and room temperature on bed-sharing behaviors. Methods: Forty infants who regularly bed shared with > or = 1 parent > or = 5 hours per night were recruited. Overnight video of the family and physiological monitoring of the infant was conducted in infants' homes. Infant sleep position, potential for exposure to expired air, head covering and uncovering, breastfeeding, movements, family sleep arrangements, responses to the infant, and interactions were logged. Results: All infants slept with their mother. Fathers were included in 18 studies and siblings in 4. Infants usually slept beside the mother, separated from the father/siblings (if present), facing the mother, with head at mothers' breast level, touching, or with mother cradling. Median overnight breastfeeding duration was 40.5 minutes. Mothers commonly faced their infant, but infants were rarely in a position that potentially exposed them to maternal expired air. Fathers were seldom in contact with the infant during sleep. Of the 102 head-covering episodes observed in 22 infants, 80% were because of changes in adult sleep position. Sixty-eight percent of head uncovering was facilitated by the mother; half of these events were prompted by the infant. A 1 degree C increase in room temperature decreased infant head covering by 0.2 hours. Conclusions: The mother-infant relationship is of prime importance during bed sharing, whether the father is present or not. The focus around breastfeeding often dictates the sleep position of the infant and mother, though room temperature may also influence this. In colder rooms infants tend to spend more time with their face covered by bedding. Frequent maternal interactions rely on the ability of the mother to arouse with little stimulation. Mothers, perhaps impaired by alcohol, smoking, or overtiredness, may not be able to respond appropriately.

Full-text available at: <http://www.pediatrics.org> (not a U.S. Government site)

Flaig C.

**Inappropriate mediastinal baroreceptor reflex as a possible cause of sudden infant death syndrome - Is thorough burping before sleep protective?**

Med Hypotheses. 2007; 68(6):1276-86. E-pub 2006 Dec 4.

Despite extensive research, a link between the assumed mechanisms of death and known risk factors for sudden infant death syndrome (SIDS) has not yet been established. Modifiable risk factors such as

prone sleeping position, nicotine exposure and thermal stress and non-avoidable risk factors like male gender and some risky socio-economic conditions could be detected, but the etiology of SIDS remains unknown. In many SIDS cases histopathological findings suggest an involvement of vital autonomic control functions and unidentified trigger factors seem to play a role. From a hypothetical point of view, a developmental sympatheticovagal imbalance of the cardiovascular reflex control could cause a predisposition for SIDS. An assumed gastroesophageal trigger impulse is possibly developed during the first weeks of life and could lead to the infant's vagal reflex death. Air swallowed during feeding escapes through the esophagus while the infant is sleeping. The temporarily bloated esophagus exerts pressure on neighboring mediastinal baroreceptors, which is potentially misinterpreted as a rise in arterial pressure. The following cardiodepressor baroreceptor reflex could lead to arterial hypotension, bradycardia and cardiac arrest. Sleeping in prone position may create an increased thoracic pressure on mediastinal baroreceptors, causing a more pronounced vagal reflex and an increased likelihood of SIDS. Prone position in connection with soft objects in the infant's sleeping environment potentially generates an increased oculobulbar pressure, resulting in an additional cardiodepressor condition (Aschner-Dagnini phenomenon). From the sixth month of life onwards the sympatheticovagal balance seems to have matured sufficiently to compensate the life-threatening challenges in most infants. Insufficient postprandial burping could either create another independent modifiable risk factor or present the missing link to a common trigger mechanism for SIDS. Further investigations may possibly lead to the explicit recommendation to burp all infants sufficiently and repeatedly before sleep.

Full-text available at: <http://www.sciencedirect.com> (not a U.S. Government site)

Rao H, May C, Hannam S, Rafferty GF, Greenough A.

**Survey of sleeping position recommendations for prematurely born infants on neonatal intensive care unit discharge.**

Eur J Pediatr. 2006 Nov 14; [E-pub ahead of print]

Introduction: Prematurely born infants are at an increased risk of sudden infant death syndrome (SIDS), particularly when sleeping prone. Parents are strongly influenced in their choice of sleeping position for their infant by practitioners. The aim of this study was to determine the neonatal units' recommendations regarding the sleeping position for premature infants prior to and after discharge and ascertain whether there had been changes from those recorded in a survey performed in 2001-2002. Materials and Methods: A questionnaire survey was sent to all 229 neonatal units in the United Kingdom; 80% responded. Results and Discussion: The majority (83%) of units utilized the supine sleep position for infants at least 1-2 weeks prior to discharge, but after discharge, only 38% of the units actively discouraged prone sleeping and 17% additionally recommended side sleeping. Compared to the previous survey, significantly more units started infants with supine sleeping 1-2 weeks prior to discharge ( $p < 0.0001$ ) and fewer recommended side sleeping after discharge ( $p = 0.0015$ ). However, disappointingly, less actively discouraged prone sleeping after discharge ( $p = 0.0001$ ). Conclusion: Recommendations regarding sleeping position for prematurely born infants after neonatal discharge by some practitioners remain inappropriate. Evidence-based guidelines are required as these would hopefully inform all neonatal units' recommendations.

Full-text available at: <http://www.springerlink.com> (not a U.S. Government site)

Majnemer A, Barr RG.

**Association between sleep position and early motor development.**

J Pediatr. 2006 Nov; 149(5):623-629.e1

Objective: To compare motor performance in infants sleeping in prone versus supine positions. Study Design: Healthy 4-month-olds (supine: n = 71, prone: n = 12) and 6-month olds (supine: n = 50, prone: n = 22) were evaluated with the Alberta Infant Motor Scale (AIMS) and Peabody Developmental Motor Scale (PDMS), and parents completed a positioning diary. Infants were reassessed at 15 months. Results: At 4 months, motor scores were lower in the supine group and were less likely to achieve prone extension ( $P < .05$ ). At 6 months, there were wide discrepancies on the AIMS (supine: 44.5 +/- 21.6, prone: 60.0 +/- 18.8,  $P = .005$ ) and the gross motor PDMS (supine: 85.7 +/- 7.6, prone: 90.2 +/- 9.5,  $P = .03$ ). Motor delays were documented in 22% of babies sleeping supine. Prone sleep-positioned infants were more likely to sit and roll. Daily exposure to awake prone positioning was predictive of motor performance in infants sleeping supine. At 15 months, sleep position continued to predict motor performance. Conclusions: Infants sleeping supine may exhibit early motor lags, associated with less time in prone while awake. This has implications for accurate interpretation of assessment of infants at risk and prevention of inappropriate referrals. Rate of infant motor development appears influenced by extrinsic factors such as positioning practices.

Full-text available at: <http://www.sciencedirect.com> (not a U.S. Government site)

Maggio AB, Schappi MG, Benkebil F, Posfay-Barbe KM, Belli DC.

**Increased incidence of apparently life-threatening events due to supine position.**

Paediatr Perinat Epidemiol. 2006 Nov; 20(6):491-6.

Gastro-oesophageal reflux (GOR) has a high prevalence in infancy. The supine position is among numerous aggravating factors. The exact relationship between GOR and apparently life-threatening events (ALTE) is not clear, although it has been repeatedly investigated. In 1992 the worldwide Back to Sleep campaign was implemented, which had a dramatic effect on the incidence of sudden infant death syndrome (SIDS) with a drop of 50%. Although the vast majority of children now sleep on their back, the effect of this position on ALTE has not been studied. In this retrospective study, we aim to define the potential association between GOR and ALTE. We hypothesise that the incidence of ALTE has increased since the 1992 recommendation. No bias in the population's selection was introduced, as our centre is the only one for paediatric emergencies in the county. A total of 107 children presenting with ALTE were identified during the study period (1987-99). A pH study was performed in the 75 patients presenting with ALTE in the last 6 years of the study (1994-99). Neither morbidity nor mortality was noted in a long-term 4-year follow-up. Our present results show that the frequency of ALTE increased sevenfold ( $P < 0.005$ ) between 1992 and 1999. The ALTE episodes took place significantly more often in the post-prandial period. The prevalence of GOR was much higher in patients presenting with ALTE (nearly 75%) when compared with the general population. Furthermore, on medical treatment for GOR, very few patients presented with a second episode of ALTE. Consequently it is thought that GOR and ALTE are linked and that ALTE patients would benefit from GOR treatment. The worldwide marked decrease in SIDS since the implementation of the supine position possibly masks the negative effect of an increase in ALTE.

Full-text available at: <http://www.blackwell-synergy.com> (not a U.S. Government site)

Aris C, Stevens TP, Lemura C, Lipke B, McMullen S, Cote-Arsenault D, Consenstein L.  
**NICU nurses' knowledge and discharge teaching related to Infant Sleep Position and risk of SIDS.**

Adv Neonatal Care. 2006 Oct; 6(5):281-294.

Infants requiring neonatal intensive care are often placed prone during their acute illness. After hospital discharge the American Academy of Pediatrics (AAP) recommends supine sleep position to reduce the risk of Sudden Infant Death Syndrome (SIDS). Little is known about nursing knowledge and practice regarding best sleep positions for infants as they transition from neonatal intensive care to home.

**Objective:** To explore and describe neonatal intensive care unit (NICU) nurses' knowledge and practice in the NICU, and to determine the content of parent instruction regarding infant sleep position at discharge. **Study Design:** This survey was conducted in 2 phases. In Phase I, a questionnaire was designed and completed by 157 neonatal nurses currently practicing in Level III and IV NICUs in the state of New York. After content analysis of responses and item revisions, a panel of experts reviewed questionnaire items. Phase II involved completion of the final questionnaire by 95 NICU nurses in 4 additional hospitals. The combined results of Phase I and II are reported. **Results:** Of 514 questionnaires distributed, 252 (49%) were completed and analyzed. During NICU hospitalization, nurse respondents identified prone position as the best general sleep position for preterm infants (65%) followed by either prone or side-lying (12%). The nurses' assessment of the infants' readiness for supine sleep position at the time of NICU discharge varied. Most nurses responded that preterm infants were ready to sleep supine anytime (29%), close to discharge (13%), when maintaining their body temperature in an open crib (25%), between 34 to 36 weeks postmenstrual age (PMA) (15%), after 37 weeks PMA (13%), and when the infant's respiratory status was stable (6%). Typical sleep positions chosen for full-term infants in the NICU were supine (40%), side or supine (30%), all positions (18%), side (8%), prone or side (3%), and prone (1%). Frequently cited reasons to place full-term infants to sleep prone were: reflux (45%), upper airway anomalies (40%), respiratory distress (29%), inconsolability (29%), and to promote development (17%). At NICU discharge, 52% of nurses instructed parents to place their infants in the supine position for sleep. The most common nonsupine sleep positions recommended by nurses at discharge were either supine or side (38%), and exclusive side positioning (9%). **Conclusions:** Nearly 95% of respondents identified a nonsupine sleep position as optimal for hospitalized preterm infants. Further, only 52% of neonatal nurses routinely provide discharge instructions that promote supine sleep positions at home. This study suggests that nursing self-reports of discharge teaching practices are inconsistent, and in some cases in direct conflict with the national "Back to Sleep" recommendations, which emphasize that the supine position is the safest position for healthy full-term and preterm infants after hospital discharge.

Full-text available at: <http://www.medscape.com> (not a U.S. Government site)

Colson ER, Levenson S, Rybin D, Calianos C, Margolis A, Colton T, Lister G, Corwin MJ.  
**Barriers to following the supine sleep recommendation among mothers at four centers for the Women, Infants, and Children Program.**

Pediatrics. 2006 Aug; 118(2):e243-50.

Objectives: The risk for sudden infant death syndrome in black infants is twice that of white infants, and their parents are less likely to place them in the supine position for sleep. We previously identified barriers for parents to follow recommendations for sleep position. Our objective with this study was to quantify these barriers, particularly among low-income, primarily black mothers. Design/Methods: We conducted face-to-face interviews with 671 mothers, 64% of whom were black, who attended Women, Infants, and Children Program centers in Boston, Massachusetts, Dallas, Texas, Los Angeles, California, and New Haven, Connecticut. We used univariate analyses to quantify factors that were associated with choice of sleeping position and multivariate logistic regression to calculate adjusted odds ratios for the 2 outcome variables: "ever" (meaning usually, sometimes, or last night) put infant in the prone position for sleep and "usually" put infant in the supine position to sleep. Results: Fifty-nine percent of mothers reported supine, 25% side, 15% prone, and 1% other as the usual position. Thirty-four percent reported that they ever placed infants in the prone position. Seventy-two percent said that a nurse, 53% a doctor, and 38% a female friend or relative provided source of advice. Only 42% reported that a nurse, only 36% a doctor, and only 15% a female friend or relative recommended the supine position for sleep. When a female friend or relative recommended the prone position, mothers were more likely ever to place their infants in the prone position and less likely usually to choose supine compared with those who received no advice from friends or relatives. When a doctor or a nurse recommended a non supine position, the mothers were less likely to choose supine compared with those who received no advice from a doctor or a nurse. Mothers who trusted the opinion of a doctor or a nurse about infant sleeping position were more likely to place their infants in the supine position. Half of the mothers believed that infants were more likely to choke when supine, and they were less likely to place their infants supine. Mothers who believed that infants are more comfortable in the prone position (36%) were more likely to place their infants prone. Twenty-nine percent believed that having their infants sleep with an adult helps prevent sudden infant death syndrome, and only 43% believed that sudden infant death syndrome is related to sleeping position. Conclusions: We identified specific barriers to placing infants in the supine position for sleep (lack of or wrong advice, lack of trust in providers, knowledge and concerns about safety and comfort) in low-income, primarily black mothers that should be considered when designing interventions to get more infants onto their back for sleep.

Full-text available at: <http://www.pediatrics.org> (not a U.S. Government site)

Moon RY, Kotch L, Aird L.

**State child care regulations regarding infant sleep environment since the Healthy Child Care America-Back to Sleep campaign**

Pediatrics. 2006 Jul; 118(1):73-83.

Background: Despite overall decreases in sudden infant death syndrome deaths and prone sleeping, the proportion of sudden infant death syndrome deaths that occurs in child care settings has remained constant at approximately 20%. In 2003, the American Academy of Pediatrics' Healthy Child Care America program launched its own Back to Sleep campaign to promote the Back to Sleep message for those who care for young children. Objectives: The purpose of this study was to evaluate the effectiveness of the first 2 years of the Healthy Child Care America-Back to Sleep campaign in improving child care regulations by assessing the inclusion of the elements of a safe sleep environment in the individual state regulations for child care centers and family child care homes. Methods: We

examined regulations available in October 2005 for licensed child care centers and family child care homes in the 50 states and the District of Columbia for specific regulations pertaining to (1) sudden infant death syndrome risk-reduction training for child care providers, (2) infant sleep position, (3) crib safety, (4) bedding safety, (5) smoking, and (6) provision of information about sleep positioning policies and arrangements to parents before the infant is enrolled in child care. Results: Since 2003, when the Healthy Child Care America-Back to Sleep campaign began, 60 of the 101 state regulations for either child care centers or FCCHs have been revised. More than half of these regulations written since 2003 mandate a nonprone sleep position and restrictions on soft bedding in the crib, and the change in these regulations since 2003 is statistically significant. However, of the 101 existing state regulations, only 49 require that infants sleep nonprone, 18 mandate sudden infant death syndrome training for child care providers, 81 have  $\geq 1$  crib safety standard, and 43 restrict soft bedding in the crib. Only 4 regulations require that parents be provided with sleep policy information. Conclusions: The initial 2 years of the Healthy Child Care America Back to Sleep campaign have been successful in promoting safe infant sleep regulations. Efforts must continue so that safe sleep regulations exist in all jurisdictions.

Full-text available at: <http://www.pediatrics.org> (not a U.S. Government site)

Colson ER, Levenson S, Rybin D, Calianos C, Margolis A, Colton T, Lister G, Corwin MJ.

**Barriers to following the supine sleep recommendation among mothers at four centers for the Women, Infants, and Children Program**

Pediatrics. 2006 Aug; 118(2):e243-50.

Objectives: The risk for sudden infant death syndrome in black infants is twice that of white infants, and their parents are less likely to place them in the supine position for sleep. We previously identified barriers for parents to follow recommendations for sleep position. Our objective with this study was to quantify these barriers, particularly among low-income, primarily black mothers. Design/Methods: We conducted face-to-face interviews with 671 mothers, 64% of whom were black, who attended Women, Infants, and Children Program centers in Boston, Massachusetts, Dallas, Texas, Los Angeles, California, and New Haven, Connecticut. We used univariate analyses to quantify factors that were associated with choice of sleeping position and multivariate logistic regression to calculate adjusted odds ratios for the 2 outcome variables: "ever" (meaning usually, sometimes, or last night) put infant in the prone position for sleep and "usually" put infant in the supine position to sleep. Results: Fifty-nine percent of mothers reported supine, 25% side, 15% prone, and 1% other as the usual position. Thirty-four percent reported that they ever placed infants in the prone position. Seventy-two percent said that a nurse, 53% a doctor, and 38% a female friend or relative provided source of advice. Only 42% reported that a nurse, only 36% a doctor, and only 15% a female friend or relative recommended the supine position for sleep. When a female friend or relative recommended the prone position, mothers were more likely ever to place their infants in the prone position and less likely usually to choose supine compared with those who received no advice from friends or relatives. When a doctor or a nurse recommended a nonsupine position, the mothers were less likely to choose supine compared with those who received no advice from a doctor or a nurse. Mothers who trusted the opinion of a doctor or a nurse about infant sleeping position were more likely to place their infants in the supine position. Half of the mothers believed that infants were more likely to choke when supine, and they were less likely to place their infants supine. Mothers who believed that infants are more comfortable

in the prone position (36%) were more likely to place their infants prone. Twenty-nine percent believed that having their infants sleep with an adult helps prevent sudden infant death syndrome, and only 43% believed that sudden infant death syndrome is related to sleeping position. Conclusions: We identified specific barriers to placing infants in the supine position for sleep (lack of or wrong advice, lack of trust in providers, knowledge and concerns about safety and comfort) in low-income, primarily black mothers that should be considered when designing interventions to get more infants onto their back for sleep.

Full-text available at: <http://www.pediatrics.org> (not a U.S. Government site)

Levy J, Habib RH, Liptsen E, Singh R, Kahn D, Steele AM, Courtney SE.

**Prone versus supine positioning in the well preterm infant: Effects on work of breathing and breathing patterns.**

Pediatr Pulmonol. 2006 Jun 15; [E-pub ahead of print]

Premature infants with respiratory distress oxygenate better and have improved breathing synchrony when they are nursed in the prone position. We investigated whether work of breathing (WOB) is decreased in the prone position in healthy premature infants nearing discharge from the neonatal intensive care unit. Nineteen convalescing premature infants in room air were studied in both supine and prone position. Positioning order was randomized. Mean birth weight was 1358 +/- 332 (SD) g, gestational age 29.7 +/- 2.1 weeks, weight at study 1757 +/- 248 g, and age at study 33.6 +/- 1.4 days. Calibrated respiratory inductance plethysmography (RIP) was used to measure tidal volume; an esophageal catheter estimated pleural pressure. Inspiratory, elastic, and resistive WOB were calculated and were unaffected by prone versus supine positioning ( $P = 0.46, 0.36, \text{ and } 0.87$ , respectively). Similarly, respiratory rate, tidal volume, minute ventilation, and lung compliance did not differ between positions. These data suggest that sleep position recommendations for healthy premature infants discharged home without oxygen should be no different than for term infants.

Full-text available at: <http://www3.interscience.wiley.com> (not a U.S. Government site)

Kato I, Scaillet S, Groswasser J, Montemitro E, Togari H, Lin JS, Kahn A, Franco P.

**Spontaneous arousability in prone and supine position in healthy infants.**

Sleep. 2006 Jun 1; 29(6):785-90.

Study Objective: Compared with control infants, those who will be future victims of sudden infant death syndrome (SIDS) show a decreased arousability during sleep, with fewer cortical arousals and more-frequent subcortical activations. These findings suggest an incomplete arousal process in victims of SIDS. Prone sleep position, a major risk factor for SIDS, has been reported to reduce arousal responses during sleep. The present study was undertaken to evaluate whether the prone sleep position impairs the arousal process in healthy infants. Methods: Twenty-four healthy infants were studied polygraphically during 1 night; 12 infants regularly slept supine and 12 infants regularly slept prone. Infants were matched for sex, gestational age, and age at recording. Arousals were differentiated into subcortical activations or cortical arousals, according to the presence of autonomic and/or electroencephalographic changes. Frequencies of subcortical activations and cortical arousals were compared in the prone- and the supine-sleeping infants. Results: Compared with supine sleepers, prone sleepers had significantly fewer cortical arousals during rapid eye movement (REM) sleep ( $p = .043$ ).

There were no significant differences in cortical arousals between the 2 groups during non-REM sleep. No significant differences were seen in the frequencies of subcortical activations during both REM and non-REM sleep between supine and prone sleepers. The ratio of cortical arousal to subcortical activation showed no significant differences between the prone and the supine sleepers. Conclusions: Prone sleep position decreased the frequency of cortical arousals but did not change the frequency of subcortical activations, as has been previously found in SIDS victims. These results suggest specific pathways for impairment of the arousal process in SIDS victims.

Full-text available at: <http://www.journalsleep.org/> (not a U.S. Government site)

Baddock SA, Galland BC, Bolton DP, Williams SM, Taylor BJ.

**Differences in infant and parent behaviors during routine bed sharing compared with cot sleeping in the home setting.**

Pediatrics. 2006 May; 117(5):1599-607.

Objectives: To observe the behavior of infants sleeping in the natural physical environment of home, comparing the 2 different sleep practices of bed sharing and cot sleeping quantifying to factors that have been identified as potential risks or benefits. Methods: Forty routine bed-sharing infants, aged 5-27 weeks were matched for age and season of study with 40 routine cot-sleeping infants. Overnight video and physiologic data of bed-share infants and cot-sleep infants were recorded in the infants' own homes. Sleep time, sleep position, movements, feeding, blanket height, parental checks, and time out of the bed or cot were logged. Results: The total sleep time was similar in both groups (bed-sharing median: 8.6 hours; cot-sleeping median: 8.2 hours). Bed-sharing infants spent most time in the side position (median: 5.7 hours, 66% of sleep time) and most commonly woke at the end of sleep in this position, whereas cot-sleeping infants most commonly slept supine (median: 7.5 hours, 100%) and woke at the end of sleep in the supine position. Prone sleep was uncommon in both groups. Head covering above the eyes occurred in 22 bed-sharing infants and 1 cot-sleeping infant. Five of these bed-sharing infants were head covered at final waking time, but the cot-sleeping infant was not. Bed-sharing parents looked at or touched their infant more often (median: 11 vs 4 times per night) but did not always fully wake to do so. Movement episodes were shorter in the bed-sharing group as was total movement time (37 vs 50 minutes respectively), whereas feeding was 3.7 times more frequent in the bed-sharing group than the cot-sleeping group. Conclusions: Bed-share infants without known risk factors for sudden infant death syndrome (SIDS) experience increased maternal touching and looking, increased breastfeeding, and faster and more frequent maternal responses. This high level of interaction is unlikely to occur if maternal arousal is impaired, for example, by alcohol or overtiredness. Increased head covering and side sleep position occur during bed-sharing, but whether these factors increase the risk of SIDS, as they do in cot sleeping, requires further investigation.

Full-text available at: <http://www.pediatrics.org> (not a U.S. Government site)

Vennemann MM, Fischer D, Jorch G, Bajanowski T.

**Prevention of sudden infant death syndrome (SIDS) due to an active health monitoring system 20 years prior to the public "Back to Sleep" campaigns.**

Arch Dis Child. 2006 Apr; 91(4):324-6. E-pub 2006 Jan 6.

Before reunification, the post neonatal mortality rate was lower in East Germany than in West

Germany. Moreover, the incidence of SIDS (Sudden Infant Death Syndrome) was much lower in the East. By exploring the archives and talking to witnesses from the former East Germany who were involved at the time, we found that as early as in 1972, active monitoring of infant and child mortality rates had shown that the prone sleeping position was dangerous for infants. In contrast, in the west, the risk factor of prone sleeping was only discovered in the early 1990s.

Full-text available at: <http://adc.bmjournals.com> (not a U.S. Government site)

Fifer WP, Myers MM, Sahni R, Ohira-Kist K, Kashyap S, Stark RI, Schulze KF.

**Interactions between sleeping position and feeding on cardiorespiratory activity in preterm infants.**

Dev Psychobiol. 2005 Nov; 47(3):288-96.

Infants sleeping in the prone position are at greater risk for sudden infant death syndrome (SIDS). Sleep position-dependent changes in cardiorespiratory activity may contribute to this increased risk. Cardiorespiratory activity is also affected by feeding. Twenty prematurely-born infants were studied at 31-36 weeks postconceptional age while sleeping in the prone and supine positions. Heart rate, respiratory rate, and patterns of variability were recorded during interfeed intervals, and effects of position and time after feeding were analyzed by repeated measures analyses of variance. There were significant effects of both sleeping position and time after feeding. Heart rate is higher and heart period variability is lower in the prone position, and the effects of sleeping position on cardiac functioning are more pronounced during the middle of the intrafeed interval. In preterm infants, autonomic responses to nutrient processing modulate the cardiorespiratory effects of sleeping position. Prone sleeping risk may vary with time after feeding.

Full-text available at: <http://www3.interscience.wiley.com> (not a U.S. Government site)

American Academy of Pediatrics Task Force on Sudden Infant Death Syndrome.

**The changing concept of sudden infant death syndrome: Diagnostic coding shifts, controversies regarding the sleeping environment, and new variables to consider in reducing risk.**

Pediatrics. 2005 Nov; 116(5):1245-55.

There has been a major decrease in the incidence of sudden infant death syndrome (SIDS) since the American Academy of Pediatrics (AAP) released its recommendation in 1992 that infants be placed down for sleep in a non prone position. Although the SIDS rate continues to fall, some of the recent decrease of the last several years may be a result of coding shifts to other causes of unexpected infant deaths. Since the AAP published its last statement on SIDS in 2000, several issues have become relevant, including the significant risk of side sleeping position; the AAP no longer recognizes side sleeping as a reasonable alternative to fully supine sleeping. The AAP also stresses the need to avoid redundant soft bedding and soft objects in the infant's sleeping environment, the hazards of adults sleeping with an infant in the same bed, the SIDS risk reduction associated with having infants sleep in the same room as adults and with using pacifiers at the time of sleep, the importance of educating secondary caregivers and neonatology practitioners on the importance of "back to sleep," and strategies to reduce the incidence of positional plagiocephaly associated with supine positioning. This statement reviews the evidence associated with these and other SIDS-related issues and proposes new recommendations for further reducing SIDS risk.

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<http://aappolicy.aappublications.org/cgi/reprint/pediatrics;116/5/1245.pdf>

(not a U.S. Government site)

Goetter MC, Stepan MB.

**First-time mothers' selection of infant supine sleep positioning.**

J Perinat Educ. 2005 Fall; 14(4):16-23.

The incidence of Sudden Infant Death Syndrome (SIDS) has decreased dramatically since the inception of the "Back to Sleep" campaign initiated by the American Academy of Pediatrics in 1992. However, that decrease has leveled off and many new parents cease to follow the recommendation to place their infants in the supine position for sleep between 1 and 3 months of age, the peak age for the incidence of SIDS. Shortened hospital stays for new mothers and the overwhelming amount of required patient teaching dictate the need to find the best method of instruction. The purpose of this study was to determine if a one-on-one teaching intervention improved the effectiveness of patient education and led to an increase in the desired behavior of placing the infant to sleep in the supine position. A quantitative experimental approach was used to examine the difference in compliance of supine infant positioning. Participants were drawn from a convenience sample of 61 primiparous women between the ages of 18 and 35 years with random assignment to either the experimental or control group. Compared to mothers in the control group, mothers in the experimental group demonstrated greater compliance in selecting supine sleep position in the first week home from the hospital and on the day of follow-up 6 weeks later. However, no difference in "usual position" was reported at 6 weeks and for the night previous to follow-up.

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( not a U.S. Government site)

Moon RY, Sprague BM, Patel KM.

**Stable prevalence but changing risk factors for sudden infant death syndrome in child care settings in 2001.**

Pediatrics. 2005 Oct; 116(4):972-7.

Objective: A total of 20% of sudden infant death syndrome (SIDS) cases in the 1990s occurred in child care settings. This is much higher than the 8% expected from Census Bureau data. Factors that were associated with child care SIDS included older age; white race; older, more educated mothers; and unaccustomed prone position. Since these findings, much emphasis has been placed on promoting a safe sleep environment in child care. The objectives of this study were to determine the Proportion of SIDS Occurring In Child Care In 2001 And To Assess Risk Factors For SIDS In Child Care. Methods: We conducted a retrospective review of all SIDS deaths that occurred in 2001 in 13 US states. Information regarding demographics, SIDS risk factors, and child care arrangements were collected and analyzed. Deaths that occurred in child care were compared with deaths that occurred during parental care. Results: Of 480 deaths, 79 (16.5%) occurred in child care settings. Of these child care deaths, 36.7% occurred in family child care homes, 17.7% occurred in child care centers, 21.3% occurred in relative care, and 17.7% occurred with a nanny/babysitter at home. Infants in child care

were more likely to be older and to die between the hours of 8 am and 4 pm and less likely to be exposed to secondhand smoke. There was no difference in usual, found, or placed sleep position between child care and home deaths. Approximately one half of the infants who died of SIDS in both settings were found prone, and 20% of deaths in both settings were among infants who were unaccustomed to prone Sleep. Conclusions: The proportion of SIDS deaths in child care has declined slightly but still remains high at 16.5%. Infants in child care are no more likely to be placed or found prone and no more likely to be on an unsafe sleep surface. Educational efforts with child care providers have been effective and should be expanded to unregulated child care providers. In addition, there may be other, yet-unidentified factors in child care that place infants in those settings at higher risk for SIDS.

Full-text available at: <http://www.pediatrics.org> (not a U.S. Government site)

Vennemann MM, Findeisen M, Butterfass-Bahloul T, Jorch G, Brinkmann B, Kopcke W, Bajanowski T, Mitchell EA; The GeSID Group.

**Modifiable risk factors for SIDS in Germany: results of GeSID.**

Acta Paediatr. 2005 Jun; 94(6):655-60.

Background: The incidence of sudden infant death syndrome (SIDS) has been falling in Germany over the last decade. However, little is known about the prevalence and the importance of well-known risk factors in Germany since a local prevention campaign in 1992. Design: A 3-y, population-based, case-control study was conducted in half of Germany, consisting of 333 cases. All sudden and unexpected deaths in infancy, if they fitted the inclusion criteria, were included in the study. Parental interview was carried out soon after the death, and three living control infants, matched for age, gender, region and sleep time, were recruited. Results: The prevalence of placing infants prone to sleep was only 4% in the control group, but this was associated with a markedly increased risk of SIDS (adjusted odds ratio, aOR=6.08). Other modifiable risk factors for SIDS were: maternal smoking during pregnancy, breastfeeding for less than 2 wk (aOR=1.71) and co-sleeping (aOR=2.71), while using a pacifier during the last sleep reduced the risk (aOR=0.39). Conclusions: Previously recognized risk factors for SIDS also occur in Germany. Despite knowledge about the major modifiable risk factors for SIDS, these factors are still present in Germany. To reduce the incidence of SIDS in Germany, a continued effort is needed to inform all parents about preventable risk factors for SIDS.

Full-text available at: <http://www.tandf.co.uk> (not a U.S. Government site)

Alex N, Thompson JM, Becroft DM, Mitchell EA.

**Pulmonary aspiration of gastric contents and the sudden infant death syndrome.**

J Paediatr Child Health. 2005 Aug; 41(8):428-31.

Objective: To determine ante-mortem and post-mortem risk factors for the finding of gastric contents in pulmonary airways (aspiration of gastric contents) at post-mortem examination in the sudden infant death syndrome (SIDS). Methods: There were 217 post-neonatal deaths in the Auckland region of the New Zealand Cot Death Study. No deaths were certified as due to aspiration of gastric contents. There were 138 SIDS cases. The parents of 110 (80%) of these cases were interviewed. Histological sections from the periphery of the lungs in 99 of the 110 cases were reviewed for evidence of aspiration of gastric contents. A wide range of variables were analyzed in SIDS cases with and without aspiration to

determine risk factors. Results: Aspiration of gastric contents was identified in 37 (37%) of SIDS cases. Aspiration was of mild-to-moderate degree and in no case was severe and a potential cause of death. Finding infants on their backs at death ( $P = 0.024$ ) and conducting the post-mortem on the day after the death or subsequently ( $P = 0.033$ ) were statistically significant variables linked to identification of aspiration. Position placed to sleep; Symptoms of Gastro-Oesophageal Reflux and other variables were not related to aspiration. Conclusions: The only determinants for aspiration of gastric contents identified were agonal or post-mortem events, supporting the contention that aspiration has limited relevance to the mechanism of SIDS.

Full-text available at: <http://www.sciencedirect.com> (not a U.S. Government site)

Pelligra R, Doman G, Leisman G.

**A reassessment of the SIDS Back to Sleep Campaign.**

ScientificWorldJournal. 2005 Jul 21; 5:550-7.

The Back to Sleep Campaign was initiated in 1994 to implement the American Academy of Pediatrics' (AAP) recommendation that infants be placed in the nonprone sleeping position to reduce the risk of the Sudden Infant Death Syndrome (SIDS). This paper offers a challenge to the Back to Sleep Campaign (BTSC) from two perspectives: (1) the questionable validity of SIDS mortality and risk statistics, and (2) the BTSC as human experimentation rather than as confirmed preventive therapy. The principal argument that initiated the BTSC and that continues to justify its existence is the observed parallel declines in the number of infants placed in the prone sleeping position and the number of reported SIDS deaths. We are compelled to challenge both the implied causal relationship between these observations and the SIDS mortality statistics themselves.

Full-text available at: <http://www.thescientificworld.co.uk/headeradmin/upload/2005.03.71.pdf> (not a U.S. Government site)

Shields LB, Hunsaker DM, Muldoon S, Corey TS, Spivack BS.

**Risk factors associated with sudden unexplained infant death: A prospective study of infant care practices in Kentucky.**

Pediatrics. 2005 Jul; 116(1):e13-20.

Objective: To ascertain the prevalence of infant care practices in a metropolitan community in the United States with attention to feeding routines and modifiable risk factors associated with sudden unexplained infant death (specifically, prone sleeping position, bed sharing, and maternal smoking). Methods: We conducted an initial face-to-face meeting followed by a telephone survey of 189 women who gave birth at a level I hospital in Kentucky between October 14 and November 10, 2002, and whose infants were placed in the well-infant nursery. The survey, composed of questions pertaining to infant care practices, was addressed to the women at 1 and 6 months postpartum. Results: A total of 185 (93.9%) women participated in the survey at 1 month, and 147 (75.1%) mothers contributed at 6 months. The racial/ethnic composition of the study was 56.1% white, 30.2% black, and 16.4% biracial, Asian, or Hispanic. More than half of the infants (50.8%) shared the same bed with their mother at 1 month, which dramatically decreased to 17.7% at 6 months. Bed sharing was significantly more common among black families compared with white families at both 1 month (adjusted odds ratio [OR]: 5.94; 95% confidence interval [CI]: 2.71-13.02) and 6 months (adjusted OR: 5.43; 95% CI:

2.05-14.35). Compared with other races, white parents were more likely to place their infants on their back before sleep at both 1 and 6 months. Black parents were significantly less likely to place their infants on their back at 6 months compared with white parents (adjusted OR: 0.14; 95% CI: 0.06-0.33). One infant succumbed to sudden infant death syndrome at 3 months of age, and another infant died suddenly and unexpectedly at 9 months of age. Both were bed sharing specifically with 1 adult in the former and with 2 children in the latter. Conclusions: Bed sharing and prone placements were more common among black infants. Breastfeeding was infrequent in all races. This prospective study additionally offers a unique perspective into the risk factors associated with sudden infant death syndrome and sudden unexplained infant death associated with bed sharing by examining the survey responses of 2 mothers before the death of their infants combined with a complete postmortem examination, scene analysis, and historical investigation.

Full-text available at: <http://www.pediatrics.org> (not a U.S. Government site)

Lahr MB, Rosenberg KD, Lapidus JA.

**Health departments do it better: Prenatal care site and prone infant sleep position.**

Matern Child Health J. 2005 Jun; 9(2):165-72.

Objectives: Reduction of prone infant sleep position has been the main public health effort to reduce the incidence of Sudden Infant Death Syndrome (SIDS). Methods: Oregon Pregnancy Risk Assessment Monitoring System (PRAMS) surveys a stratified random sample of women after a live birth. In 1998-1999, 1867 women completed the survey (64.0% unweighted response; 73.5% weighted response). Results: Overall, 9.2% of all women "usually" chose prone infant sleep position, while 24.2% chose side and 66.5% chose supine position. Women receiving care from private physicians or HMOs more often chose prone position (10.6%) than women receiving prenatal care from health department clinics (2.5%), hospital clinics (6.1%) or other sites (8.3%). Compared to health department prenatal clinic patients, private prenatal patients were more likely to choose prone infant sleep position, adjusted odds ratio = 4.78 (95% confidence interval [CI] 1.64-13.92). Conclusions: Health Department clinics have done a better job than private physicians in educating mothers about putting infants to sleep on their backs. Providers-especially private providers-should continue to stress the importance

Full-text available at: <http://www.springerlink.com> (not a U.S. Government site)

Blair P, Ward Platt MP, Smith IJ, Fleming PJ.

**Sudden Infant Death Syndrome and sleeping position in pre-term and low birth weight infants: An opportunity for targeted intervention.**

Arch Dis Child. 2005 May 24; [E-pub ahead of print]

Aims: Few families now place their infant prone to sleep but many still use the side position, despite strong evidence of a significant association with Sudden Infant Death Syndrome (SIDS). Some maternity hospital staff still advise the side position to parents of pre-term infants. We report the combined effects of SIDS risk factors in the sleeping environment for infants who were "small at birth" (i.e. pre-term [ $<37$ weeks], low birth-weight [ $<2500$ g] or both). Methods: A three year population-based, case-control study, with parental interviews after each death and reference sleep of age-matched controls. Based in five former Health Regions in England (population 17.7 million) with

325 cases and 1300 controls. *Results:* Of the SIDS infants 26% were "small at birth" compared to 8% of the controls. The most common sleeping position was supine, both for controls (69%) and those SIDS infants (48%) born at term or  $\geq 2500$ g, but for "small at birth" SIDS infants the commonest sleeping position was side (48%). The combined effect of the risk associated with being "small at birth" and factors in the infant sleeping environment remained multiplicative despite controlling for possible confounding in the multivariate model. The risk of SIDS associated with being "small at birth" and being put down in the side position (multivariate OR=14.96[95% CI:5.10-43.93]), bed-sharing with parents who habitually smoke (multivariate OR=37.41[95% CI:5.83-239.86]) or being a routine dummy user who did not use a dummy for the last sleep (multivariate OR=17.50 [95%CI:6.14- 49.86]) were each more than multiplicative. For those "small at birth" SIDS who slept in a room separate from the parents the large combined effect (multivariate OR=79.45[95%CI: 18.03-350.20]) showed evidence of a significant interaction ( $p=0.047$ ). No excess risk was identified from bed-sharing with non-smoking parents for infants born at term or birthweight  $\geq 2500$ g (multivariate OR=1.12[95%CI:0.30-4.27]). *Conclusion:* The combined effects of SIDS risk factors in the sleeping environment and being pre-term or low birthweight generate high risks for these infants. Their longer postnatal stay allows an opportunity to target parents and staff with risk reduction messages.

Full-text available at: <http://adc.bmjournals.com> (not a U.S. Government site)

Sahni R, Schulze KF, Kashyap S, Ohira-Kist K, Fifer WP, Myers MM.

**Sleeping position and electrocortical activity in low birthweight infants.**

Arch Dis Child Fetal Neonatal Ed. 2005 Jul; 90(4):F311-5.

**Objective:** To evaluate the effects of prone and supine sleeping positions on electrocortical activity during active (AS) and quiet (QS) sleep in low birthweight infants. **Design:** Randomised/crossover study. **Setting:** Infant Physiology Laboratory at Children's Hospital of New York. **Patients:** Sixty three healthy, growing, low birthweight (birth weight 795-1600 g) infants, 26-37 weeks gestational age. **Interventions:** Six hour continuous two channel electrocortical recordings, together with minute by minute behavioural state assignment, were performed. The infants were randomly assigned to prone or supine position during the first three hours, and positions were reversed during the second three hours. **Outcome Measures and Results:** Fast Fourier transforms of electroencephalograms (EEGs) were performed each minute and the total EEG power (TP), spectral edge frequency (SEF), absolute (AP) and relative (RP) powers in five frequency bands (0.01-1.0 Hz, 1-4 Hz, 4-8 Hz, 8-12 Hz, 12-24 Hz) were computed. Mean values for TP, SEF, AP, and RP in the five frequency bands in the prone and supine positions during AS and QS were then compared. In the prone sleeping position, during AS, infants showed significantly lower TP, decreased AP in frequency bands 0.01-1.0 Hz, 4-8 Hz, 8-12 Hz, 12-24 Hz, increased RP in 1-4 Hz, and a decrease in SEF. Similar trends were observed during QS, although they did not reach statistical significance. **Conclusions:** The prone sleeping position promotes a shift in EEG activity towards slower frequencies. These changes in electrocortical activity may be related to mechanisms associated with decreased arousal in the prone position and, in turn, increased risk of sudden infant death syndrome.

Full-text available at: <http://fn.bmjournals.com/cgi/content/full/90/4/F311> (not a U.S. Government site)

Inbar Z, Meibar R, Shehada S, Irena V, Rubin L, Rishpon S.

**"Back to sleep": Parents compliance with the recommendation on the most appropriate sleeping position of infants, Haifa District, Israel, 2001.**

Prev Med. 2005 Jun; 40(6):765-8.

Background: In 1993, the Israel Ministry of Health issued a formal recommendation to avoid placing healthy infants to sleep in the prone position in order to prevent sudden infant death. The objective of the study was to study parents' compliance with this recommendation and to identify characteristics of noncompliant parents of infants aged less than 6 months old. Methods: The study population consisted of 1912 parents of infants aged 0-12 months who visited the Haifa District primary preventive health centers during the study week and answered the self-administered questionnaire. Results: 15.6% of infants younger than 1 year were placed to sleep in the prone position: 12.4% among infants younger than 3 months, and 17.6% among infants 3-6 months old. Surprisingly, multiple logistic regression analysis demonstrated that Israeli-born Jewish mothers were more likely to place their babies prone than Israeli-born Arab mothers or mothers born in the former Soviet Union who had immigrated to Israel after 1990. Conclusions: At-risk behaviors are usually associated with minority and immigrant populations. Culture specific and other possible reasons for our unusual findings are discussed.

Full-text available at: <http://www.sciencedirect.com> (not a U.S. Government site)

Gilbert R, Salanti G, Harden M, See S.

**Infant sleeping position and the sudden infant death syndrome: Systematic review of observational studies and historical review of recommendations from 1940 to 2002.**

Int J Epidemiol. 2005 Aug; 34(4):874-87.

Background: Before the early 1990s, parents were advised to place infants to sleep on their front contrary to evidence from clinical research. Methods: We systematically reviewed associations between infant sleeping positions and sudden infant death syndrome (SIDS), explored sources of heterogeneity, and compared findings with published recommendations. Results: By 1970, there was a statistically significantly increased risk of SIDS for front sleeping compared with back (pooled odds ratio (OR) 2.93; 95% confidence interval (CI) 1.15, 7.47), and by 1986, for front compared with other positions (five studies, pooled OR 3.00; 1.69-5.31). The OR for front vs the back position was reduced as the prevalence of the front position in controls increased. The pooled OR for studies conducted before advice changed to avoid front sleeping was 2.95 (95% CI 1.69-5.15), and after was 6.91 (4.63-10.32). Sleeping on the front was recommended in books between 1943 and 1988 based on extrapolation from untested theory. Conclusions: Advice to put infants to sleep on the front for nearly a half century was contrary to evidence available from 1970 that this was likely to be harmful. Systematic review of preventable risk factors for SIDS from 1970 would have led to earlier recognition of the risks of sleeping on the front and might have prevented over 10 000 infant deaths in the UK and at least 50 000 in Europe, the USA, and Australasia. Attenuation of the observed harm with increased adoption of the front position probably reflects a "healthy adopter" phenomenon in that families at low risk of SIDS were more likely to adhere to prevailing health advice. This phenomenon is likely to be a general problem in the use of observational studies for assessing the safety of health promotion.

Full-text available at: <http://ije.oxfordjournals.org> (not a U.S. Government site)

Alexander RT, Radisch D.

**Sudden infant death syndrome risk factors with regards to sleep position sleep surface, and co-sleeping.**

J Forensic Sci. 2005 Jan; 50(1):147-51.

We present a study of 102 Sudden Infant Death Syndrome (SIDS) deaths using a retrospective review of medical examiner autopsy reports. The prevalence of sleep related risk factors with regards to sleep surface, sleep position, and co-sleeping were determined in a population of infants less than 1-year-old. Of the 102 SIDS deaths, 67 (65.7%) were not in a crib, 63 (61.8%) were prone, and 48 (47.1%) were co-sleeping. However, 94 (92.2%) of these deaths had at least one risk factor present. Only 8 (7.8%) infants had slept alone, in a crib or bassinet, and on their back or side. Infants less than 4-months-old had a higher rate of co-sleeping (54.7%) than the older infants (25.9%), and a higher frequency of heart malformations at post-mortem examination. The older infants were more likely to exhibit pulmonary and tracheal inflammation, and neuropathology.

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Anderson ME, Johnson DC, Batal HA.

**Sudden Infant Death Syndrome and prenatal maternal smoking: Rising attributed risk in the Back to Sleep era.**

BMC Med. 2005 Jan 11; 3(1):4.

Background: Parental smoking and prone sleep positioning are recognized causal features of Sudden Infant Death. This study quantifies the relationship between prenatal smoking and infant death over the time period of the Back to Sleep campaign in the United States, which encouraged parents to use a supine sleeping position for infants. Methods: This retrospective cohort study utilized the Colorado Birth Registry. All singleton, normal birth weight infants born from 1989 to 1998 were identified and linked to the Colorado Infant Death registry. Multivariable logistic regression was used to analyze the relationship between outcomes of interest and prenatal maternal cigarette use. Potential confounders analyzed included infant gender, gestational age, and birth year as well as maternal marital status, ethnicity, pregnancy interval, age, education, and alcohol use. Results: We analyzed 488,918 birth records after excluding 5835 records with missing smoking status. Smokers were more likely to be single, non-Hispanic, less educated, and to report alcohol use while pregnant ( $p < 0.001$ ). The study included 598 SIDS cases of which 172 occurred in smoke-exposed infants. Smoke exposed infants were 1.9 times (95% CI 1.6 to 2.3) more likely to die of SIDS. The attributed risk associating smoking and SIDS increased during the study period from approximately 50% to 80%. During the entire study period 59% (101/172) of SIDS deaths in smoke-exposed infants were attributed to maternal smoking. Conclusions: Due to a decreased overall rate of SIDS likely due to changing infant sleep position, the attributed risk associating maternal smoking and SIDS has increased following the Back to Sleep campaign. Mothers should be informed of the 2-fold increased rate of SIDS associated with maternal cigarette consumption.

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Jones MW.

**Supine and Prone Infant Positioning: A Winning Combination.**

J Perinat Educ. 2004 Winter; 13(1):10-20.

Since 1992, the optimal sleeping position for infants in the United States has been supine. This position has been shown to greatly reduce the rate of Sudden Infant Death Syndrome (Skadberg, Morild, & Markestad, 1998). However, the supine position may lead to other unintended consequences or complications. Through a review of literature, this article explores some of the complications associated with the "Back to Sleep" campaign in the U.S. and discusses educational strategies for perinatal educators.

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Franco P, Scaillet S, Groswasser J, Kahn A.

**Increased cardiac autonomic responses to auditory challenges in swaddled infants.**

Sleep. 2004 Dec 15; 27(8):1527-32.

**Study Objectives:** When infants have been swaddled and sleep supine, their risk of dying from sudden infant death syndrome (SIDS) is reduced with an odds ratio of 0.64 to 0.69. Alternatively, the risk for SIDS in swaddled infants shows a 3-fold increase in the prone position. The protective role of swaddling during supine sleep has remained unexplained. This study was designed to evaluate the effects of swaddling on cardiac reactivity to auditory stimuli during sleep in both the prone and the supine position. **Design:** Thirty healthy infants with a median age of 11 weeks (range 8 to 15 weeks) were studied polygraphically for 1 night while sleeping successively prone and supine, or vice versa. The infants were studied while swaddled and nonswaddled in both positions. Heart rates were studied during rapid eye movement sleep, before and after exposure to 90 dB(A) of white-noise. **Results:** Ten infants were excluded from the study because they woke up during the position change or the auditory challenge. Before the administration of the noise stimulus, swaddling decreased values of basal heart rates in the supine position only ( $P = .049$ ). Following swaddling, the values of basal heart rate were significantly lower in the supine than in the prone position ( $P = .003$ ). Auditory challenges were followed by a greater increase in heart rate when the supine sleeping infants were swaddled than when not swaddled ( $P = .018$ ). When swaddled, beat-to-beat heart-rate variability increased following auditory stimulation in the supine position only ( $P = .012$ ). **Conclusion:** When sleeping supine, swaddled infants had greater cardiac autonomic changes in response to noise challenges than when they were not swaddled.

Full-text available at: <http://www.journalsleep.org/> (not a U.S. Government site)

Bredemeyer SL.

**Implementation of the SIDS guidelines in midwifery practice.**

Aust J Midwifery. 2004 Nov; 17(4):17-21.

The literature suggests that midwives strongly influence parenting practices immediately after birth and during early postnatal management of the newborn. Midwives must therefore be aware of the

current evidence and public health recommendations for reducing the risk of Sudden Infant Death Syndrome (SIDS) and provide consistent information about use of the supine position. Midwives must also include information about environmental factors that are also known to increase the risk of SIDS such as exposure to cigarette smoke, covering the infant's face during sleep and other potential unsafe sleeping practices such as co-sleeping and bed sharing with their infant. The position midwives use to settle infants and place them for sleep is an important example for parents. The position favoured by midwives when placing a newborn to sleep will have a significant impact on parental practice after discharge home. A standardised evidenced based approach to the SIDS Guidelines immediately after birth will facilitate consistency in practice and uniformity in the message parents are given about safe sleeping practices for their newborn infant.

Rambaud C, Guilleminault C.

**Back to sleep" and unexplained death in infants.**

Sleep. 2004 Nov 1; 27(7):1359-66.

Objective: Investigation of body position in infants with sudden and apparently unexplained death. Determination of the upper airway space of the infants in different positions by computed tomography (CT) scan. Comparison of the CT scan, the body position at death scene, and the autopsy results. *Design:* Prospective investigation on all infants referred to a specialized center investigating abrupt and apparently unexplained death of infants. *Subjects:* Full-term infants with sudden and clinically unexplained death. Four extra infants studied at different postmortem times to verify absence of change in measurement in postmortem CT scan over time. *Data Collected:* Position of infant when found dead. CT scan of upper airway in 3 positions (prone face down, prone head rotated, supine nose up), presence or absence of upper airway obstruction, level and length of the obstruction, presence or absence of cause of death, and presence or absence of small maxillomandibular complex at autopsy. *Results:* Twenty-seven children had unexpected crib deaths (17 of them determined to be sudden infant death syndrome at autopsy). Fourteen children were found dead in the prone position; for 8 of them, this was their normal sleeping position. Airway occlusion behind the base of tongue was seen on CT scan in 24 of the 27 infants (89%) when placed prone head down; in 13 (48%) when placed prone with the head rotated to the side, and in 5 (18%) infants in the supine position. Four infants had mild facial dysplasia and had been found dead in the supine position; in 3 of them, sudden infant death syndrome was found to be the cause of death. The stability of CT scan findings over time was demonstrated after death in 3 different body positions. *Conclusion:* Supine sleeping position may not be necessarily protective when small jaws are present, and sleeping position may also be a factor in abrupt deaths in infants even if "explained by autopsy."

Full-text available at: <http://www.journalsleep.org/> (not a U.S. Government site)

Paluszynska DA, Harris KA, Thach BT.

**Influence of sleep position experience on ability of prone-sleeping infants to escape from asphyxiating microenvironments by changing head position.**

Pediatrics.2004 Dec; 14(6):1634-9.

Objective: Several studies have found that back- or side-sleeping infants who are inexperienced in prone sleeping are at much higher risk for sudden infant death syndrome (SIDS) when they turn to prone or are placed prone for sleep compared with infants who normally sleep prone. Moreover, such

inexperienced infants are more likely to be found in the face-down position at death after being placed prone compared with SIDS infants who are experienced in prone sleeping. We hypothesized that lack of experience in prone sleeping is associated with increased difficulty in changing head position to avoid an asphyxiating sleep environment. **Methods:** We studied 38 healthy infants while they slept prone. Half of these were experienced and half were inexperienced in prone sleeping. To create a mildly asphyxiating microenvironment, we placed infants to sleep prone with their faces covered by soft bedding. We recorded inspired CO<sub>2</sub> (CO<sub>2</sub>I), electrocardiogram, and respiration, and we videotaped head movements. Also, we assessed gross motor development (Denver Development Scale). **Results:** When sleeping prone, with their faces covered by bedding, all infants experienced mild asphyxia as a result of rebreathing. All aroused and attempted escape from this environment. Infants used 3 stereotyped head-repositioning strategies. The least effective was nuzzling into the bedding with occasional brief head lifts. More effective were head lifts combined with a head turn. Some infants, however, could turn only to 1 side, right or left. Infants who were inexperienced in prone sleeping had less effective protective behaviors than experienced infants. Infant age did not correlate with efficacy of protective behaviors. Infants who were experienced in prone sleep had advanced gross motor development compared with inexperienced infants. **Conclusion:** Infants who are inexperienced in prone sleeping have decreased ability to escape from asphyxiating sleep environments when placed prone. These observations potentially explain the increased risk associated with prone sleep in infants who are inexperienced. The increased occurrence of the face-down position in such infants is also potentially explained. These findings suggest that airway protective behaviors may be acquired through the mechanism of operant conditioning (learning).

Full-text available at: <http://www.pediatrics.org> (not a U.S. Government site)

Rambaud C, Guilleminault C.

**"Back to sleep" and unexplained death in infants.**

Sleep 2004 Nov 1; 27(7): 1359-66.

**Objective:** Investigation of body position in infants with sudden and apparently unexplained death. Determination of the upper airway space of the infants in different positions by computed tomography (CT) scan. Comparison of the CT scan, the body position at death scene, and the autopsy results. **Design:** Prospective investigation on all infants referred to a specialized center investigating abrupt and apparently unexplained death of infants. **Subjects:** Full-term infants with sudden and clinically unexplained death. Four extra infants studied at different postmortem times to verify absence of change in measurement in postmortem CT scan over time. **Data Collected:** Position of infant when found dead. CT scan of upper airway in 3 positions (prone face down, prone head rotated, supine nose up), presence or absence of upper airway obstruction, level and length of the obstruction, presence or absence of cause of death, and presence or absence of small maxillomandibular complex at autopsy. **Results:** Twenty-seven children had unexpected crib deaths (17 of them determined to be sudden infant death syndrome at autopsy). Fourteen children were found dead in the prone position; for 8 of them, this was their normal sleeping position. Airway occlusion behind the base of tongue was seen on CT scan in 24 of the 27 infants (89%) when placed prone head down; in 13 (48%) when placed prone with the head rotated to the side, and in 5 (18%) infants in the supine position. Four infants had mild facial dysplasia and had been found dead in the supine position; in 3 of them, sudden infant death syndrome was found to be the cause of death. The stability of CT scan findings over time was demonstrated after death in 3 different body positions. **Conclusion:** Supine sleeping position may not be necessarily protective when

small jaws are present, and sleeping position may also be a factor in abrupt deaths in infants even if "explained by autopsy."

Full-text available at: <http://www.journalsleep.org/> (not a U.S. Government site)

Paluszynska DA, Harris KA, Thach BT.

**Influence of sleep position experience on ability of prone-sleeping infants to escape from asphyxiating microenvironments by changing head position.**

Pediatrics. 2004 Dec; 114(6): 1634-9.

Objective: Several studies have found that back- or side-sleeping infants who are inexperienced in prone sleeping are at much higher risk for sudden infant death syndrome (SIDS) when they turn to prone or are placed prone for sleep compared with infants who normally sleep prone. Moreover, such inexperienced infants are more likely to be found in the face-down position at death after being placed prone compared with SIDS infants who are experienced in prone sleeping. We hypothesized that lack of experience in prone sleeping is associated with increased difficulty in changing head position to avoid an asphyxiating sleep environment. Methods: We studied 38 healthy infants while they slept prone. Half of these were experienced and half were inexperienced in prone sleeping. To create a mildly asphyxiating microenvironment, we placed infants to sleep prone with their faces covered by soft bedding. We recorded inspired CO<sub>2</sub> (CO<sub>2</sub>I), electrocardiogram, and respiration, and we videotaped head movements. Also, we assessed gross motor development (Denver Development Scale). Results: When sleeping prone, with their faces covered by bedding, all infants experienced mild asphyxia as a result of rebreathing. All aroused and attempted escape from this environment. Infants used 3 stereotyped head-repositioning strategies. The least effective was nuzzling into the bedding with occasional brief head lifts. More effective were head lifts combined with a head turn. Some infants, however, could turn only to 1 side, right or left. Infants who were inexperienced in prone sleeping had less effective protective behaviors than experienced infants. Infant age did not correlate with efficacy of protective behaviors. Infants who were experienced in prone sleep had advanced gross motor development compared with inexperienced infants. Conclusion: Infants who are inexperienced in prone sleeping have decreased ability to escape from asphyxiating sleep environments when placed prone. These observations potentially explain the increased risk associated with prone sleep in infants who are inexperienced. The increased occurrence of the face-down position in such infants is also potentially explained. These findings suggest that airway protective behaviors may be acquired through the mechanism of operant conditioning (learning).

Full-text available at: <http://www.pediatrics.org> (not a U.S. Government site)

Martin-Du Pan RC, Benoit R, Girardier L.

**The role of body position and gravity in the symptoms and treatment of various medical diseases.**

Swiss Med Wkly. 2004 Sep 18; 134(37-38): 543-51.

Postural medicine studies the effects of gravity on human body functions and the ability to influence various diseases by changing the body's position. Orthostasis requires numerous cardiovascular and neurohumoral adaptations to prevent hypotension and a resulting decrease in cerebral perfusion. Sitting upright or in a semi-sitting position reduces venous return in patients with heart failure,

intracranial pressure in patients with intracranial hypertension, intraocular pressure in glaucoma patients and may decrease gastro-oesophageal reflux. A left recumbent posture also decreases reflux. A right lateral position results in a lower sympathetic tone than lying on the left side and is beneficial in patients with heart failure or after an infarction without bradycardia. A 40 to 70% decreased prevalence of the sudden infant death syndrome has been observed since the recommendation to avoid laying infants to sleep in a prone position. Sleeping in a supine posture increases the severity of sleep apnoea compared to a lateral position. In patients with acute respiratory distress syndrome, a prone position can rapidly improve blood oxygenation. Idiopathic oedema, orthostatic proteinuria, intradiscal pressure and venous circulation in legs are improved in the decubitus position, whereas arterial flow is reduced. Health risks due to microgravity and prolonged bed rest, such as osteoporosis, venous thrombosis or pressure sores, are discussed.

Full-text available at: <http://www.smw.ch/> (not a U.S. Government site)

Tauman R, Reisner SH, Amitai Y, Wasser J, Nehama H, Sivan Y.

**Sleep position in Israeli Jewish infants following the "back to sleep" campaign.**

Isr Med Assoc J. 2004 Sep; 6(9): 540-5.

**Background:** Prone sleeping has been recognized as a risk factor for sudden infant death syndrome. Ten years ago, non-prone sleeping was recommended in many countries around the world including Israel. The rate of infants sleeping prone and the rate of parents' adherence with the recommendations have not been studied. **Objectives:** To study infants' sleep position and parents' adherence to recommendations, and to identify risk factors for prone sleeping following the campaign to prevent prone sleeping in the Israeli population. **Methods:** We conducted a longitudinal telephone survey with the parents of 608 randomly selected 2 month old infants, repeated at 4 and 6 months. **Results:** Non-prone sleeping decreased from 75% to 67% and 63% at 2, 4 and 6 months respectively. There was a significant relationship between prone positioning and the use of a home apnea monitor at 2 months ( $P = 0.038$ , odds ratio 1.37, 95% confidence interval 0.94-2.15). Other risk factors for prone sleeping were the level of religious practice, with ultra-Orthodox Jews having the highest prevalence (2 months: OR 2.78, 95% CI 1.75-4.55) and higher parity - especially in families with more than five children ( $P = 0.041$ ). **Conclusions:** The prone sleeping position is relatively high in Israel. Groups at high risk were closely associated with the level of religiousness and parity. Efforts to promote supine sleeping should be directed towards identifiable groups.

Full-text available at: <http://www.ima.org.il/imag/> (not a U.S. Government site)

Rusen ID, Liu S, Sauve R, Joseph KS, Kramer MS.

**Sudden infant death syndrome in Canada: Trends in rates and risk factors, 1985-1998.**

Chronic Dis Can. 2004 Win; 25(1): 1-6.

In Canada, sudden infant death syndrome (SIDS) remains the leading cause of postneonatal death. However, SIDS rates have been declining in many countries, including Canada. This decline has been largely attributed to recommendations to avoid placing infants to sleep in the prone position. We examined the postneonatal rate of mortality due to SIDS and to other causes in relation to the initial risk reduction campaign. The postneonatal mortality rate due to SIDS decreased from 0.97 to 0.54 per 1,000 neonatal survivors between 1985-1989 and 1994-1998 (relative risk [RR] = 0.56, 95%

confidence interval [CI] 0.51-0.62). The rate of postneonatal mortality due to other causes also decreased during the same period, though to a smaller extent, from 1.19 to 0.86 (RR = 0.72, 95% CI 0.66-0.78). With the exception of seasonality, established risk factors for SIDS remained essentially unchanged between the two time periods. The observed reduction in postneonatal SIDS is consistent with a positive impact of the initial recommendations regarding risk reduction. However, the lack of reliable risk factor data limits the extent to which the decline can be attributed directly to the campaign.

Horne RS, Franco P, Adamson TM, Groswasser J, Kahn A.

**Influences of maternal cigarette smoking on infant arousability.**

Early Hum Dev. 2004 Aug; 79(1): 49-58.

Since the reduction in the incidence of the prone sleeping position, maternal cigarette smoking has become the strongest modifiable risk factor for Sudden Infant Death Syndrome (SIDS). This risk is dose dependent. Various mechanisms have been postulated to explain the increased risk of SIDS associated with maternal smoking, among these, impairment of arousal from sleep. This paper reviews the effects of maternal smoking on infant arousability from sleep, cardiorespiratory controls and sleep architecture. Infants exposed to maternal smoking have been shown to have both decreased spontaneous and evoked arousability from sleep. Such impairment of arousal has been demonstrated to be associated with changes in control of autonomic cardiac function. Sleep architecture appears not to be altered by smoking. During arousal, heart rate, blood pressure and breathing movements increase, while gross body movements occur to avoid the stimulus. Any impairment in arousability from sleep could occur when infants are exposed to maternal cigarette smoking, and could possibly contribute to the final pathway to SIDS.

Full-text available at: <http://www.sciencedirect.com> (not a U.S. Government site)

Nakamura A, Kuwaki T.

**Sleep apnea in mice: a useful animal model for study of SIDS?**

Pathophysiology. 2004 Jun; 10(3-4): 253-257.

Although the incidence of sudden infant death syndrome (SIDS) has been decreased by education programs to avoid sleeping in prone position, the pathological mechanisms of SIDS have not fully been understood. Basic research on sleep apnea using experimental animals may help further understanding and prevention of SIDS because the syndrome is thought as inability to wake up from respiratory arrest (apnea) during sleep. Although several animal models of sleep apnea have been described previously, mice would be useful experimental animals in that these animals are frequently used in genetic engineering. Those considerations prompted us to establish a method for measuring ventilation of mice concomitantly with electroencephalography and electromyography for assessing sleep-wake states. Normal wild-type mice developed two types of central sleep apneas (CSA), that is, post-sigh and spontaneous apneas, as normal humans do. Moreover, post-sigh apneas in mice were observed exclusively during slow-wave sleep (SWS) while spontaneous apneas were seen in both SWS and rapid eye movement (REM) sleep. These characteristics are very similar to those of sleep apneas in healthy human infants and children. Therefore, mice seem to be a promising experimental animal model for studying the genetic and molecular basis of respiratory regulation and dysregulation during sleep in humans, especially infants and children. However, we should keep in mind limitations in

studying mice as an animal model of SIDS, since they are nocturnal rodents and they sleep in the prone position.

Full-text available at: <http://www.sciencedirect.com> (not a U.S. Government site)

Bullock LF, Mickey K, Green J, Heine A.

**Are nurses acting as role models for the prevention of SIDS.**

MCN Am J Matern Child Nurs. 2004 May-Jun; 29(3): 172-7.

**Purpose:** To examine nurses' knowledge, attitude, and practice in positioning healthy newborns for sleep in the hospital setting. **Design and Methods:** A cross-sectional descriptive design was used to survey a convenience sample of practicing maternal child nurses in 58 Missouri hospitals. A 24-item investigator designed questionnaire was developed with input from SIDS Resources in Missouri. **Results:** A total of 528 surveys were analyzed. These nurses reported no longer placing infants in the prone position for sleep, but almost 75% of those answering the survey used either the side-lying position or a mixture of side and back positioning, even though 96% of the nurses said they were aware of the AAP Guidelines recommending "back to sleep." Forty-five percent of the nurses thought the infant would be at risk for aspiration if only placed on his/her back. Only 53% of the nurses knew their hospital's policy about newborn positioning; 80% of those who knew about the policy said it included the lateral position as being acceptable practice. **Clinical Implications:** Nurses are the role models for new parents regarding newborn sleep position, and are in a unique position to influence parents' decisions about how to place their infants for sleep at home. Because nurses continue to worry about aspiration when newborns are placed on their backs, it is clear that more education is needed for hospital nurses about newborn sleep position and hospital policies, as well as AAP Guidelines.

Full-text available at: <http://www.mcnjournal.com> (not a U.S. Government site)

Stastny PF, Ichinose TY, Thayer SD, Olson RJ, Keens TG.

**Infant sleep positioning by nursery staff and mothers in newborn hospital nurseries.**

Nurs Res. 2004 Mar-Apr; 53(2): 122-9.

**Background:** Although advice from healthcare professionals may influence parental infant placement choice to reduce sudden infant death syndrome risk, literature on nursery staff infant placement behaviors and the degree to which they influence maternal infant sleep positioning is limited. **Objective:** To assess newborn placement practices of the mother and nursery staff and their interrelationship in the hospital setting. **Methods:** A cross-sectional survey-based study was conducted among hospital newborn nursery staff (n = 96) and mothers of newborns (n = 579) at eight perinatal hospitals in Orange County, California. **Results:** Although a majority of sampled nursery staff (72%) identified the supine position as the placement that most lowers sudden infant death syndrome risk, only 30% reported most often placing infants to sleep in that position, with most staff (91%) citing fear of aspiration as the motivation for supine position avoidance. Only 34% of staff reported advising exclusive supine infant positioning to mothers. Approximately 36% of mothers reported using supine infant placement exclusively. Maternal infant placement choice varied by both the advice (p <.01) and the placement modeling (p <.01) provided by staff, with the highest proportion of usual supine infant placement found among mothers who reported receiving both. A mother's race/ethnicity also affected the reception of exclusive supine placement recommendations (p <.01). **Conclusions:** Exclusive supine

infant placement appears to be underused by both nursery staff and mothers of newborn infants. Culturally grounded educational intervention with nursery staff regarding infant positioning and placement in the hospital setting is indicated.

Full-text available at: <http://www.nursingresearchonline.com> (not a U.S. Government site)

Malloy MH, Freeman DH.

**Age at death, season, and day of death as indicators of the effect of the back to sleep program on sudden infant death syndrome in the United States 1992-1999.**

Arch Pediatr Adolesc Med. 2004 Apr; 158(4): 359-65.

**Background:** In June 1992, the American Academy of Pediatrics Task Force on Infant Positioning and Sudden Infant Death Syndrome (SIDS) made its first recommendation concerning placing infants in a supine position. Since the publication of this recommendation, SIDS rates in the United States have declined 44%. Before this recommendation, SIDS had a marked seasonal pattern and was noted to occur more frequently on weekends. **Objective:** The objective of this study was to determine if significant changes in SIDS rates have occurred in age at death (0-27 days vs 1-6 months vs 7-11 months), season of death, and weekday of death since the implementation of the recommendations for supine positioning of infants for sleep. **Design:** United States natality and mortality data were used for the years 1992 through 1994. United States linked infant birth and death certificate files were used for the years 1995 through 1999. Season of death was calculated from month of death and was ordered for analysis from winter to fall to spring to summer; day of death was ordered from Monday to Sunday and additionally analyzed as weekend (Saturday and Sunday) vs weekday (Monday through Friday). **Results:** During the 8 years, 28 548 deaths were attributed to SIDS among residents of the United States. The average annual decrease in the SIDS rate for neonates aged 0 to 27 days was 6.6%; for infants aged 1 to 6 months, 9.0%; and for infants aged 7 to 11 months, 6.1%. The average decline in seasonal rates from winter to summer was 11.2% per season. A significant interaction between year of death and season indicated a diminishing rate of seasonal variation. The odds ratio for weekend vs weekday SIDS deaths was 0.98 (95% confidence interval, 0.96-1.01). There was no significant interaction between year of death and weekday of death, which indicates no change in the relationship since the implementation of the supine sleeping recommendations. **Conclusions:** These data provide insights into the effect of the supine sleep recommendations on SIDS. The reduction in seasonal variation of SIDS suggests advantages conferred by supine sleeping in colder seasons.

Full-text available at: <http://archpedi.ama-assn.org/> (not a U.S. Government site)

Moon RY, Oden RP, Grady KC.

**Back to Sleep: An educational intervention with women, infants, and children program clients.**

Pediatrics. 2004 Mar; 113(3 Pt 1): 542-7.

**Objective:** The incidence of sudden infant death syndrome (SIDS) is 2 to 3 times higher in the black population compared with the US population as a whole. Prone sleeping is also twice as prevalent in black infants. Standard modes of communication (media, brochures) regarding the Back to Sleep (BTS) campaign have been less effective with blacks. The objective of this study was to determine whether a 15-minute educational intervention is effective in changing sleep position practice among black parents. **Methods:** A trained health educator led 15-minute sessions about safe infant sleep practices for

groups of 3 to 10 parents of young infants who attended a Women, Infants, and Children clinic in Washington, DC. We performed pre- and post session surveys, asking about sleep position, reasons for choosing a sleep position, and knowledge of the relationship between sleep position and SIDS. We then interviewed parents 6 months after the intervention and compared this group with a group of parents at a different Women, Infants, and Children site who did not receive the intervention. Results: A total of 310 parents/caregivers participated in sessions from October 2001 to July 2002. Mothers comprised 84.5% of the participants, fathers 6.5%, and other relatives 9.0%. Parents had a mean age of 26.2 years (range: 15-64; standard deviation: 8.3), and 76.5% had graduated from high school. For 51%, this was their first child. Before the intervention, more than half (57.7%) of infants reportedly slept on their back, with the remainder sleeping back/side or side (15%) and prone (17.3%). Approximately 85% (266) of infants were sleeping in the same room as the parents. Only 28.1% of parents initially believed that prone sleeping definitely increases the risk of SIDS. Infants were more likely to be placed supine when previous children were placed supine or when parents had more than a high school education. Parents were also more likely to place infants supine when they believed that prone increases the risk of SIDS, they had previous knowledge of BTS, and they were aware that the American Academy of Pediatrics recommends supine position for infants. Sleep position was not affected by where the infant slept, number of parents in the home, presence of a grandmother in the home, or presence of smokers in the home. Immediately after the intervention, 85.3% planned to place infants on the back, and 55.7% now believed that prone definitely increases the risk of SIDS. When compared with a control group of parents 6 months after the intervention, parents who attended the educational intervention were more likely to place their infants on the back (75% vs 45%), less likely to bedshare (16% vs 44.2%), less likely to cite infant comfort as a reason for sleep position (14.5% vs 29.2%), and more likely to be aware of BTS recommendations (72.4% vs 38.9%). Conclusions: A 15-minute educational session with small groups of black parents is effective in informing parents about the importance of safe sleep position and in changing parent behavior. The effect of the intervention is sustained throughout the first 6 months of life, when the infant is at the highest risk for SIDS.

Full-text available for downloading: <http://pediatrics.aappublications.org/cgi/reprint/113/3/542>  
(not a U.S. Government site)

Matthews T, McDonnell M, McGarvey C, Loftus G, O'Regan M.

**A multivariate "time based" analysis of SIDS risk factors.**

Arch Dis Child. 2004 Mar; 89(3): 267-71.

*Aims:* To investigate the influence of analytical design on the variability of published results in studies of sudden infant death syndrome (SIDS). *Methods:* The results of a prospective case-control study, of 203 cases of SIDS, and 622 control infants are presented. All variables significant on univariate analysis were included in a multivariate model analyzed in nine stages, starting with sociodemographic variables, then sequentially and cumulatively adding variables relating to pregnancy history, current pregnancy, birth, the interval from birth to the week prior to death, the last week, the last 48 hours, and the last sleep period. A ninth stage was created by adding placed to sleep prone for the last sleep period. *Results:* As additional variables are added, previously published SIDS risk factors emerged such as social deprivation, young maternal age, > or =3 previous live births, maternal smoking and drinking, urinary tract infection in pregnancy, reduced birth weight, and the infant having an illness, regurgitation, being sweaty, or a history of crying/colic in the interval from birth to the week before

death, with co-sleeping and the lack of regular soother use important in the last sleep period. As the model progressed through stages 1-9, many significant variables became non-significant (social deprivation, young maternal age, maternal smoking and drinking) and in stage 9 the addition of placed to sleep prone for the last sleep period caused  $> \text{ or } = 3$  previous live births and a reduced birth weight to become significant. Conclusions: The variables found to be significant in a case-control study, depend on what is included in a multivariate model.

Full-text available at: <http://adc.bmjournals.com/> (not a U.S. Government site)

Stastny PF, Ichinose TY, Thayer SD, et al.

**Infant sleep positioning by nursery staff and mothers in newborn hospital nurseries.**

Nursing Research. 2004 Mar-Apr; 53(2):122-9.

*Background:* Although advice from healthcare professionals may influence parental infant placement choice to reduce sudden infant death syndrome risk, literature on nursery staff infant placement behaviors and the degree to which they influence maternal infant sleep positioning is limited. *Objective:* To assess newborn placement practices of the mother and nursery staff and their interrelationship in the hospital setting. *Methods:* A cross-sectional survey-based study was conducted among hospital newborn nursery staff ( $n = 96$ ) and mothers of newborns ( $n = 579$ ) at eight perinatal hospitals in Orange County, California. *Results:* Although a majority of sampled nursery staff (72%) identified the supine position as the placement that most lowers sudden infant death syndrome risk, only 30% reported most often placing infants to sleep in that position, with most staff (91%) citing fear of aspiration as the motivation for supine position avoidance. Only 34% of staff reported advising exclusive supine infant positioning to mothers. Approximately 36% of mothers reported using supine infant placement exclusively. Maternal infant placement choice varied by both the advice ( $p < .01$ ) and the placement modeling ( $p < .01$ ) provided by staff, with the highest proportion of usual supine infant placement found among mothers who reported receiving both. A mother's race/ethnicity also affected the reception of exclusive supine placement recommendations ( $p < .01$ ). *Conclusions:* Exclusive supine infant placement appears to be underused by both nursery staff and mothers of newborn infants. Culturally grounded educational intervention with nursery staff regarding infant positioning and placement in the hospital setting is indicated.

Full-text available at: <http://www.nursingresearchonline.com> (not a U.S. Government site)

American Academy of Pediatrics. **Task Force on Infant Sleeping Position and SIDS.**

**Infant sleep position and SIDS: Questions and answers for health care providers.**

Bethesda, MD: National Institute of Child Health and Human Development (NIH). Nov 2004. 12 p.

This brochure, a product of the national 'Back to Sleep' campaign in the United States, presents questions and answers for health care providers on infant sleeping position and sudden infant death syndrome (SIDS). The 'Back to Sleep' campaign was initiated in June 1994 to alert new parents and health professionals to sleeping position as a possible risk factor for SIDS. The brochure answers the following questions: What advice should health care providers give to parents on ways to reduce the risk of SIDS? What sleep position is safest for full-term babies in hospital nurseries? Is the side position as effective at reducing the risk of SIDS as the back sleep position? Will babies choke if they are placed on their backs; Does back sleeping cause infants to have flat heads? Why should parents and

caregivers avoid soft surfaces for their infants to sleep on? Can a baby ever be placed on his or her stomach; Are there any circumstances when a baby should be placed to sleep on his or her stomach? How should preterm babies be placed for sleep? What advice should a health care provider give to a parent or caregiver whose infant has difficulty sleeping in the back position? How often should parents or caregivers check on an infant during sleep to make sure the baby has not rolled into the stomach position from the back position? At what age can parents and caregivers stop placing their babies on their backs to sleep? Should parents or caregivers use products that are designed to keep babies on their backs or sides during sleep? What advice should health care providers give to parents of babies in childcare? Does bed sharing reduce the risk of SIDS? Information on the campaign's history is included.

Full-text available for downloading at:

[http://www.nichd.nih.gov/sids/BTS\\_QA\\_for\\_health\\_professionals.pdf](http://www.nichd.nih.gov/sids/BTS_QA_for_health_professionals.pdf)

McGarvey C, McDonnell M, et al.

**Factors relating to the infants last sleep environment in Sudden Infant Death Syndrome in the Republic of Ireland.**

Arch Dis Child. 2003 Dec; 88(12): 1058-64.

**Aim:** To identify risk factors for sudden infant death syndrome (SIDS) in the sleeping environment of Irish infants. **Methods:** A five-year population based case-control study with parental interviews conducted for each case and three controls matched for age, place of birth, and last sleep period. A total of 203 SIDS cases and 622 control infants born 1994–98 were studied. **Results:** In a multivariate analysis, co-sleeping significantly increased the risk of SIDS both as a usual practice (adjusted OR 4.31; 95% CI 1.07 to 17.37) and during the last sleep period (adjusted OR 16.47; 95% CI 3.73 to 72.75). The associated risk was dependent on maternal smoking (OR 21.84; 95% CI 2.27 to 209.89), and was not significant for infants who were 20 weeks of age (OR 2.63; 95% CI 0.49 to 70.10) or placed back in their own cot/bed to sleep (OR 1.07; 95% CI 0.21 to 5.41). The use of pillows, duvets, and bedding with tog value 10 were not significant risk factors when adjusted for the effects of confounding variables, including maternal smoking and social disadvantage. However, the prone sleeping position remains a significant SIDS risk factor, and among infants using soothers, the absence of soother use during the last sleep period also significantly increased the SIDS risk (OR 5.83; CI 2.37 to 14.36). **Conclusion:** Co-sleeping should be avoided in infants who are <20 weeks of age, or whose mothers smoked during pregnancy. The prone position remains a factor in some SIDS deaths, and the relation between soother use and SIDS is a complex variable requiring further study.

Full-text available at: <http://adc.bmjournals.com/> (not a U.S. Government site)

Chung EK, Hung YY, et al.

**Infant sleep position: Associated maternal and infant factors.**

Ambul Pediatr 2003 Sept-Oct; 3(5): 234-9.

**Objectives:** To determine the maternal and infant characteristics associated with the back sleep position for infants to guide efforts to increase its use and reduce the risk of Sudden Infant Death Syndrome. **Methods:** Cross-sectional survey of 3349 mothers delivering in California, February-May 1999. **Results:** Fifty-two percent of infants were placed in the back sleep position. Factors associated

with a lower likelihood of using the back position included all levels of maternal education less than college (eg, for education eighth grade or less--adjusted odds ratio [OR] 0.59; 95% confidence interval [CI], 0.40-0.86); income at or below federal poverty level (OR, 0.65; 95% CI, 0.47-0.90); multiparity (OR, 0.80; 95% CI, 0.67-0.95); race/ethnicity African American (OR, 0.49; 95% CI, 0.37-0.65) and Asian/Pacific Islander (OR, 0.65; 95% CI, 0.48-0.89); speaking a non-English language (OR, 0.69; 95% CI, 0.55, 0.86); and infant age over 7 months (OR, 0.70, 95% CI, 0.52-0.96). Women in Los Angeles (OR, 0.57; 95% CI, 0.42-0.77) and urban areas other than San Diego (OR, 0.70; 95% CI, 0.53-0.92) were less likely to use the back position than those in San Francisco. *Conclusions:* Greater efforts are needed to promote the back sleep position among families with mothers who lack education beyond some college; live in poverty; and who are African American, Asian/Pacific Islander, multiparous, or non-English speaking.

Full-text available at: <http://www.ambpeds.org/journal.cfm> (not a U.S. Government site)

de Chalain T.

**The Safe-T-Sleep device: safety and efficacy in maintaining infant sleeping position.**

N Z Med J. 2003 Sep 12; 116(1181):U581

*Aims:* The issue of infant sleeping position has socio-political ramifications. Current recommendations endorse supine sleeping as an aid to reducing the risk of sudden infant death syndrome (SIDS). Persistent sleeping of a newborn infant in the same position may induce plagiocephaly without synostosis (PWS). Parents in our craniofacial clinic, whose children present with PWS, often feel torn between apparently conflicting goals--avoiding SIDS and avoiding PWS. The Safe-T-Sleep device, a form of infant sleep wrap, purportedly allows safe semi-supine positioning, thus ameliorating PWS (by preventing the infant from lying on the cranial 'flat spot') while not increasing the risk of SIDS. Before recommending the device to parents in our plagiocephaly clinics, we designed a prospective, hospital-based trial to assess the safety and efficacy of the device in maintaining selected sleeping positions. This was not a trial of the efficacy of the Safe-T-Sleep device in treating plagiocephaly. *Methods:* The devices were trialed on 31 babies, between birth and 11 months of age. A total of 396 hours of observations were recorded. *Results:* The device maintained the selected body position in 94% of recorded observations and head position in 87%. There were no significant adverse events or complications associated with the use of the Safe-T-Sleep device. *Conclusions:* The device appears to be safe and effective. It is now being advocated in our clinic as an aid to active counter-positioning strategies to passively correct incipient or established positional plagiocephaly in younger babies.

Full-text available at: <http://www.nzma.org.nz/journal/index.shtml> (not a U.S. Government site)

Hunt CE, Lesko SM, Vezina RM, et al.

**Infant sleep position and associated health outcomes.**

Arch Pediatr Adolesc Med. 2003 May; 157(5): 469-74.

*Background:* The incidence of sudden infant death syndrome has decreased in the United States as the percentage of infants sleeping prone has decreased, but persisting concerns about the safety of supine sleeping likely contribute to prone sleeping prevalence rates that remain higher than 10%. *Objective:* To document health outcomes in infants aged 1 to 6 months in relation to sleep position. *Design:* Prospective cohort study. *Setting:* Massachusetts and Ohio, from February 21, 1995, to December 31,

1998. Study Participants: A total of 3733 infants with consistent sleep positions at ages 1, 3, and 6 months. Main Outcome Measures: Descriptive statistics and multiple logistic regression analysis relating sleep position at each follow-up age to symptoms in the prior week (fever, cough, wheezing, stuffy nose, trouble breathing or sleeping, diarrhea, vomiting, or spitting up) and outpatient visits in the prior month (ear infection, breathing problem, vomiting, spitting up, colic, seizure, accident, or injury). Results: No symptoms or outpatient visits were significantly more common among infants sleeping on the side or supine than in infants sleeping prone, and 3 symptoms were less common: (1) fever at 1 month in infants sleeping in the supine (adjusted odds ratio [OR], 0.56; 95% confidence interval [CI], 0.34-0.93) and side positions (OR, 0.48; 95% CI, 0.28-0.82); (2) stuffy nose at 6 months in the supine (OR, 0.74; 95% CI, 0.61-0.89) and side positions (OR, 0.82; 95% CI, 0.68-0.99); and (3) trouble sleeping at 6 months in the supine (OR, 0.57; 95% CI, 0.44-0.73) and side positions (OR, 0.69; 95% CI, 0.53-0.89). Also, outpatient visits for ear infections were less common at 3 and 6 months in infants sleeping in the supine position (OR, 0.64; 95% CI, 0.46-0.88; and OR, 0.73; 95% CI, 0.58-0.92, respectively) and at 3 months in the side position (OR, 0.68; 95% CI, 0.49-0.96). Conclusions: No identified symptom or illness was significantly increased among non-prone sleepers during the first 6 months of life. These reassuring results may contribute to increased use of the supine position for infant sleeping. 13 references.

Full-text available at: <http://archpedi.ama-assn.org/> (not a U.S. Government site)

Li, De-Kun, Petitti DB, et al.

**Infant sleeping position and the risk of Sudden Infant Death Syndrome in California, 1997-2000.**  
Am J Epidemiol 2003 Mar 1; 157(5): 446-55.

To assess the association between infant sleeping position and risk of sudden infant death syndrome (SIDS) in an ethnically diverse US population, the authors conducted a population-based case-control study in 11 counties in California from May 1997 through April 2000. The authors conducted in-person interviews with the mothers of 185 SIDS cases and 312 randomly selected race/ethnicity- and age-matched controls to collect information on sleeping positions. Infants who had last been put down to sleep in the prone or side position were at greater risk of SIDS than were infants who had last been put down on their backs (adjusted odds ratio (AOR) = 2.6 (95% confidence interval (CI): 1.5, 4.5) and AOR = 2.0 (95% CI: 1.2, 3.4) for the prone and side positions, respectively). The risk of SIDS was especially high for an unstable side position in which an infant was placed on its side and found prone (AOR = 8.7, 95% CI: 3.3, 22.7). Infants who were usually placed on their backs to sleep but had last been put down in the prone or side position (an unaccustomed position) had a significantly high risk of SIDS (AOR = 8.2 (95% CI: 2.6, 26.0) and AOR = 6.9 (95% CI: 2.3, 20.6) for the prone and side positions, respectively). Infants placed in an unaccustomed prone or side sleeping position had a higher risk of SIDS than infants who were always placed prone or on the side.

Full-text available at: <http://aje.oxfordjournals.org/> (not a U.S. Government site)

Tuladhar R, Harding R, et al.

**Effects of sleep position sleep state and age on heart rate responses following provoked arousal in term infants.**

Early Hum Dev. 2003 Apr; 71(2): 157-69.

Previous studies have suggested that autonomic dysfunction may be involved in Sudden Infant Death Syndrome (SIDS). The major risk factors for SIDS are the prone sleeping position and maternal smoking. Our aim was to examine the effects of sleeping position and maternal smoking on the postnatal maturation of autonomic function by examining heart rate responses following arousal in healthy term infants. Twenty-four infants (11 born to mothers who smoked during pregnancy and 13 to mother who did not smoke) were studied using daytime polysomnography and multiple measurements of arousal threshold (cm H<sub>2</sub>O) in response to air-jet stimulation applied alternately to the nares were made in both active sleep (AS) and quiet sleep (QS). We demonstrated no difference between smoking and non-smoking groups of infants in any of our measurements, and thus combined data from the groups. Baseline (BHR) was elevated in the prone compared to the supine position in quiet sleep (QS) at 2–3 weeks ( $p < 0.001$ ) and 5–6 months ( $p < 0.001$ ), and in active sleep (AS) at 2–3 and 5–6 months ( $p < 0.05$ ). BHR was significantly elevated in AS compared to QS in the supine position at all ages ( $p < 0.01$ ) and in the prone position at 2–3 ( $p < 0.001$ ) and 5–6 months ( $p < 0.05$ ). Increases in heart rate (HR%) following arousal were significantly greater in the supine compared to the prone position in QS at 2–3 weeks ( $p < 0.05$ ) and in AS at both 2–3 ( $p < 0.01$ ) and 5–6 months ( $p < 0.05$ ). HR% was significantly greater in AS compared to QS in both supine ( $p < 0.05$ ) and prone ( $p < 0.001$ ) positions at 2–3 weeks and in the supine position at 2–3 months ( $p < 0.001$ ). We conclude that sleep state, sleep position and postnatal age affect the cardiac responses following arousal from sleep in healthy term infants. Impairment of heart rate control in the prone position may be important in understanding the increased risk for SIDS in this position. 37 references.

Full-text available at: <http://www.sciencedirect.com> (not a U.S. Government site)

### **Back to Sleep: Can we influence child care providers?**

Pediatrics. 2003 Oct; 112(4): 878-882.

**Objectives:** Despite the fact that 20% of sudden infant death syndrome (SIDS) deaths occur in child care settings, many child care providers continue to be unaware of the association of SIDS and infant sleep position and/or are misinformed as to the risks and benefits of the various sleep positions. The objective of this study was to determine whether an educational program for child care providers regarding SIDS and safe sleep environment is effective in 1) providing basic information and understanding regarding SIDS risk reduction practices, 2) changing child care provider behavior, and 3) promoting development of written sleep position policies. **Methods:** We designed a 60-minute educational in-service for child care providers, to be led by a trained health educator. All providers who attended the in-service were asked to complete surveys before and after the in-service. Surveys assessed provider knowledge, beliefs, and practices. A 6-month follow-up interview was conducted with child care centers that had providers participating in the in-service. **Results:** A total of 96 childcare providers attended the educational in-service. Providers who were using the supine position exclusively increased from 44.8% to 78.1%. This change in behavior was sustained, with 85% of centers placing infants exclusively supine 6 months after the intervention. Awareness of the American Academy of Pediatrics recommendation of supine as the preferred position for infants increased from 47.9% to 78.1%, and 67.7% of centers continued to recognize supine as the recommended position 6 months later. The percentage of centers that reported written sleep position policies increased from 18.8% to 44.4%. **Conclusions:** A targeted educational in-service for child care providers is effective in increasing awareness and knowledge, changing child care provider behavior, and promoting

development of written sleep position policies. This change is sustained over at least a 6-month period .18 references.

Full-text available at: <http://www.pediatrics.org> (not a U.S. Government site)

Persing J, James H, Swanson J, et al.

**Prevention and management of positional skull deformities in infants.**

Pediatrics. 2003 Jul; 112(1): 199-202.

Cranial asymmetry may be present at birth or may develop during the first few months of life. Over the past several years, pediatricians have seen an increase in the number of children with cranial asymmetry, particularly unilateral flattening of the occiput. This increase likely is attributable to parents following the American Academy of Pediatrics "Back to Sleep" positioning recommendations aimed at decreasing the risk of sudden infant death syndrome. Although associated with some risk of deformational plagiocephaly, healthy young infants should be placed down for sleep on their backs. This practice has been associated with a dramatic decrease in the incidence of sudden infant death syndrome. Pediatricians need to be able to properly diagnose skull deformities, educate parents on methods to proactively decrease the likelihood of the development of occipital flattening, initiate appropriate management, and make referrals when necessary. This report provides guidelines for the prevention, diagnosis, and management of positional skull deformity in an otherwise normal infant without evidence of associated anomalies, syndromes, or spinal disease.

Full-text available at: <http://www.pediatrics.org> (not a U.S. Government site)

Hauck FR, Herman SM, Donovan M, et al.

**Sleep environment and the risk of sudden infant death syndrome in an urban population: The Chicago Infant Mortality Study.**

Pediatrics. 2003 May; 111(5 part 2): 1207-1214.

Objectives: To examine risk factors for sudden infant death syndrome (SIDS) with the goal of reducing SIDS mortality among blacks, which continues to affect this group at twice the rate of whites. Methods: We analyzed data from a population-based case-control study of 260 SIDS deaths that occurred in Chicago between 1993 and 1996 and an equal number of matched living controls to determine the association between SIDS and factors in the sleep environment and other variables related to infant care. Results: The racial/ethnic composition of the study groups was 75.0% black; 13.1% Hispanic white; and 11.9% non-Hispanic white. Several factors related to the sleep environment during last sleep were associated with higher risk of SIDS: placement in the prone position (unadjusted odds ratio [OR]: 2.4; 95% confidence interval [CI]: 1.7-3.4), soft surface (OR: 5.1; 95% CI: 3.1-8.3), pillow use (OR: 2.5; 95% CI: 1.5-4.2), face and/or head covered with bedding (OR: 2.5; 95% CI: 1.3-4.6), bed sharing overall (OR: 2.7; 95% CI: 1.8-4.2), bed sharing with parent(s) alone (OR: 1.9; 95% CI: 1.2-3.1), and bed sharing in other combinations (OR: 5.4; 95% CI: 2.8-10.2). Pacifier use was associated with decreased risk (unadjusted OR: 0.3; 95% CI: 0.2-0.5), as was breastfeeding either ever (OR: 0.2; 95% CI: 0.1-0.3) or currently (OR: 0.2; 95% CI: 0.1-0.4). In a multivariate model, several factors remained significant: prone sleep position, soft surface, pillow use, bed sharing other than with parent(s) alone, and not using a pacifier. Conclusions: To lower further the SIDS rate among black and other

racial/ethnic groups, prone sleeping, the use of soft bedding and pillows, and some types of bed sharing should be reduced.

Full-text available at: <http://www.pediatrics.org> (not a U.S. Government site)

Moon, R.Y.; Weese-Mayer, D.E.; Silvestri, J.M.

**Nighttime child care: Inadequate Sudden Infant Death Syndrome risk factor knowledge, practice, and policies.**

Pediatrics. 2003 Apr; 111(4): 795-799.

Background: Millions of children in the US have parents who work alternative shifts. As a result, extended-hour and nighttime childcare centers have increased in number to meet the needs of parents working nonstandard hours. Recognizing that 20% of sudden infant death syndrome (SIDS) occurs in childcare settings and that childcare providers may place infants prone, it is important to determine sleep position practices in nighttime childcare centers. Objective: To determine if nighttime childcare centers 1) follow Back to Sleep recommendations; 2) are aware of the need for a safe sleep environment; and 3) have written policies directing proper SIDS risk reduction practices. Design: A descriptive, cross-sectional survey of licensed childcare centers in the US offering evening and nighttime care. All nighttime centers caring for infants <6 months old were recruited for the study. Results: Out of 153 eligible centers, 110 centers in 27 states completed the survey. Infants were placed prone in 20% of centers, although only 1 center placed infants exclusively prone. Infants slept in cribs in 53.6% of centers, but slept in uncluttered sleep environments in only 18.2% of centers. Smoking was prohibited in 86.4% of centers. The most commonly cited reason for avoiding prone altogether was SIDS risk reduction; however, 10 centers that cited SIDS risk reduction continued to place infants prone at least some of the time, because of parental request or concerns about infant comfort. Over half (59%) of the centers had written policies; however, presence of written policy was not associated with avoidance of prone position. In over one third of centers with written policies, providers were unaware of the content of the policy. Conclusions: Twenty percent of nighttime childcare centers place infants prone at least some of the time. Most providers who place infants prone do so because of lack of awareness or misinformation about safe sleep environment. Although the Back to Sleep campaign has been effective in communicating the risks of sleeping prone, non-prone positioning is not universal among nighttime childcare providers. Additional educational efforts toward childcare providers remain necessary. In addition, parents as advocates for their own infants need to be proactive in assuring that safe sleep practices are implemented in childcare settings. 24 references.

Full-text available at <http://www.pediatrics.org> (not a U.S. Government site)

Rasinski KA, Kuby A, Bzdusek SA, et al.

**Effect of a sudden infant death syndrome risk reduction education program on risk factor compliance and information sources in primarily black urban communities.**

Pediatrics. 2003Apr; 111(4): e347-e354.

Background: In the US, a higher incidence of sudden infant death syndrome (SIDS) and a slower decline in the incidence of SIDS has been found among blacks when compared with white infants. The continued racial disparity in SIDS is thought to be attributable to lack of compliance with SIDS risk reduction recommendations. Objectives: To better understand the disparities in SIDS risk reduction

behaviors, we sought to study compliance and information sources related to SIDS among primarily black communities in a city with a high SIDS incidence rate before and after a targeted educational campaign. Design: Pre- and post-SIDS Risk Reduction Education Program telephone surveys were performed in targeted Chicago communities with at least 86% blacks. Data collection for Survey 1 was from September 22 to November 4, 1999. Data collection for Survey 2 was from November 17, 2001, to January 12, 2002, 24 months after the aggressive implementation of a comprehensive, ethnically sensitive risk reduction program. *Results:* Survey 1 analyzed data from 480 mothers with an infant <12 months of age (327 black, 66 white, and 87 Hispanic) and Survey 2 had 472 mothers (305 black, 77 white, and 90 Hispanic). The incidence of nighttime prone sleeping at Survey 1 was 25% among black respondents, 17% in whites, and 12% in Hispanics and decreased (but not significantly) among all groups by Survey 2. Overall, in Survey 2 compared with Survey 1, fewer mothers reported putting their infants on an adult bed, sofa, or cot both during the day and at night, with the biggest change seen in black mothers for daytime naps. Despite the same educational initiative, blacks increased the use of pillows, stuffed toys, and soft bedding in the sleep environment as compared with whites. More mothers in Survey 2 than in Survey 1 said that they noticed their infants sleeping on their back during the newborn hospitalization. Significantly more black and white mothers in Survey 2 compared with Survey 1 reported that a doctor or nurse had told them what the best position was for putting their infants to sleep, and all 3 groups said that the health care providers indicated that placing the infant on its back was the best sleep position. In examining the relationship between information sources and SIDS risk behaviors, among all groups observation of sleep position in hospital had no effect on behavior after newborn discharge; however, specific instruction by a nurse or doctor in the hospital about how to properly place the infant for sleep influenced behavior after the mother left the hospital. *Conclusions:* The Surveys indicate the greatest impact of the SIDS risk factor educational initiative targeted at black communities was changing behaviors regarding safe sleep locations by reducing the incidence of infants placed for nighttime and daytime sleep in adult beds, sofas, or cots. Although these data indicate considerable progress as a result of the targeted educational initiative, our findings suggest that cultural explanations for specific infant care practices must be more clearly understood to close the gap between SIDS risk factor compliance and apparent knowledge about SIDS risk factors.

Full-text available at: <http://www.pediatrics.org> (not a U.S. Government site)

Patel AL, Paluszynska D, Harris KA, Thach BT.

**Occurrence and mechanisms of sudden oxygen desaturation in infants who sleep face down.**

*Pediatrics.* 2003 Apr; 111(4): e328-e332.

**Objectives:** Infants who sleep prone and face down on soft bedding are particularly vulnerable for sudden infant death syndrome. It has been suggested that 1 mechanism of death in this situation involves rebreathing of expired air. Many infants tolerate rebreathing while lying prone face down for long periods with stable saturations. Others occasionally have rapid desaturations and may require intervention to terminate rebreathing. The present study had 3 objectives: 1) to determine the frequency of rapid desaturations in a large group of healthy infants, 2) to elucidate the mechanism of these desaturations, and 3) to determine the timing of these events during periods of rebreathing. **Methods:** We studied respiratory tracings and videotapes of 56 healthy 1- to 6-month-old infants who were sleeping face down and rebreathing on soft bedding in our laboratory. We compared the frequency of desaturations during rebreathing and nonrebreathing periods. We measured respiratory frequency and apnea occurrence before desaturation and nonrebreathing control episodes. We also measured minute

ventilation during steady state before desaturation and just before desaturation. Results: There were 25 desaturation episodes in infants while rebreathing, occurring in 11 (19.6%) of the 56 infants. Episodes were significantly more frequent during rebreathing than during nonrebreathing periods. Three desaturation episodes reached <85%; 2 required interventions to terminate rebreathing. The respiratory frequency was not different between nonrebreathing control and desaturation episodes. Brief apneas were significantly more frequent preceding desaturation than control episodes (44% vs 4%). Just before episodes, there was a transient decrease in minute volume despite increasing inspired carbon dioxide in 3 episodes. There was evidence of partial or complete pharyngeal airway obstruction in 3 episodes. Thirty-six percent of all episodes were immediately preceded by behavioral arousal. Conclusions: Rebreathing in prone sleeping infants is associated with an increased frequency of episodic desaturations. Desaturation may result from respiratory pattern changes such as brief apneas often associated with evidence of behavioral arousal or failure to increase ventilation in the face of rising inspired carbon dioxide, also associated with behavioral arousal.

Full-text available at: <http://www.pediatrics.org> (not a U.S. Government site)

Vernacchio L, Corwin MJ, Lesko SM, et al.

**Sleep position of low birth weight infants.**

Pediatrics.2003 Mar; 111(3): 633-640.

Objectives: To describe sleep positions among low birth weight infants, variations in sleep position according to birth weight, and changes in sleep position over time. To analyze risk factors and influences associated with prone sleep. Design: Prospective cohort study. Setting: Massachusetts and Ohio, 1995-1998. Study Participants: Mothers of 907 low birth weight infants. Results: At 1, 3, and 6 months after hospital discharge, the prevalence of prone sleeping was 15.5%, 26.8%, and 28.3%, respectively. The corresponding rates for supine sleeping were 23.8%, 37.9%, and 50.2% and for side sleeping were 57.3%, 32.4%, and 20.6%. Very low birth weight (VLBW) infants (<1500 g) were most likely to be placed in the prone position. From 1995 through 1998, prone sleeping 1 month after hospital discharge declined among all low birth weight infants from 19.9% to 11.4%; among VLBW infants, the decline in prone sleeping was replaced almost entirely by an increase in side sleeping, whereas in larger low birth weight infants, it was replaced primarily by supine sleeping. Among mothers who placed their infants to sleep in non-prone positions, professional medical advice was cited most frequently as the most influential reason, whereas among mothers of prone-sleeping infants, the infant's preference was cited most frequently. However, mothers of prone-sleeping VLBW infants also frequently cited the influence of medical professionals and nursery practices as most important in the choice of sleeping position. The factors most strongly associated with prone sleeping were single marital status (odds ratio [OR]: 3.0; 95% confidence interval [CI]: 1.5-6.2), black race (OR: 2.6; 95% CI: 1.5-4.5), birth weight <1500 g (OR: 2.4; 95% CI: 1.3-4.3), and multiparity (OR: 2.1, 95% CI: 1.2-3.5). Conclusions: Prone sleep decreased among low birth weight infants from 1995 to 1998. However, VLBW infants, who are at very high risk for sudden infant death syndrome, are more likely to sleep prone than larger low birth weight infants.

Full-text available at: <http://www.pediatrics.org> (not a U.S. Government site)

Ariagno RL, Mirmiran M, Adams MM, et al.

**Effect of position on sleep, heart rate variability, and QT interval in preterm infants at 1 and 3 months' corrected age.**

Pediatrics.2003 Mar; 111(3): 622-625.

Objectives: Prone sleeping position has a strong link to sudden infant death syndrome (SIDS), and the "Back to Sleep" campaign has played an important role in reducing SIDS. We tested the hypothesis that the mechanism of the sleep position effect is based on changes in sleep, arousal, heart rate variability (HRV), and the QT interval of the electrocardiogram. Study Design: We studied 16 premature infants longitudinally, at 1 and 3 months' corrected age. Videosomnography recordings were made during the infants' normal daytime naps. Each infant was recorded in both supine and prone positions. The recordings were analyzed in 30-second epochs, which were classified as awake, active sleep (AS), quiet sleep (QS), or indeterminate sleep. Electrocardiogram data were sampled with an accuracy of 1 millisecond. Time domain analysis of HRV was measured by standard deviation of all R-R intervals and by the square root of the mean of the sum of the squares of the differences between adjacent R-R intervals. Frequency domain analysis was done for low frequency (0.04-0.14 Hz) and high frequency (0.15-0.5 Hz) HRV. We measured QT, JT, and R-R intervals during AS and QS for each position. Results: We found no significant differences between supine and prone position, either in total sleep time or in percentage of QS. Percentage of AS was significantly lower in the supine position, but only at 1 month corrected age. The incidence of short, spontaneous, sleep transitions was significantly higher in supine, also only at 1 month corrected age. Time domain analysis of HRV showed a significantly lower variability in prone, but only during QS. Frequency domain analysis of HRV showed no differences between the 2 sleeping positions. Both QT and JT intervals were significantly longer in prone during QS, but only at 1 month corrected age. Conclusions: Despite the commonly held belief, prone position did not substantially increase total sleep at these ages. On the other hand, prone sleeping decreased the number of sleep transitions at 1 month corrected age, increased QT and JT intervals, and reduced HRV, thereby potentially increasing the vulnerability for SIDS. This study supports "Back to Sleep" as the position of choice not only for term but also for preterm infants after discharge home.

Full-text available at: <http://www.pediatrics.org> (not a U.S. Government site)

Corwin MJ, Lesko SM, Heeren T, et al.

**Secular changes in sleep position during infancy: 1995-1998.**

Pediatrics.2003 Jan; 111(1): 52-60.

Objectives: Prone sleeping among infants has been associated with an increased risk of sudden infant death syndrome. The objective of this study was to compare factors associated with sleep position in 1995-1996 and 1997-1998 and to assess secular trends in use of prone infant sleep position from 1995 through 1998 among families stratified by race and education. Methods: A prospective cohort study was conducted in eastern Massachusetts and northwest Ohio of 12 029 mothers of infants who weighed > or =2500 g at birth. Descriptive statistics and multivariate odds ratios were used to relate maternal and infant characteristics to prone and supine sleeping. Results: A total of 14 206 mothers (25% of those eligible) were enrolled. A total of 12 029 mothers (85% of enrolled) responded to the 1-month and 11 552 mothers (81% of enrolled) responded to the 3-month follow-up questionnaire. A decline in use of the prone sleep position and increase in use of the supine position was observed during the 4 years of the study. Factors associated with prone and supine sleep position were similar in 1995-1996

and 1997-1998. In 1997-1998, use of prone sleeping at 1 month of age reached the goal of  $\leq 10\%$  only among infants of white and Asian women, married women, women who were older than 25 years, women who were college graduates, and women with incomes  $> \$55,000$  per year. At 3 months of age, however, prone sleeping increased to 12% to 17% in these groups. These same groups were most likely to use the supine position; 38% to 45% were supine at 1 month, increasing to 56% to 64% by 3 months of age. However, as of the end of 1998, approximately 27% of infants of non-college-educated black and Hispanic mothers were placed to sleep in the prone position and only 20% to 30% were being placed to sleep in the supine position at 3 months of age. Conclusions: Recommendations to avoid prone sleep position and especially the recommendation that supine sleep position is preferred have not been effectively delivered to black and Hispanic families and to families of low-income and less than a college education.

Full-text available at: <http://www.pediatrics.org> (not a U.S. Government site)

Ozawa Y, Takashima S.

**Developmental neurotransmitter Pathology in the brainstem of Sudden Infant Death Syndrome: A review and sleep position.**

Forensic Sci Int. 2002 Sep 14; 130 (Suppl 1): S53-59.

Developmental studies on neurotransmitters and their receptors in sudden infant death syndrome (SIDS) infants and controls are reviewed, including comparison between the prone and supine positions at death. In SIDS infants, there are an increase of glial fibrillary acidic protein (GFAP)-positive astrocytes in the brainstem, an increase of substance P (SP) in the medulla and pons, a decrease of tyrosine hydroxylase (TH)-positive catecholaminergic neurons in the ventrolateral medulla (VLM), and vagal nuclei in the medulla oblongata and basal ganglia, a decrease of tryptophan hydroxylase (TrH)-positive serotonergic neurons in the periaqueductal gray matter (PAG), and decreases of 5-hydroxytryptamine 1A (5-HT<sub>1A</sub>) and 5-HT<sub>2A</sub> receptor immunoreactivities in the VLM and vagal nuclei in the medulla oblongata. These findings may be the result of chronic or repeated hypoxia and at the same time suggest hypofunction or immaturity of cardiorespiratory regulation. In contrast, 5-HT<sub>1A</sub> and 5-HT<sub>2A</sub> receptor immunoreactivities are increased in the PAG of SIDS infants. These increased immunoreactivities may reflect delayed neuronal maturation or a developmental abnormality of the nociceptive reaction of cardiorespiratory and arousal control in SIDS. Also, there are no differences of brainstem gliosis and catecholaminergic neuron changes between the prone and supine positions. Therefore, these changes may be predisposing factors for SIDS. 56 references.

Full-text available at: <http://www.sciencedirect.com> (not a U.S. Government site)

American Academy of Pediatrics; American Public Health Association; National Resource Center for Health and Safety in Child Care.

**Reducing the Risk of Sudden Infant Death Syndrome (SIDS). Applicable Standards from Caring for Our Children.**

Elk Grove, IL: American Academy of Pediatrics.

This pamphlet presents the standards for SIDS prevention in child care settings, providing critical information for child care providers, government policy makers, health care consultants, and parents. It

includes standards for caregiver qualification and training, proper sleep position, bedding, and reporting as well as related health policies. 12 references.

Full-text available for downloading at: <http://nrc.uchsc.edu/SPINOFF/SIDS/SIDS.htm> (not a U.S. Government site)

Ishikawa T, Isono S, Aiba J, et al.

**Prone position increases collapsibility of the passive pharynx in infants and small children.**

Am J Respir Crit Care Med. 2002 Sep 1; 166(5): 760-764.

On the basis of two observations that avoiding prone sleeping decreased incidence of sudden infant death syndrome and that obstructive sleep apnea is closely linked with the syndrome, we hypothesized that the prone position may increase upper airway collapsibility in infants and small children. Passive pharyngeal collapsibility of 19 infants and small children (10-101 weeks old) was examined in three postures: supine with face straight up, supine with neck rotated, and prone with neck rotated. The collapsibility was evaluated with the maximal distension of the most collapsible region, pharyngeal stiffness, and pharyngeal closing pressure, estimated from static pressure-area relationship of the passive pharynx. No significant changes in pharyngeal stiffness were detected; however, maximal distension was reduced in the prone position (mean +/- SD, 0.56 +/- 0.26 versus 0.44 +/- 0.20 cm(2); supine with face straight up versus prone position,  $p < 0.05$ ). Pharyngeal closing pressure increased at neck rotation in the supine position (-4.5 +/- 2.4 versus -2.8 +/- 2.3 cm H(2)O; supine with face straight up versus supine with neck rotated,  $p < 0.05$ ), and a further increase was observed in the prone position (-0.3 +/- 2.9 cm H(2)O,  $p < 0.05$  versus supine with neck rotation). Pharyngeal closing pressure in the prone position was above atmospheric pressure in half of our subjects, whereas all subjects had negative pharyngeal pressure in the supine position. We conclude that the prone position increases upper airway collapsibility, although the mechanism is yet unclear.

Full-text available at: <http://ajrccm.atsjournals.org/> (not a U.S. Government site)

Williams SM, Mitchell EA, Taylor BJ.

**Are risk factors for sudden infant death syndrome different at night?**

Arch Dis Child. 2002 Oct; 87(4): 274-278.

Aims: To determine whether the risk factors for SIDS occurring at night were different from those occurring during the day. Methods: Large, nationwide case-control study, with data for 369 cases and 1558 controls in New Zealand. Results: Two thirds of SIDS deaths occurred at night (between 10 pm and 7 30 am). The odds ratio (95% CI) for prone sleep position was 3.86 (2.67 to 5.59) for deaths occurring at night and 7.25 (4.52 to 11.63) for deaths occurring during the day; the difference was significant. The odds ratio for maternal smoking for deaths occurring at night was 2.28 (1.52 to 3.42) and that for the day 1.27 (0.79 to 2.03); that for the mother being single was 2.69 (1.29 to 3.99) for a nighttime death and 1.25 (0.76 to 2.04) for a daytime death. Both interactions were significant. The interactions between time of death and bed sharing, not sleeping in a cot or bassinet, Maori ethnicity, late timing of antenatal care, binge drinking, cannabis use, and illness in the baby were also significant, or almost so. All were more strongly associated with SIDS occurring at night. Conclusions: Prone sleep position was more strongly associated with SIDS occurring during the day, whereas night time deaths were more strongly associated with maternal smoking and measures of social deprivation.

Full-text available at: <http://adc.bmjournals.com/> (not a U.S. Government site)

Sawaguchi T, Franco P, Kato I, et al.

**Interaction between apnea, prone sleep position and gliosis in the brainstems of victims of SIDS.**  
Forensic Sci Int. 2002 Sep 14; 130 (Suppl): S44-S52.

Among 27,000 infants studied prospectively to characterize their sleep-wake behavior, 38 infants died suddenly and unexpectedly under 6 months of age. Of these, 26 died from sudden infant death syndrome (SIDS), 5 from congenital cardiac abnormalities, 2 from infected pulmonary dysplasia, 2 from septic shock with multi-organ failure, 1 from a prolonged seizure, 1 from prolonged neonatal hypoxemia, and 1 from meningitis and brain infarction. The frequency and duration of apneas recorded some 3-12 weeks prior to the infants' death were analyzed. The brainstem materials were collected and studied in an attempt to elucidate the relationship between sleep apnea, and prone sleep position and gliosis in some nuclei associated with cardiorespiratory characteristics, such as nucleus ambiguus in the medulla oblongata and the solitary nucleus, as well as structures associated with arousal phenomenon, such as the reticular formation, the superior central nucleus and the nucleus raphe magnus in the pons, the dorsal raphe nuclei in the midbrain and medulla oblongata, periaqueductal gray matter in midbrain, and locus ceruleus. Gliosis was estimated as the density of glial fibrillary acidic protein (GFAP)-positive reactive astrocytes. Variant-covariant analyses were carried out using the characteristics of apnea as an independent variable and sleep position and gliosis as dependent variables. A significant association was found only in the frequency of obstructive apnea and prone position ( $P < 0.001$ ) and gliosis in the raphe nuclei in the midbrain ( $P < 0.001$ ). Although prone position is a well-known risk factor for SIDS, the frequency of obstructive apnea has not been associated with the prone sleep position. The observed relation between prone sleep and the density of gliosis does not relate to epidemiological findings. Further studies are needed to investigate the unexpected statistical association.

Full-text available at: <http://www.sciencedirect.com> (not a U.S. Government site)

Moon RY, Omron R.

**Determinants of infant sleep position in an urban population.**

Clin Pediatr. 2002 Oct; 41(8): 569-573.

The incidence of SIDS has decreased by 40% since the Back to Sleep campaign was initiated. However, the rate of SIDS in the District of Columbia continues to be approximately double the national rate. The purpose of this study was to determine the prevalence and determinants of prone sleeping among infants in the District of Columbia and to ascertain what information is being provided to parents by health care professionals by a cross-sectional survey of parents of infants 0-6 months of age presenting for well child care at Children's Health Center, Children's National Medical Center, in Washington, DC. We recruited a consecutive sample of 126 parent-infant pairs, of which 92.9% were African-American. The average infant was 73 days old, was 3,003 grams at birth, and was full term. When asked how the infants were placed for sleep the night before the interview, 34.1 % of parents had placed the infant supine, 50.8% side, and 15.1% prone. Nearly half (48%) of infants slept in an adult bed with the mother. More than one third of the infants had been placed prone for sleep at least once since hospital discharge. Most common reasons for sleeping supine included SIDS risk reduction or health care professional

advice. Side sleepers did so primarily because of concern about vomiting, health care provider advice, or SIDS. Infants were placed prone primarily because the infant slept better. When asked about information received from a health care provider, 70.6% of parents stated that they had received information about sleep position and 64.3% about the hazards of passive smoking. Eight parents observed nursery personnel placing their infants prone. Only 16.7% of the total study population had received a Back to Sleep brochure, read it, and recalled that it recommended back sleeping. Infants were more likely to sleep prone if there was a grandparent in the home (OR 2.9,  $p < 0.05$ ) or if they were the firstborn (OR 2.17,  $p < 0.05$ ). Infants were more likely to sleep supine if parents had heard a back recommendation from a health care professional (OR 5.7,  $p < 0.001$ ). Infants were least likely to sleep supine if the parents had heard a side or a side/back recommendation (OR 0.26,  $p = 0.001$ ). Infant sleep position was not related to reading the Back to Sleep brochure. In conclusion, more than one third (35.7%) of infants in this predominantly African-American population have been placed prone for sleep at least once; 15% slept prone the night before the interview. Almost one third of parents received no information about sleep position, but parents receiving a verbal supine recommendation were most likely to place their infant supine. Receiving written information did not affect sleep position. Improved educational efforts for parents of African-American newborns should continue to focus on encouraging supine positioning, smoke cessation, and other safe sleep practices.

Full-text available at: <http://www.westminsterpublications.com/> (not a U.S. Government site)

Horne RS, Bandopadhyay P, Vitkovic J, et al.

**Effects of age and sleeping position on arousal from sleep in preterm infants.**

Sleep. 2002 Nov 1; 25(7): 746-750.

**Study Objectives:** Preterm infants are at increased risk of sudden infant death syndrome (SIDS). We investigated whether the prone sleeping position impaired arousal from sleep in healthy preterm infants and whether this impairment was related to cardiorespiratory variables, temperature or postnatal age. **Design:** Longitudinal **Setting:** Participants: 14 healthy preterm infants (mean 32 +/- 0.4 weeks) were studied using daytime polysomnography on 4 occasions: 36-38 weeks postconception age, 2 to 3 weeks postterm, 2 to 3 months postterm, and 5 to 6 months postterm. **Interventions:** N/A. **Measurements:** Multiple measurements of arousal threshold (cm H<sub>2</sub>O) in response to air-jet stimulation applied alternately to the nares were made in both active sleep and quiet sleep when infants slept both prone and supine. **Results:** thresholds were significantly higher in both AS and QS when infants slept prone at 36 to 38 weeks postconception age and 2 to 3 months postterm but not at 2 to 3 weeks or 5 to 6 months postterm. These increases were independent of any sleep position-related changes in either rectal or abdominal skin temperature, respiratory rate, oxygen saturation or heart rate. **Conclusions:** At the age when the risk of SIDS is highest, the prone position significantly impairs arousal from both active sleep and quiet sleep in healthy infants born prematurely. This impairment in arousability occurred with no clinically significant changes in cardiorespiratory parameters or body temperature. Decreased arousability from sleep in the prone position may explain its role as a risk factor for SIDS.

Full-text available at: <http://www.journalsleep.org/> (not a U.S. Government site)

Iyasu S, Randall LL, Welty TK, et al.

**Risk factors for sudden infant death syndrome among northern plains Indians.**

JAMA. 2002 Dec 4; 288(21): 2717-723.

Context: Sudden infant death syndrome (SIDS) is a leading cause of post neonatal mortality among American Indians, a group whose infant death rate is consistently above the US national average. Objective: To determine prenatal and postnatal risk factors for SIDS among American Indians. Design, Setting, And Participants: Population-based case-control study of 33 SIDS infants and 66 matched living controls among American Indians in South Dakota, North Dakota, Nebraska, and Iowa enrolled from December 1992 to November 1996 and investigated using standardized parental interview, medical record abstraction, autopsy protocol, and infant death review. Outcome Measures: Association of SIDS with maternal socioeconomic and behavioral factors, health care utilization, and infant care practices. Results: The proportions of case and control infants who were usually placed prone to sleep (15.2% and 13.6%, respectively), who shared a bed with parents (59.4% and 55.4%), or whose mothers smoked during pregnancy (69.7% and 54.6%) were similar. However, mothers of 72.7% of case infants and 45.5% of control infants engaged in binge drinking during pregnancy. Conditional logistic regression revealed significant associations between SIDS and 2 or more layers of clothing on the infant (adjusted odds ratio [aOR], 6.2; 95% confidence interval [CI], 1.4-26.5), any visits by a public health nurse (aOR, 0.2; 95% CI, 0.1-0.8), periconceptional maternal alcohol use (aOR, 6.2; 95% CI, 1.6-23.3), and maternal first-trimester binge drinking (aOR, 8.2; 95% CI, 1.9-35.3). Conclusions: Public health nurse visits, maternal alcohol use during the periconceptional period and first trimester, and layers of clothing are important risk factors for SIDS among Northern Plains Indians. Strengthening public health nurse visiting programs and programs to reduce alcohol consumption among women of childbearing age could potentially reduce the high rate of SIDS.

Full-text available at: <http://jama.ama-assn.org/> (not a U.S. Government site)

Gerard CM, Harris KA, Thach BT.

**Physiologic studies on swaddling: an ancient childcare practice, which may promote the supine position for infant sleep.**

J Pediatr. 2002 Sep; 141(3): 398-404.

Objectives: The calming effects of swaddling may help infants accept back sleeping and so reduce the risk of sudden infant death syndrome. We hypothesized that swaddling, with minimal leg restraint, would be accepted by post-neonatal infants with minimal respiratory effects. Study design: Post neonatal infants (n = 37) were studied for the introduction of swaddling. Four infants were studied by using traditional swaddling techniques. Swaddle tightness was increased in 13 infants, simulating traditional swaddles. Respiratory variables-respiratory rate, tidal volume, oxygen saturation, heart rate, sigh rate, and "grunting"-were measured. Results: Hips were flexed and abducted in the swaddle. The majority of infants accepted swaddling while supine, including 78% of infants who slept prone at home. Acceptance decreased with increasing age. With increased swaddle pressure, respiratory rate increased during quiet sleep (P <.05). In rapid eye movement sleep, a slight effect on heart rate was observed (P <.05). Other variables did not change. Conclusions: Older infants including usual prone sleepers generally accept a form of swaddling that has minimal respiratory effects. The reintroduction of swaddling, without restricting hip movement or chest wall excursion, combined with supine sleeping, may promote further sudden infant death syndrome reduction.

Full-text available at: <http://journals.elsevierhealth.com/periodicals/ympd> (not a U.S. Government site)

Krous HF, Floyd CW, Nadeau JM, et al.

**Medial smooth muscle thickness in small pulmonary arteries in sudden infant death syndrome revisited.**

Pediatr Dev Pathol. 2002 Jul-Aug; 5(4): 375-385.

Increased relative medial thickness (RMT) of smooth muscle in small pulmonary arteries, peripheral extension of smooth muscle into the alveolar wall arteries, and right ventricular hypertrophy (RVH), in response to purported prolonged hypoxia, have been reported in sudden infant death syndrome (SIDS). Prone sleep position, an important risk factor for SIDS, predisposes infants to hypoxia from airway obstruction or rebreathing. Since publication of the earlier pulmonary artery studies, the SIDS definition has been expanded, and sudden infant death investigational protocols have been implemented. Our aims in this study were to (1) compare RMT in preacinar arteries (PA), intra-acinar arteries accompanying small airways (SIA), and alveolar wall arteries (AW) in SIDS infants and controls; (2) correlate RMT with postmortem variables; (3) determine if peripheral extension occurred more often in SIDS infants than in controls; and (4) determine if RVH occurred in SIDS.

Movat-stained sections from standardized tissue blocks taken prospectively from the apex of the right upper lobe from 88 SIDS cases and 17 controls were evaluated using a computer-assisted digitizing system with images obtained from a microscope with an attached video camera. When adjusted for age, the RMT values for the SIA arteries were significantly greater in controls, while the PA and AW arteries were not statistically different between the SIDS cases and controls. Peripheral medial smooth muscle extension did not differ between the groups, and RVH was not seen in SIDS cases. Given the recent identification of brain stem abnormalities interfering with protective cardiorespiratory responses against acute life-threatening hypoxia perhaps precipitated by prone sleeping, our data suggest that SIDS is an acute event not preceded by recurrent or prolonged apnea and hypoxia.

Full-text available at: <http://www.springerlink.com> (not U.S. Government Website)

Kinney, HC, McHugh T, Miller K, et al.

**Subtle developmental abnormalities in the inferior olive: an indicator of prenatal brainstem injury in the sudden infant death syndrome.**

J Neuropathol Exp Neurol 2002 May; 61(5): 427-441.

Subtle quantitative abnormalities in neuronal populations derived from the rhombic lip (i.e. arcuate nucleus at the ventral medullary surface, external granular layer of the cerebellum) have been reported in victims of the sudden infant death syndrome (SIDS). In this study, we examined the inferior olive, a major rhombic lip derivative, to determine if subtle rhombic lip abnormalities also involve this nucleus in SIDS. We analyzed the number and density of neurons and reactive astrocytes in the inferior olive in 29 SIDS cases and 29 controls. Computer-assisted cell counting procedures were used in sections stained with hematoxylin and eosin/Luxol fast blue. There was a significant difference in the postconceptionally age-adjusted mean for neuronal density between SIDS cases (7,687 +/- 255 neurons/mm<sup>3</sup>) and controls (8,889 +/- 255 neurons/mm<sup>3</sup>) (p = 0.002). The difference in age-adjusted mean neuronal number between SIDS cases (1,932 +/- 89 neurons/2 sections) and controls (2,172 +/- 89 neurons/2 sections) was marginally significant (p = 0.063). Reactive astrocytes

were present in the inferior olive in SIDS cases, but their number, density, and developmental profile were not significantly different from that of control infants dying of diverse known causes. SIDS victims found dead in cribs, beds, and sofas, prone or supine had subtle olivary abnormalities, suggesting that affected infants are at risk in various sleeping situations. We propose that at least some SIDS victims experience intrauterine brainstem injury including the olivo-arcuato-cerebellar circuitry derived from the rhombic lip. These observations provide future directions for SIDS research concerning the role of early insults in pregnancy, the rhombic lip, and the interactions of the ventral medulla and cerebellum in cardioventilatory control.

Ford KM, Linker LA.

**Compliance of licensed childcare centers with the American Academy of Pediatrics' recommendations for infant sleep positions.**

J Community Health Nurs.2002 Sum; 19(2): 83-91.

Sudden Infant Death Syndrome is an elusive and tragic cause of infant mortality. In 1992, the American Academy of Pediatrics (AAP) recommended that healthy term infants be placed in the supine or lateral positions for sleep, based on research conducted in Europe, Australia, and New Zealand. The AAP modified its recommendation in 1994, indicating a preference for the supine position. Since the initial AAP proposal, national educational programs have worked to encourage parents and health care providers to utilize AAP guidelines. Studies have been done on parental use of the supine position. However, very little information exists about the procedures utilized in licensed childcare facilities. A survey of childcare providers was conducted to determine the risk for Sudden Infant Death Syndrome, as indicated by rates of compliance with AAP guidelines. Results show that although the majority of the childcare providers knew the AAP recommendations, only 14.3% were in complete compliance. We make recommendations for the role of the public health nurse in facilitating compliance in childcare centers along with suggestions for future research.

Full-text available at: <http://www.erlbaum.com> (not U.S. Government Site)

Galland BC, Taylor BJ, Bolton DP.

**Prone versus supine sleep position: A review of the physiological studies in SIDS research.**

J Paediatr Child Health.2002 Aug; 38(4): 332-338.

A number of physiological studies, published over the last 10 years, have investigated the links between prone sleeping and sudden infant death syndrome (SIDS). This review evaluates those studies and derives an overview of the different affects of sleeping prone or supine in infancy. Generally, compared with the supine, the prone position raises arousal and waking thresholds, promotes sleep and reduces autonomic activity through decreased parasympathetic activity, decreased sympathetic activity or an imbalance between the two systems. In addition, resting ventilation and ventilatory drive is improved in preterm infants, but in older infants (>1 month), there is no improvement in ventilation, and in 3-month-old infants, the position is adverse in terms of poorer ventilatory drive (in active sleep only). The majority of findings suggest a reduction in physiological control related to respiratory, cardiovascular and autonomic control mechanisms, including arousal during sleep in the prone position. Since the majority of these findings are from studies of healthy infants, continued reinforcement of the supine sleep recommendations for all infants is emphasized.

Full-text available at: <http://www.blackwell-synergy.com> (not U.S. Government Site)

Peitsch WK, Keefer CH, LaBrie RA, Mulliken JB.

**Incidence of cranial asymmetry in healthy newborns.**

Pediatrics.2002 Dec; 110(6): e72.

Objective: During recent years, coincident with the recommendation to position infants supine, the incidence of posterior deformational plagiocephaly has increased dramatically. The purpose of our study was to determine whether early signs of cranial flattening could be detected in healthy neonates and to document incidence and potential risk factors. Design: A cross-sectional study was performed in healthy newborns. Physical findings, anthropometric cranial measurements, and data on pregnancy and birth were recorded. Results: The incidence of localized cranial flattening in singletons was 13%; other anomalous head shapes were found in 11% of single-born neonates. In twins, localized flat areas were much more frequent with an incidence of 56%. The following risk factors for cranial deformation were identified: assisted vaginal delivery, prolonged labor, unusual birth position, primiparity, and male gender. Conclusion: We propose that localized lateral or occipital cranial flattening at birth is a precursor to posterior deformational plagiocephaly. The infant lies supine, with the head turned to the flattened area, and is unable to roll. Intrauterine risk factors for localized cranial flattening are the same as for deformational plagiocephaly. To avoid postnatal progression from a localized cranial flattening to posterior-lateral deformational plagiocephaly, we suggest amending the recommendation of the American Academy of Pediatrics on sleep position: Alternate the head position and allow sleeping on the side and, when awake, supervise prone time.

Full-text available at: <http://www.pediatrics.org> (not U.S. Government Site)

Gerard CM, Harris KA, Thach BT.

**Spontaneous arousals in supine infants while swaddled and unswaddled during rapid eye movement and quiet sleep.**

Pediatrics.2002 Dec; 110(6): e70.

Objective: Supine sleep is recommended for infants to decrease the risk of sudden infant death syndrome, but many parents report that their infants seem uncomfortable supine. Many cultures swaddle infants for sleep in the supine position. Swaddled infants are said to "sleep better"; presumably they sleep longer or with fewer arousals. However, there have been no studies of the effect of swaddling on spontaneous arousals during sleep. Arousal is initiated in brainstem centers and manifests as a sequence of reflexes: from sighs to startles and then to thrashing movements. Such "brainstem arousals" may progress to full arousal, but most do not. Methods: Twenty-six healthy infants, aged 80 +/- 7 days, were studied during normal nap times. Swaddled (cotton spandex swaddle) and unswaddled trials were alternated for each infant. Sleep state (rapid eye movement [REM] or quiet sleep [QS]) was determined by behavioral criteria (breathing pattern, eye movements) and electroencephalogram/electrooculogram (10 infants). Respiration, submental and biceps electromyogram, and video recording were used to detect startles and sighs (augmented breaths). Full arousals were classified by eye opening and/or crying. Frequencies of sighs, startles, and full arousals per hour were calculated. Progression of events was calculated as percentages in each sleep state, as was duration of sleep state. Results: Swaddling decreased startles in QS and REM, full arousal in QS, and progression of startle to arousal in QS. It resulted in shorter arousal duration during REM sleep and

more REM sleep. Conclusions: Swaddling has a significant inhibitory effect on progression of arousals from brainstem to full arousals involving the cortex in QS. Swaddling decreases spontaneous arousals in QS and increases the duration of REM sleep, perhaps by helping infants return to sleep spontaneously, which may limit parental intervention. For these reasons, a safe form of swaddling that allows hip flexion/abduction and chest wall excursion may help parents keep their infants in the supine sleep position and thereby prevent the sudden infant death syndrome risks associated with the prone sleep position.

Full-text available at: <http://www.pediatrics.org> (not U.S. Government Site)

Hauck FR, Moore CM, Herman SM, et al.

**The contribution of prone sleeping position to the racial disparity in sudden infant death syndrome: The Chicago Infant Mortality Study.**

Pediatrics. 2002 Oct; 110(4): 772-780.

Background: Rates of sudden infant death syndrome (SIDS) are over twice as high among African Americans compared with Caucasians. Little is known, however, about the relationship between prone sleeping, other sleep environment factors, and the risk of SIDS in the United States and how differences in risk factors may account for disparities in mortality. Objective: To assess the contribution of prone sleeping position and other potential risk factors to SIDS risk in a primarily high-risk, urban African American population. Design, Setting, and Population: Case-control study consisting of 260 infants ages birth to 1 year who died of SIDS between November 1993 and April 1996. The control group consists of an equal number of infants matched on race, age, and birth weight. Prospectively collected data from the death scene investigation and a follow-up home interview for case infants were compared with equivalent questions for living control participants to identify risk factors for SIDS. Main Outcome Measures: Risk of SIDS related to prone sleeping position adjusting for potential confounding variables and other risk factors for SIDS, and comparisons by race-ethnicity. Results: quarters of the SIDS infants were African American. There was more than a twofold increased risk of SIDS associated with being placed prone for last sleep compared with the nonprone positions (odds ratio [OR]: 2.4; 95% confidence interval [CI]: 1.6-3.7). This OR increased after adjusting for potential confounding variables and other sleep environment factors (OR: 4.0; 95% CI: 1.8-8.8). Differences were found for African Americans compared with others (OR: 1.8; 95% CI: 1.2-2.6 and OR: 10.3, 95% CI: 10.3 [3.2-33.8, respectively]). The population attributable risk was 31%. Fewer case mothers (46%) than control mothers (64%) reported being advised about sleep position in the hospital after delivery. Of those advised, a similar proportion of case mothers as control mothers were incorrectly told or recalled being told to use the prone position, but prone was recommended in a higher proportion of black mothers (cases and controls combined) compared with non-black mothers. Conclusions: Prone sleeping was found to be a significant risk factor for SIDS in this primarily African American urban sample, and approximately one third of the SIDS deaths could be attributed to this factor. Greater and more effective educational outreach must be extended to African American families and the health personnel serving them to reduce prone prevalence during sleep, which appears, in part, to contribute to the higher rates of SIDS among African American infants.

Full-text available at: <http://www.pediatrics.org> (not U.S. Government Site)

Colson ER, Cohen-Joslin S, et al.

**Changing nursery practice gets inner-city infants in the supine position for sleep.**

Arch Pediatr Adolesc Med. 2002 Jul; 156(7): 717-720.

Objectives: To determine whether an educational intervention to change nursery practice would result in more inner-city parents placing their infants in the supine position for sleep.

Design: Semistructured interviews were conducted at the 2-week health supervision visit with 1 convenience sample of parents before and a different convenience sample of parents after an educational intervention was conducted to change nursery practice in positioning infants for sleep.

Setting: University hospital clinic located in an urban setting. Participants: Parents of 2-week-old infants at their first health supervision visit in an urban, university-affiliated clinic. All parents who were approached agreed to participate. Intervention: Nurses were instructed to place infants

exclusively in the supine position in the nursery and to instruct parents to exclusively place infants in the supine sleeping position at home. Main Outcome Measures: The usual sleeping position in which parents reported placing their 2-week old infants. Results: Before the intervention, 41 percent of parents reported that a clinician had told them to place their infants to sleep in the supine position compared with 81 percent after the intervention (odds ratio [OR], 6.1; 95 percent confidence interval [CI], 3.1-12.3). Before the intervention, 37 percent of parents reported that the nursery staff placed their infants to sleep in the supine position, compared with 88 percent of the intervention, 42 percent of parents reported that they usually placed their infants to sleep in the supine position at home compared with 75 percent after the intervention (OR, 4.2; 95 percent CI, 2.1-7.9). Conclusion: After an educational intervention to change practice in a well-newborn nursery, many more parents reported placing their infants in the supine position for sleep, which suggests that such an intervention may have an impact on the position in which parents place their children to sleep.

Full-text available at: <http://archpedi.ama-assn.org/> (not U.S. Government Site)

Horne RS, Ferens D, Watts AM, et al.

**Effects of maternal tobacco smoking, sleeping position, and sleep state on arousal in healthy term infants.**

Arch Dis Child Fetal Neonatal Ed. 2002 Sep; 87(2): F100-F105.

Objectives: To investigate whether a history of maternal tobacco smoking affected the maturation of arousal responses and whether sleeping position and infant age alters these relations. Design: Healthy term infants (13 born to mothers who did not smoke and 11 to mothers who smoked during pregnancy) were studied using daytime polysomnography on three occasions: (a) two to three weeks after birth, (b) two to three months after birth, and (c) five to six months after birth. Multiple measurements of arousal threshold in response to air jet stimulation were made in both active sleep (AS) and quiet sleep (QS) when infants slept both prone and supine. Results: Maternal smoking significantly elevated arousal threshold in QS when infants slept supine at 2-3 months of age ( $p < 0.05$ ). Infants of smoking mothers also had fewer spontaneous arousals from QS at 2-3 months in both prone ( $p < 0.05$ ) and supine ( $p < 0.001$ ) sleeping positions. In infants of non-smoking mothers, arousal thresholds were elevated in the prone position in AS at 2-3 months ( $p < 0.01$ ) and QS at 2-3 weeks ( $p < 0.05$ ) and 2-3 months ( $p < 0.001$ ). Conclusions: Maternal tobacco smoking significantly impairs both stimulus induced and spontaneous arousal from QS when infants sleep in the supine position, at the age when the incidence of sudden infant death syndrome is highest.

Full-text available at: <http://fn.bmjournals.com/current.shtml> (not U.S. Government Site)

Pollack HA, Frohna JG.

**Infant sleep placement after the Back to Sleep campaign.**

Pediatrics. 2002 Apr; 109(4): 608-614.

The Back to Sleep campaign has been credited with recent declines in the incidence of sudden infant death syndrome. Using survey data for the 1996-1998 birth cohorts, this epidemiologic study examines infant sleep position in a large, population-based sample. Data concerning infant sleep position were drawn from the 1996-1998 Pregnancy Risk Assessment Monitoring System for 15 states. Weighted multiple logistic regression analysis was used to examine correlates of infant sleep position. The prevalence of prone infant sleeping significantly declined between 1996 and 1998 (adjusted odds ratio [AOR] = 0.70; 95 percent confidence interval [CI] = [0.63, 078]). African Americans were more likely than non-Hispanic whites to sleep prone, (AOR = 1.45; 95 percent CI = 1.33, 1.59), and were less likely to sleep supine (AOR = 0.52; 95 percent CI = 0.48, 0.57). Hispanic/Latinos were less likely overall than non-Hispanic whites to sleep prone (AOR = 0.81; 95 percent CI = 0.69, 0.95), but were also less likely to sleep supine (AOR = 0.78; 95 percent CI = 0.69, 0.87). Adherence to sleep position recommended by the American Academy of Pediatrics increased sharply among Hispanic/Latino infants. Very low birth weight infants and infants in larger families were less likely to sleep in the recommended supine position. Infants born between 1001 and 1500 g (AOR = 0.57; 95 percent CI = 0.45, 0.72) were especially unlikely to sleep supine. Infants in households with more than 3 other children (AOR = 1.72; 95 percent CI = 1.08, 2.74) were more likely to sleep prone. Conclusions showed the prevalence of supine infant sleep increased between 1996 and 1998. Low adherence to sleep position recommendations of the American Academy of Pediatrics among African Americans, very low birth weight infants, and infants in large families remain public health concerns.

Full-text available at: <http://www.pediatrics.org> (not U.S. Government Site)