Sudden Infant Death Syndrome: An Update

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Sudden Infant Death Syndrome: An Update

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Educational Gap

- Although the rate of sudden infant death syndrome (SIDs) deaths has remained constant–approximately 2,300 infants annually–since 2001, many deaths that previously would have been classified as SIDS now are attributed to other sleep-related causes.
- The American Academy of Pediatrics Task Force on SIDS recently published a new Policy Statement and Technical Report providing evidence-based guidance on the other causes of sleep-related infant deaths, such as soft bedding, prone sleep position, and bed sharing.

Objectives

After completing this article, readers should be able to:

1. Discuss possible etiologic mechanisms for sudden infant death syndrome (SIDS).
2. Identify the risk factors for SIDS.
3. Discuss the American Academy of Pediatrics SIDS Task Force recommendations and underlying rationale.
4. Discuss the most common reasons for nonadherence with SIDS risk reduction recommendations.

Introduction

In 2007, *Pediatrics in Review* published a review article on sudden infant death syndrome (SIDS). (1) This article uses that article as a reference and provides an update on the topic.

What We Knew Then

Definition

SIDS is defined as a sudden unexplained death before 1 year of age. The death usually occurs in a previously healthy infant, and the cause of death remains unexplained despite a thorough case investigation, including a complete autopsy, death scene investigation, and review of the clinical history.

Epidemiology

In the United States, ~2,300 infants die of SIDS each year. Despite the success of the Back to Sleep campaign, which is associated with a steady decline in deaths from SIDS from the beginning of the campaign in 1994 up to 2000, SIDS remains the third leading cause of death in infancy and the most common cause of death between 1 month and 1 year of age. Since 2001, the SIDS rate has remained constant. In addition, the rate of other sudden unexpected infant deaths, such as suffocation, asphyxia, and other ill-defined or unspecified causes of death,

Abbreviations

ASSB: accidental suffocation and strangulation in bed
LB: live birth
OR: odds ratio
SIDS: sudden infant death syndrome

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has risen. Many deaths that previously would have been classified as SIDS are now being classified as having resulted from these other causes of death (see later in this article).

Risk factors for SIDS have been identified through epidemiologic studies. SIDS is more likely to occur in male infants, at a 3:2 ratio. Other risk factors include prone and side sleeping position, maternal smoking during pregnancy, environmental tobacco smoke, overheating, soft bedding, inadequate prenatal care, young maternal age, prematurity or low birth weight, and African American or American Indian/Alaska Native heritage.

Pathophysiology

SIDS is a polygenic, multifactorial condition, with genetic, environmental, and behavioral/sociocultural factors as contributors. Failure of arousal mechanisms likely plays an important role in the final pathway to death. Serotonin receptor abnormalities have been found throughout the ventral medulla in victims of SIDS, possibly representing a network dysfunction that affects arousal and cardiorespiratory responses. In addition, several studies have demonstrated polymorphisms in the promoter region of a serotonin transporter protein gene known as 5-HTT, with alleles that increase promoter effectiveness (resulting in reduced serotonin concentrations at nerve endings), which are found more often in infants who have died of SIDS.

Polymorphisms also have been found in other genes that may be pertinent in SIDS, such as SCN5A, a sodium channel gene that is related to a prolonged QT interval, and genes affecting autonomic nervous system development. Thus, it appears that certain infants may have a genetic predisposition to SIDS, which becomes manifest when the infant experiences some type of environmental challenge, such as prone positioning or tobacco exposure.

Risk Reduction

SIDS risk reduction strategies have focused on eliminating risk factors that are associated with SIDS in epidemiologic studies:

1. Back to sleep for every sleep.
2. Use a firm sleep surface.
3. Keep soft objects and loose bedding out of the crib.
4. Avoid tobacco smoke exposure during pregnancy and after birth.
5. Room sharing without bed sharing is recommended.
6. Consider offering a pacifier at nap time and bedtime.
7. Avoid overheating.
8. Do not use home cardiorespiratory monitors as a strategy to reduce the risk of SIDS.

What We Have Learned Since Then

Epidemiology

As mentioned, there have been increases in other causes of sudden and unexpected infant death. Largely because of advances and improved training in death scene investigation, many deaths that previously would have been classified as SIDS are now being classified as the result of other causes of sleep-related infant death. In the past 20 years, much of the decline in SIDS rates may be explained by increasing rates of these other causes of death (Fig 1). In particular, the infant mortality rate from accidental suffocation and strangulation in bed (ASSB) has quadrupled in recent years. ASSB and ill-defined or unspecified deaths are associated particularly with soft bedding, prone sleep position, and bed sharing.

There continue to be racial and ethnic disparities, not only for SIDS, but for ASSB and ill-defined or unspecified deaths. For all three conditions, non-Hispanic black infants and American Indian/Alaska Native infants have much higher mortality rates than other infants of other racial and ethnic groups. SIDS rates for non-Hispanic black infants (99/100,000 live births [LBs]) and American Indian/Alaska Native infants (112/100,000 LBs) are twice as high as those of non-Hispanic white infants (55/100,000 LBs) and almost four times those of Asian/Pacific Islander and Hispanic infants. ASSB rates for non-Hispanic black infants (32.4/100,000 LBs) and American Indian/Alaska Native infants (44.0/100,000 LBs) are more than double those of non-Hispanic white infants (12.9/100,000 LBs). Rates of infant death from ill-defined or unspecified causes for non-Hispanic black infants (47.3/100,000 LBs) and American Indian/Alaska Native infants (64.9/100,000 LBs) are also more than double those of non-Hispanic white infants (21.1/100,000 LBs).

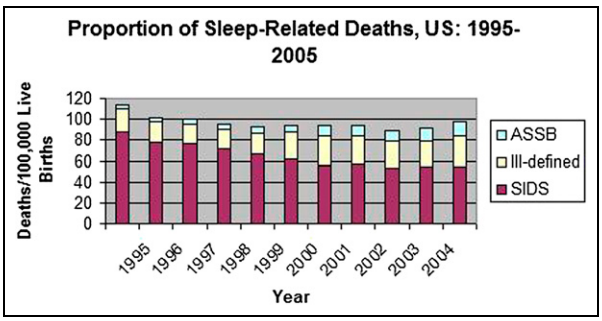

Figure 1. Proportion of sleep-related infant deaths in the United States, 1995 to 2005. Data source: Linked birth/infant death records 1995–2005 on CDC WONDER online database. US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics, Division of Vital Statistics.

Risk Reduction

The American Academy of Pediatrics (AAP) Task Force on SIDS recently published an updated policy statement (2) and technical report. (3) The reader is referred to these documents for additional details.

SLEEP POSITION. The prone position places infants at high risk for SIDS (odds ratio [OR] 2.3–13.1). The side position places infants at similarly high risk for SIDS, and indeed the population-attributable risk for the side sleep position is higher than that for the prone position. Recent studies have demonstrated the possible mechanisms by which the prone position places infants at higher risk for SIDS. There is evidence suggesting that prone sleeping results in altered autonomic control of the infant cardiovascular system during sleep, particularly at 2 to 3 months of age, and may result in decreased cerebral oxygenation. These data may provide more impetus for parents and caregivers to place infants in the supine position, because many are still reluctant to do so.

One common reason for the reluctance is fear that the infant will choke or aspirate while in the supine position; this concern is particularly true when the infant has been diagnosed with gastroesophageal reflux. It may be helpful to explain to parents that the infant's airway protective mechanisms (including the gag reflex, which is often misinterpreted as choking or aspiration) will prevent aspiration. Indeed, multiple studies in different countries have demonstrated no increased incidence of aspiration since the change to supine sleeping. Even infants with gastroesophageal reflux should be placed supine for sleep.

Parents and caregivers also will use nonsupine sleep positions if they perceive that the infant is uncomfortable or does not sleep well while supine. Infants are less likely to arouse when they are in the prone position; however, frequent awakenings in an infant should not be interpreted as being abnormal or undesirable. On the contrary, sleeping for sustained periods should be interpreted as being undesirable, because the ability to arouse from sleep is an important protective response.

BED SHARING. The AAP recommends that infants share a room with their parents without bed sharing. This arrangement has been shown to be safer than both bed sharing (when the infant sleeps on the same surface as another person) and solitary sleeping (when the infant sleeps in a separate room from the parent), and decreases the risk of SIDS by ~50%. In addition, adult beds are not designed for infant safety, and many accidental infant deaths attributable to suffocation, entrapment, asphyxia, and ill-defined or unspecified cause occur when the infant is bed sharing with another person. Infants are at highest risk of SIDS or accidental death while bed sharing during the first 3 months of life and if they are born prematurely or with low birth weight. In recent years, there has been increased concern about bed sharing among public health officials because of rising rates of infant deaths occurring during bed sharing.

The AAP believes that currently there is insufficient evidence to recommend any bed-sharing situation as safe, particularly because not all risks associated with bed sharing (such as parental fatigue) can be controlled. Specific bed-sharing situations are especially hazardous. These situations include:

- When the infant is <2 to 3 months of age, regardless of whether or not parents are smokers
- When one or both parents are smokers
- When the infant is placed on sofas, armchairs, or waterbeds (extremely soft surfaces)
- When pillows or blankets are present
- When there are multiple bed sharers (ie, other than the parents)
- When the person bed sharing with the infant is not a parent
- When the person bed sharing with the infant has consumed alcohol, medications, or illicit drugs that can affect arousal

There is currently insufficient evidence to determine whether the risk of bed sharing is increased when the adult bed sharer is obese.

There are several common reasons that induce parents to bed share with their infants. For some parents, bed sharing is the only option because of space or financial reasons. For these parents, often there are local organizations through which free or low-cost cribs or portable cribs can be obtained. For others, bed sharing facilitates feeding (both breast and formula feeding) and bonding. In addition, many parents bed share because they believe that they can best monitor and keep the infant safe that way. For some parents, the safety concerns are primarily environmental dangers, such as vermin, stray gunfire, or random kidnappings. For others, it is the belief that parental vigilance at all times will keep the infant safe, and bed sharing is viewed as a strategy to maintain vigilance while sleeping, thus keeping the infant safe.

Some parents choose to bed share specifically if they are aware that their infant's sleep behavior or environment is unsafe; for example, if the infant sleeps in the prone position. It may be helpful for clinicians to recommend room sharing without bed sharing as an option that will allow parental vigilance and easy access for feeding, bonding with, and monitoring the infant without exposing the infant to the risks associated with bed sharing.

CRIB AND BEDDING ACCESSORIES. Blankets, pillows, and other soft bedding can increase the risk of SIDS and suffocation. It is dangerous to place pillows, quilts, comforters, sheepskins, and other soft surfaces under, on top of, or close to the infant. These practices increase SIDS risk up to 21-fold, particularly when the infant is placed prone in the presence of soft bedding. Use of soft bedding also has been associated with accidental suffocation deaths. Therefore, the AAP recommends that infants sleep on a firm surface, without any soft or loose bedding in the area. Infant sleep clothing can be used in place of blankets.

Parents and caregivers frequently place blankets and pillows under, on, or close to the sleeping infant. The most frequently cited reasons for use of blankets and pillows are the perceptions that these items will make the infant sleep more comfortably (ie, the infant will fall asleep more quickly or will sleep for a more sustained period of time, or that the infant will not be cold while asleep) or will keep the infant safe from injury or falls. Pillows in particular are used to create a barrier to prevent falls or to cushion injury if the infant moves.

A qualitative study found that, although mothers were aware of the need for a firm sleep surface, they believed that they were following that recommendation if they placed padding (blankets or a pillow) in between a mattress and sheet, as long as the sheet was pulled tautly over the padding. (4)

Crib bumper pads or similar products generally are used because of the perception that they will protect the infant from injury (eg, limb entrapment between crib slats or head injury from hitting railings) and for esthetic reasons; however, there have been recent concerns about infant deaths from suffocation, entrapment, and strangulation associated with bumper pads. In addition, studies indicate that bumper pad use prevents only minor injuries. A recent study of crib injuries concluded that the risk of suffocation or strangulation far outweighed the potential benefits of preventing minor injury with bumper pad use. (5)

Parents frequently use wedges and positioning devices that are marketed as products that will decrease the risk of SIDS or gastroesophageal reflex. There is no evidence suggesting that these devices are effective against SIDS, suffocation, or gastroesophageal reflux; however, there have been reports of deaths from suffocation and entrapment associated with these devices. These devices therefore are not recommended.

It is important for providers to counsel parents and caregivers about the importance of eliminating soft bedding from the infant's sleep area. Because of the common misperception that these products will keep their infants safe, parents may unknowingly place their infants at higher risk for SIDS and accidental death when they use products such as blankets, pillows, bumper pads, and positioners.

BREASTFEEDING. Recent reports, including a meta-analysis, (6) demonstrate a protective effect of breastfeeding (nursing or pumped human milk) against SIDS, with an approximate halving of the risk when the baby is breastfed; the protective effect is even stronger when the infant is exclusively breastfed. Possible reasons for this protective effect include decreased infectious diseases (which are associated with increased risk of SIDS) and overall immune benefits. In addition, physiologic studies demonstrate that breastfed infants are more easily aroused from sleep than formula-fed infants.

Infants can be brought into the adult bed for feeding; however, after feeding, when the mother is ready to go back to sleep, the infant should be returned to his or her own sleep area (ie, crib or bassinet). In addition, because of the extremely high risk of SIDS associated with sofas and armchairs, mothers who are likely to fall asleep while nursing should not nurse on a sofa or armchair.

PACIFIERS. Multiple studies, including two meta-analyses, have found pacifier use to be associated with a decreased risk of SIDS (adjusted OR 0.39–0.48). (7)(8) The mechanism of action is unknown, but it is theorized that pacifier use may alter arousal thresholds or autonomic responses during sleep; however, the decreased risk of SIDS persists even when (as frequently occurs) the pacifier falls out of the infant's mouth after falling asleep. A recent study has demonstrated that pacifier use may positively modify the effect of adverse risk factors, such as prone positioning. (9) The AAP recommends that pacifier use be encouraged as a SIDS risk reduction strategy.

Many parents are concerned about the possible negative effect of pacifier use on breastfeeding success. Randomized clinical trials have not shown pacifier use to result in shortened breastfeeding duration, if the pacifier has been introduced after 2 to 4 weeks of age. Pacifiers can be used for breastfed infants, but they should not be introduced until breastfeeding has been well established.

ROOM VENTILATION AND FANS. One US study found that the use of a fan decreased the risk of SIDS (adjusted OR 0.28; 95% confidence interval, 0.10–0.77). (10) This study, however, was limited by having a small sample of fan users and by questions about the accuracy of parental recall. Furthermore, although one other study has demonstrated a decreased risk of SIDS if the room is well ventilated, no other studies have confirmed these findings. Therefore, there is currently no recommendation for or against fan use as a SIDS risk reduction strategy.

SWADDLING. Swaddling, or wrapping the infant in a light blanket, has been used in many cultures to calm infants and promote sleep. There has been recent interest in swaddling as a way to promote supine positioning and potentially reduce the risk of SIDS. Studies investigating the relationship between SIDS and swaddling have found an increased risk of SIDS if the infant is swaddled and placed in a nonsupine position. One study found a decreased risk of SIDS if the infant was swaddled and placed in the supine position; (11) another study found a 31-fold increase in SIDS risk when swaddled, but this study did not stratify by the sleep position in which the infant was placed. (12)

Physiologic studies have demonstrated that, in general, swaddling decreases startling, increases sleep duration, and decreases spontaneous awakenings; however, studies have been less definitive about the effects of swaddling on arousal. There is some concern that swaddling may have detrimental consequences. For example, tight swaddling (which some believe to be important if the swaddling is to have a calming effect) can reduce the infant's functional residual lung capacity and can exacerbate hip dysplasia if the hips are kept in extension and adduction. Conversely, loosely applied swaddling could result in head covering and, in some cases, strangulation if the swaddle comes undone.

The AAP has not made any recommendations for or against swaddling as a SIDS risk reduction strategy. If swaddling is to be practiced, however, care must be taken so that the swaddle is not so tight as to adversely affect respirations or exacerbate hip dysplasia, but not so loose as to create a head covering, suffocation, or strangulation risk. Furthermore, swaddled infants should never be placed in the side or prone sleep positions.

IMMUNIZATIONS. Concern has been expressed that there is an increased risk of SIDS immediately after immunizations are given. Although there is a temporal relationship between immunizations and SIDS (the incidence of SIDS is highest between 2 and 4 months of age), no data suggest a causal relationship between immunization and SIDS. In fact, several large case-control studies have demonstrated a protective effect of immunizations on SIDS. A recent meta-analysis found that immunization decreased the risk of SIDS by 46%. (13)

Education and Health Messages

Although the 1994 Back to Sleep campaign was successful initially in changing sleep position for many infants, ~25% of infants continue to sleep in the nonsupine position. It is clear that the current health messages do not resonate with some parents and caregivers. It is critical for clinicians and other health professionals to understand and address some of the barriers that parents perceive about adopting safe sleep recommendations.

For many parents, the link between safe sleep recommendations and SIDS lacks plausibility. Because SIDS is defined as death from an unknown cause, many parents do not understand how any specific behavior can protect against an entity for which the cause is unknown. In addition, many parents believe that SIDS is a random and unpreventable occurrence ("God's will") and that parental actions do not influence the ultimate outcome.

Education for parents and caregivers must go beyond distribution of the guidelines. Parents generally welcome detailed explanations about the recommendations, with attention to rationale for the recommendations and addressing of parent concerns. Indeed, educational interventions for parents, caregivers, child care providers, and health professionals are effective in altering practices with regard to sleep position and sleep environment, particularly when the interventions address caregiver concerns and misconceptions about safe sleep recommendations. For instance, education about sleep position should address concerns about aspiration, choking, and infant comfort. Education about room sharing without bed sharing should address concerns about infant safety and parental vigilance.

Health messaging is more effective if the messages are consistent. When parents and caregivers hear or see practices contrary to safe sleep recommendations, they infer that the recommendations are not important. It is critical that physicians, nurses, and other health professionals provide consistent messages.

In addition, media messages are influential in individual decisions regarding sleep position and sleep environment, including use of soft bedding and infant sleep location. One study found that 36% of pictures of sleeping infants and 64% of pictures of infant sleep environments in magazines targeted toward childbearing women portrayed unsafe sleep positions and sleep environments. (14) Media and advertising messages contrary to safe sleep recommendations may create misinformation about safe sleep practices.

Summary

Based on strong research evidence:

- **All infants should be placed in the supine position for every sleep. (15)**
- **Tobacco exposure pre- (16)(17)(18)(19)(20) and postnatally (21)(22) should be avoided.**
- **Room sharing without bed sharing is recommended. (23)(24)(25)**

- It is recommended that blankets, pillows, and other soft bedding be removed from the infant sleep area. (26)(27)
- Overheating should be avoided. (11)(28)(29)(30)
- Breastfeeding should be encouraged for SIDS risk reduction. (6)
- Pacifier use should be encouraged for SIDS risk reduction. (7)(8)
- Immunizations should be encouraged for SIDS risk reduction. (13)
- The evidence for fan use or swaddling as strategies to reduce the risk of SIDS is inconclusive.

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PIR Quiz

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1. Of the following, an epidemiologic risk factor associated with sudden infant death syndrome (SIDS) is:
   - A. Caucasian race
   - B. Female gender
   - C. Paternal alcohol use
   - D. Post-term gestation
   - E. Prone sleeping position

2. Abnormalities in the receptor for which of the following neuropeptides have been identified in the brainstem of some infants with sudden infant death syndrome:
   - A. Acetylcholine
   - B. Epinephrine
   - C. Galanin
   - D. Serotonin
   - E. Vasoactive intestinal peptide

3. An intervention recommended by the authors to reduce the risk of infant SIDS is:
   - A. Avoiding the use of pacifiers before bedtime
   - B. Home cardiorespiratory monitoring
   - C. Positioning the infant on the side
   - D. Sleeping in the same room as the infant
   - E. Swaddling the infant in a soft blanket

4. The American Academy of Pediatrics Task Force on SIDS has recommended against parents sleeping in the same bed as their infants. According to the article, which of the following factors makes bed sharing especially hazardous?
   - A. Absence of blankets
   - B. Firm bed
   - C. Infant age <3 months
   - D. Maternal age <20 years
   - E. Only 1 person sharing the bed with the infant

5. A mother of a 1-month-old infant comes in for a well-child visit. As you review the infant's immunization schedule, she tells you that one of her friends' children died of SIDS 48 hours after the infant received her 4-month diphtheria, pertussis, and tetanus vaccine. Of the following, which piece of information most accurately reflects current knowledge about immunizations and SIDS?
   - A. Infants who receive immunizations have a lower risk of SIDS.
   - B. Infants who receive immunizations have the same risk of SIDS as infants who are not immunized.
   - C. Infants who receive immunizations may have a slightly higher risk of SIDS, but the benefit of the immunization far outweighs the risk.
   - D. Only the 2-month diphtheria, pertussis, and tetanus vaccine has been associated with a slightly increased risk of SIDS.
   - E. Infants at risk of SIDS should have their *Haemophilus influenzae* vaccine series postponed until 12 months.

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