

# AMERICAN ACADEMY OF PEDIATRICS

Task Force on Infant Sleep Position and Sudden Infant Death Syndrome

## Changing Concepts of Sudden Infant Death Syndrome: Implications for Infant Sleeping Environment and Sleep Position

**ABSTRACT.** The American Academy of Pediatrics has recommended since 1992 that infants be placed to sleep on their backs to reduce the risk of sudden infant death syndrome (SIDS). Since that time, the frequency of prone sleeping has decreased from >70% to ~20% of US infants, and the SIDS rate has decreased by >40%. However, SIDS remains the highest cause of infant death beyond the neonatal period, and there are still several potentially modifiable risk factors. Although some of these factors have been known for many years (eg, maternal smoking), the importance of other hazards, such as soft bedding and covered airways, has been demonstrated only recently. The present statement is intended to review the evidence about prone sleeping and other risk factors and to make recommendations about strategies that may be effective for further reducing the risk of SIDS. This statement is intended to consolidate and supplant previous statements made by this Task Force.

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ABBREVIATION. SIDS, sudden infant death syndrome.

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**S**udden infant death syndrome (SIDS) is a disease of unknown cause. Despite recent decreases in the incidence of SIDS, SIDS is still responsible for more infant deaths in the United States than any other cause of death during infancy beyond the neonatal period.<sup>1</sup>

SIDS is defined as:

"The sudden death of an infant under 1 year of age, which remains unexplained after a thorough case investigation, including performance of a complete autopsy, examination of the death scene, and review of the clinical history."<sup>2</sup>

The occurrence of SIDS is rare during the first month of life, increases to a peak between 2 and 4 months old, and then declines. The following have been consistently identified across studies as independent risk factors for SIDS: prone sleep position, sleeping on a soft surface, maternal smoking during pregnancy, overheating, late or no prenatal care, young maternal age, prematurity and/or low birth weight, and male sex.<sup>3-11</sup> Blacks and American Indians have consistently higher rates, 2 to 3 times the national average. The risk factors with the greatest potential for modification include prone sleep position, sleeping on a soft surface, maternal smoking, and overheating. National campaigns aimed at re-

ducing prone sleeping have resulted in a dramatic decrease in the incidence of SIDS in the United States (Fig 1) and numerous other countries.<sup>12-17</sup> A Back to Sleep campaign was initiated in the United States in 1994, as a joint effort of the US Public Health Service, the American Academy of Pediatrics, the SIDS Alliance, and the Association of SIDS and Infant Mortality Programs (800-505-CRIB). Despite the success of the current campaign, several modifiable risk factors remain that require increased attention. The purposes of this statement are to reemphasize the importance of infant positioning for sleep as an effective modifiable risk factor for SIDS, to focus increased attention on other modifiable environmental factors, to describe complications that may have arisen from modifying risk factors, and to make recommendations about other strategies that may be effective for further reducing the risk of SIDS.

### MODIFIABLE RISK FACTORS

#### Prone Sleeping

Prone sleeping has been recognized as a major risk factor for SIDS, with odds ratios ranging from 1.7 to 12.9 in various well designed epidemiologic studies.<sup>6,14,18-21</sup> The plausibility of a causal association between prone sleep positioning and SIDS is made most compelling by the observation that in countries, including the United States, in which campaigns to reduce the prevalence of prone sleeping have been successful, dramatic decreases in the SIDS rates have occurred. The association is further strengthened by observations that in cultures in which prone sleeping is rare, SIDS rates historically have been very low.<sup>22,23</sup> In addition, several studies have documented that the statistical relationship between prone positioning and SIDS often strengthens when corrections are made for confounding variables.<sup>6,24,25</sup>

The original 1992 sleeping position recommendation from the American Academy of Pediatrics identified any nonprone position (ie, side or supine) as being optimum for reducing SIDS risk.<sup>26</sup> Subsequent studies from England<sup>11</sup> and New Zealand<sup>27</sup> have shown that side sleeping has a slightly higher risk than the supine position, although the side-sleeping position still seems to be considerably safer than prone. The higher risk for SIDS among infants placed on their sides may relate to the relative instability of this position. Although infants placed on their sides usually roll to their backs, the risk of rolling to the prone position from the side is significantly greater than rolling to the prone position from the back.<sup>11,12,28</sup>

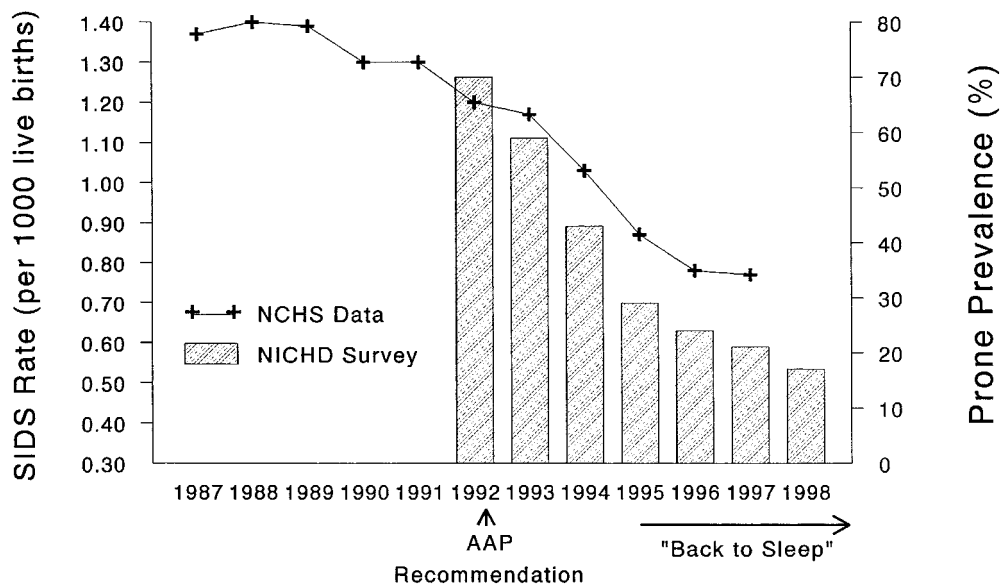
Strategies to decrease prone sleeping in the United

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The recommendations in this statement do not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

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## U.S. SIDS Rate vs Prone Prevalence



**Fig 1.** SIDS rate in the United States (line) from National Center for Health Statistics (NCHS) data and prone-positioning rate from National Institute for Child Health and Human Development (NICHD) surveys (bars). The American Academy of Pediatrics (AAP) recommendation was made at the April 1992 Spring Meeting and was published in June 1992.<sup>26</sup> The Back to Sleep campaign was begun in mid-1994.

States have included the following: 1) disseminating information to hospital nurseries and physicians, 2) targeting child care education programs, and 3) initiating public media campaigns. Although some countries have almost abolished prone sleeping,<sup>15,29,30</sup> ~20% of US infants continue to sleep prone at the highest risk age range for SIDS.<sup>12</sup> Of concern is that black infants are twice as likely to be placed prone as white infants. In addition, nearly 20% of caregivers apparently switch from placing infants in the non-prone to prone sleep position between 1 and 3 months old, the peak age range for SIDS.<sup>31,32</sup> Also, although parents may know of the recommendation, many other child caregivers, such as child care center workers, do not.<sup>33</sup> There is also some evidence that infants who are accustomed to sleeping supine are at particularly high risk for SIDS when they subsequently are placed in a prone position for sleep.<sup>34–36</sup>

### Soft Sleep Surfaces and Loose Bedding

Polystyrene bead-filled pillows were among the first soft sleep surfaces identified as contributing to the deaths of young infants<sup>37</sup> and subsequently were removed from the market following action by the US Consumer Product Safety Commission. Additional epidemiologic studies identified other soft surfaces, such as pillows, quilts, comforters, sheepskins, and porous mattresses, as a significant risk factor, particularly when placed under the sleeping infant.<sup>6,25,38–42</sup> Several reports described that in a significant number of SIDS cases, the heads of the infants, including some infants who slept supine, were covered by loose bedding. Many of these studies found loose bedding to be an epidemiologic risk factor for SIDS.<sup>11,30,36,38,40,43,44</sup>

### Overheating

There is some evidence that the risk of SIDS is associated with the amount of clothing or blankets on an infant, the room temperature, and the season of the year.<sup>6,45–48</sup> The increased risk associated with overheating is particularly evident when infants sleep prone<sup>6</sup> but is less clear when they sleep supine. It is unclear whether the relationship to clothing and climate is an independent factor or merely a reflection of the use of more clothing, quilts, and other potentially asphyxiating objects in the sleeping environment during cold weather. The SIDS statistics always have shown a distinct seasonality, with higher rates recorded during winter months. It may be that the seasonality reflects increased infections, which also are known to be more frequent during cold weather. A significant decrease has been observed in the seasonal association of SIDS as prone sleeping has decreased and SIDS rates have decreased, thus suggesting an interaction among environmental factors.

### Smoking

Maternal smoking during pregnancy has emerged as a major risk factor in almost every epidemiologic study of SIDS.<sup>9,10,49,50</sup> No intervention studies have documented a decrease in SIDS associated with a decrease in maternal smoking, although changing such behavior has been far more difficult to accomplish than changing infant sleep position. Smoke in the infant's environment after birth has emerged as a separate risk factor in a few studies,<sup>10,51</sup> although separating this variable from maternal smoking before birth is problematic.

## Bed Sharing

There are some reports of infants being suffocated by overlying by an adult, particularly when the adult is in an unnaturally depressed state of consciousness, such as from alcohol or mind-altering drugs. Co-sleeping on sofas has emerged as a major risk factor in 1 study (Peter J. Fleming, Department for Child Health, Bristol, UK, unpublished data presented at a meeting convened by US Consumer Product Safety Commission, Bethesda, MD, December 9, 1998). Others<sup>52</sup> have shown bed sharing with multiple family members in an adult bed to be particularly hazardous for the infant. Although overlying may be the mechanism in some of these cases, soft sleep surfaces, entrapment, and the likelihood of rolling to the prone position in such circumstances also may have a role. The risk of SIDS associated with co-sleeping is significantly greater among smokers.<sup>11,53-55</sup> Some behavioral studies have demonstrated that infants have more arousals and less slow-wave sleep during bed sharing,<sup>56,57</sup> but no epidemiologic evidence exists that bed sharing is protective against SIDS.

## Preterm Birth and Low Birth Weight

Infants born before term or who are low birth weight are at increased risk for SIDS, and risk increases with decreasing gestational age or birth weight.<sup>4,5</sup> The increased risk cannot be explained by a greater likelihood of apnea of prematurity among preterm SIDS victims while they are in the hospital after birth.<sup>4</sup> It is unclear whether other complications of prematurity, such as bronchopulmonary dysplasia that has been associated with SIDS, can explain a significant amount of the increased risk associated with prematurity.<sup>58</sup> There are no data suggesting that strategies designed to reduce risk in full-term infants should not also be applied to premature infants. The relationship to prone sleeping, for example, has been shown to hold for infants of low birth weight as well as for those born with a normal birth weight at term.<sup>24</sup>

## Factors Thought to Protect Against SIDS

Although several retrospective studies have demonstrated a protective effect of breastfeeding on SIDS,<sup>3,59</sup> other analyses and prospective cohort studies failed to find such an effect after adjustment for confounding variables.<sup>60-64</sup> Although breastfeeding is beneficial and should be promoted for many reasons, the Task Force believes that evidence is insufficient to recommend breastfeeding as a strategy to reduce SIDS.

Four recent studies have reported a substantially lower SIDS incidence among infants who used pacifiers than among infants who do not.<sup>11,36,65,66</sup> Although this association has been strong and consistent, it does not prove that pacifier use prevents SIDS. Mechanisms by which pacifiers might protect against SIDS have been proposed, such as stinging of the upper airway, but data are lacking to demonstrate that any of them are relevant to SIDS. Conversely, other studies have demonstrated that pacifier use can be linked to a shortened duration of

breastfeeding, increased susceptibility to otitis media, and increased dental malocclusion. The Task Force believes that additional outcome studies are required before a specific recommendation about pacifiers can be made.

## OTHER CAUSES OF INFANT DEATH SOMETIMES MISTAKEN FOR SIDS

### SIDS Among Siblings

Several studies that have evaluated SIDS among siblings have found that having a sibling who died of SIDS is a significant risk factor.<sup>4</sup> However, others have failed to find such a relationship<sup>67</sup> or have shown that siblings of infants who have died of SIDS are at risk for all causes of infant death, not just SIDS.<sup>68,69</sup> In addition, most of the studies reporting familial SIDS have the limitation of having been conducted during a period when case and scene investigations were not routine and assignment of the SIDS diagnosis may have been flawed. Thus, the true risk is unknown.

### Infanticide

The large majority of SIDS cases have no evidence of parental psychiatric disease or neglect of the infant. However, recent publications have documented that a few mothers of infants with a history of acute life-threatening events have been observed trying to harm their infants,<sup>70,71</sup> and several cases previously thought to be multiple cases of SIDS within a family<sup>72</sup> actually were cases of multiple homicide.<sup>73</sup> As the number of cases of true SIDS has decreased in recent years, the proportion of cases attributable to infanticide may be increasing.<sup>74</sup> Estimates of the incidence of infanticide among cases designated as SIDS have ranged from <1% to as much as 10%.<sup>71,75-78</sup> A thorough investigation of the case and scene is critical in every case because it improves the chances for an accurate diagnosis.<sup>79</sup> When 2 infants in the same family reportedly have died of SIDS, immediate concern should be raised about the cause of the deaths.

### Cardiac Arrhythmias

A recent publication reported that a significant number of SIDS cases in Italy had prolongation of the QT interval on a screening electrocardiogram, which may have led to a fatal cardiac arrhythmia.<sup>80</sup> However, questions about the study methods have been raised,<sup>81-88</sup> and it is unlikely that this abnormality will explain more than a small minority of SIDS cases. Despite a call to the contrary,<sup>89</sup> there seems to be little justification for a widespread program of electrocardiographic screening to identify potential SIDS victims.

## COMPLICATIONS OF NONPRONE SLEEPING

When the Academy first suggested that infants be placed for sleep in a nonprone position,<sup>25</sup> concerns were expressed that undesirable complications would ensue. Aspiration pneumonia, gastroesophageal reflux, plagiocephaly, and developmental delay were some of the feared complications.<sup>90</sup> Conversely, there is some direct and indirect evidence that in-



infants who vomit are at greater risk of choking if they are sleeping face down.<sup>91,92</sup> There is no evidence of an increase in aspiration or increased complaints of vomiting since the incidence of supine sleeping has increased dramatically.<sup>91</sup> Although gastroesophageal reflux has been reported to occur less frequently in the prone position,<sup>93-95</sup> there has been no increase in infant deaths attributable to aspiration in the United Kingdom with the change from prone to supine sleeping for infants.<sup>96</sup> Several reports have suggested an increase of occipital plagiocephaly since prone sleeping has become more frequent,<sup>97,98</sup> and there has been concern that this increase has led to an increase in unnecessary operations for craniosynostosis, perhaps secondary to a misdiagnosis of plagiocephaly as craniosynostosis (American Academy of Pediatrics, Committee on Practice and Ambulatory Medicine, Section on Plastic Surgery, and Provisional Section on Neurosurgery, Positional skull deformities, Statement in preparation). Several studies have evaluated the relationship of developmental milestones and sleep position. Attainment of gross motor milestones seems to occur slightly later in infants who sleep supine than in infants who sleep prone; however, a difference is no longer detectable by 18 months old.<sup>99,100</sup> There is some concern that caregivers may not be allowing infants to lie prone even while awake. Prone positioning when awake and observed (tummy time) is recommended for development of upper shoulder girdle strength and avoidance of occipital plagiocephaly. These reminders should become a part of routine office anticipatory guidance.

#### PROPOSED MECHANISMS OF SIDS

It is generally accepted that SIDS may be a reflection of a variety of causes of death. A leading hypothesis for a large proportion of SIDS cases is that SIDS may reflect a delayed development of arousal or cardiorespiratory control. Examinations of the brainstems of infants who died with a diagnosis of SIDS have revealed hypoplasia or decreased neurotransmitter binding of the arcuate nucleus, a region thought to be involved with the hypercapnic ventilatory response, chemosensitivity, and blood pressure responses.<sup>101,102</sup> The hypothesis is that certain infants, for reasons yet to be determined, may have a maldevelopment or delay in maturation of this region, which would affect its function and connectivity to regions regulating arousal. When the physiologic stability of such infants becomes compromised during sleep, they may not arouse sufficiently to avoid the fatal noxious insult or condition. One theory proposes that rebreathing and associated hypoxia and hypercarbia provide the noxious stimulus, while another proposes hyperthermia, perhaps in combination with asphyxia, as the stimulus. The argument has been made that prone sleep position on soft sleeping surfaces and covering of the head increase the likelihood of rebreathing, hyperthermia, or both.<sup>6,15,30,37,42,45,103-105</sup> Numerous animal and some human models have been developed to test these hypotheses.<sup>8,6,27,102,106-110</sup> In addition, protective responses to other life-threatening stimuli have been

compared in the prone and supine position. The rate of swallowing to clear the airway of stimuli to the laryngeal chemoreflex (a reflex that leads to apnea and bradycardia) is diminished in the prone position.<sup>111</sup> Arousal responses to the laryngeal chemoreflex and the baroreceptor reflex are also diminished in active sleep in the prone position.<sup>111,112</sup>

#### RECOMMENDATIONS

During the past decade, a variety of strategies have been developed that reduce the risk of SIDS. The following list includes a modification and expansion of the recommendations made by this Task Force since 1992. It should be emphasized that the recommendations are intended for sleeping infants and primarily for well infants. Individual medical conditions may warrant a physician to recommend otherwise, after weighing the relative risks and benefits.

1. Infants should be placed for sleep in a nonprone position. Supine (wholly on the back) confers the lowest risk and is preferred. However, while side sleeping is not as safe as supine, it also has a significantly lower risk than prone. If the side position is used, caretakers should be advised to bring the dependent arm forward to lessen the likelihood of the infant rolling to the prone position.
2. A crib that conforms to the safety standards of the Consumer Product Safety Commission and the ASTM (formerly the American Society for Testing and Materials) is a desirable sleeping environment for infants. (Although many cradles and bassinets also may provide safe sleeping enclosures, safety standards have not been established for these items.) Sleep surfaces designed for adults often are not free of the aforementioned hazards and may have the additional risk of entrapment between the mattress and the structure of the bed (eg, the headboard, footboard, side rails, and frame), the wall, or adjacent furniture, as well as between railings in the headboard or footboard.<sup>113</sup>
3. Infants should not be put to sleep on waterbeds, sofas, soft mattresses, or other soft surfaces.
4. Avoid soft materials in the infant's sleeping environment.
  - Soft materials or objects, such as pillows, quilts, comforters, or sheepskins, should not be placed under a sleeping infant.
  - Soft objects, such as pillows, quilts, comforters, sheepskins, stuffed toys, and other gas-trapping objects should be kept out of an infant's sleeping environment. Also, loose bedding, such as blankets and sheets, may be hazardous. If blankets are to be used, they should be tucked in around the crib mattress so the infant's face is less likely to become covered by bedding. One strategy is to make up the bedding so that the infant's feet are able to reach the foot of the crib (feet to foot), with the blankets tucked in around the crib mattress and reaching only the level of the infant's chest. Another strategy is to use sleep clothing with no other covering over the infant.

5. Bed sharing or cosleeping may be hazardous under certain conditions.<sup>54,113-115</sup>
  - As an alternative to bed sharing, parents might consider placing the infant's crib near their bed to allow for more convenient breastfeeding and parent contact.
  - If a mother chooses to have her infant sleep in her bed to breastfeed, care should be taken to observe the aforementioned recommendations (nonprone sleep position, avoidance of soft surfaces or loose covers, and avoidance of entrapment by moving the bed away from the wall and other furniture and avoiding beds that present entrapment possibilities).
  - Adults (other than the parents), children, or other siblings should avoid bed sharing with an infant.\*
  - Parents who choose to bed share with their infant\* should not smoke or use substances, such as alcohol or drugs, that may impair arousal.
6. Overheating should be avoided. The infant should be lightly clothed for sleep, and the bedroom temperature should be kept comfortable for a lightly clothed adult.<sup>11</sup> Overbundling should be avoided, and the infant should not feel hot to the touch.
7. A certain amount of tummy time while the infant is awake and observed is recommended for developmental reasons and to help prevent flat spots on the occiput. Positional plagiocephaly also can be avoided by altering the supine head position during sleep. Techniques for accomplishing this include placing the infant to sleep with the head to 1 side for a week or so and then changing to the other and periodically changing the orientation of the infant to outside activity (eg, the door of the room).
8. Although various devices have been developed to maintain sleep position or to reduce the risk of rebreathing, such devices are not recommended, because none have been tested sufficiently to show efficacy or safety.<sup>117</sup>
9. Electronic respiratory and cardiac monitors are available to detect cardiorespiratory arrest and may be of value for home monitoring of selected infants who are deemed to have extreme cardiorespiratory instability. However, there is no evidence that home monitoring with such monitors decreases the incidence of SIDS. Furthermore, there is no evidence that infants at increased risk of SIDS can be identified by in-hospital respiratory or cardiac monitoring.<sup>118</sup> There are no new data that would lead to a change in the recommendations made in the 1985 statement of the

- American Academy of Pediatrics on prolonged infantile apnea or the 1986 National Institutes of Health consensus statement on the value of home monitors.<sup>119,120</sup>
10. There is concern that the annual rate of SIDS, which has been decreasing steadily since 1992, now appears to be leveling off, as has the percentage of infants sleeping prone (Fig 1). The national campaign for reducing prone sleeping (Back to Sleep) should continue and be expanded to emphasize the safe characteristics of the sleeping environment, including safe bedding practices, and focus on the portion of the population that continues to place their infants prone. Other potentially modifiable risk factors, such as avoidance of maternal smoking, overheating, and certain forms of bed sharing, should be included as important secondary messages.

TASK FORCE ON INFANT POSITIONING AND SIDS,  
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\*It should be noted that the US Consumer Product Safety Commission is on record as opposing bed sharing by an infant and an adult, particularly if there is more than 1 adult in the bed. Many cases of infant suffocation have been reported during bed sharing.<sup>116</sup> However, it is recognized that a significant portion of the population practices bed sharing between mother and infant as a strategy to facilitate breastfeeding and that the presence of the father in the bed will be common. It is the consensus of the Task Force that there are insufficient data to conclude that bed sharing under carefully controlled conditions is clearly hazardous or clearly safe.

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## Changing Concepts of Sudden Infant Death Syndrome: Implications for Infant Sleeping Environment and Sleep Position

Task Force on Infant Sleep Position and Sudden Infant Death Syndrome

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