



## THE CHANGING CONCEPT OF SUDDEN INFANT DEATH SYNDROME

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Article Received on 18/07/2017

Article Revised on 08/08/2017

Article Accepted on 29/08/2017

### ABSTRACT

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 nonprone 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.

**KEYWORDS:** SIDS, AAP and Plagiocephaly.

### INTRODUCTION

SIDS is a diagnosis of exclusion and should be applied to only those cases in which an infant's death is sudden and unexpected, and remains unexplained after the performance of an adequate postmortem investigation, including:

1. An autopsy (by an experienced pediatric pathologist, if possible);
2. Investigation of the death scene and circumstances of the death;
3. Exploration of the medical history of the infant and family.

After investigation, some of these infant deaths are found to be caused by accidental suffocation, hyperthermia or hypothermia, neglect or some other defined cause.

Australia and New Zealand are shifting to the term "sudden unexpected death in infancy" (SUDI) for professional, scientific, and coronial clarity.

The term SUDI is now often used instead of sudden infant death syndrome (SIDS) because some coroners prefer to use the term 'undetermined' for a death

previously considered to be SIDS. This change is causing diagnostic shift in the mortality data.

In addition, the U.S. Centers for Disease Control and Prevention (CDC) has recently proposed that such deaths be called "sudden unexpected infant deaths" (SUID) and that SIDS is a subset of SUID.

#### Age

SIDS has a 4-parameter lognormal age distribution that spares infants shortly after birth - the time of maximal risk for almost all other causes of non-trauma infant death.

By definition, SIDS deaths occur under the age of one year, with the peak incidence occurring when the infant is at 2 to 4 months of age. This is considered a critical period because the infant's ability to rouse from sleep is not yet mature.

#### SIDS Facts

SIDS, also known as "cot death" or "crib death," is usually defined as the sudden and unexplained death, even after a careful and complete investigation, of an infant under 1 year of age.

According to the AAP, other facts about SIDS include that it:

1. Is rare during a baby's first month of life
2. Peaks when an infant is 2 to 3 months old
3. Is associated with the following risk factors:
  - a. Prone (stomach) sleeping
  - b. Babies who sleep on a soft surface, including using a pillow, soft mattress, soft bedding, etc.
  - c. Having a mother who smoked during her pregnancy
  - d. Having a mother who had late or no prenatal care
  - e. Getting overheated
  - f. Exposure to secondhand smoke
  - g. Preterm birth and/or low birth weight
  - h. Male gender
  - i. Is more common in black and American Indian and Alaska Native children
  - j. Is a little more common during colder months of the year
  - k. May be less common in babies who use a pacifier.

Another fact about SIDS, which is often not very well known, is that all commercial devices marketed to reduce the risk of SIDS, such as wedges, sleep positioners, special mattresses, and special sleep surfaces, have never been approved by the FDA to prevent SIDS.

#### **Risk Factors**

The cause of SIDS is unknown. Although studies have identified risk factors for SIDS, such as putting infants to bed on their stomachs, there has been little understanding of the syndrome's biological process or its potential causes. The frequency of SIDS does appear to be influenced by social, economic, and cultural factors, such as maternal education, race or ethnicity, and poverty. SIDS is believed to occur when an infant with an underlying biological vulnerability, who is at a critical development age, is exposed to an external trigger. The following risk factors generally contribute either to the underlying biological vulnerability or represent an external trigger:

#### **Tobacco smoke**

SIDS rates are higher for infants of mothers who smoke during pregnancy. SIDS correlates with levels of nicotine and derivatives in the infant. Nicotine and derivatives cause significant alterations in fetal neurodevelopment.

#### **Sleeping**

Placing an infant to sleep while lying on the stomach or the side increases the risk. This increased risk is greatest at two to three months of age. Elevated or reduced room temperature also increases the risk, as does excessive bedding, clothing, soft sleep surfaces, and stuffed animals. Bumper pads may increase the risk and, as there is little evidence of benefit from their use, they are not recommended.

Sharing a bed with parents or siblings increases the risk for SIDS. This risk is greatest in the first three months of life, when the mattress is soft, when one or more persons share the infant's bed, especially when the bed partners are using drugs or alcohol or are smoking. The risk remains, however, even in parents who do not smoke or use drugs. The American Academy of Pediatrics thus recommends "room-sharing without bed-sharing", stating that such an arrangement can decrease the risk of SIDS by up to 50%. Furthermore, the Academy recommended against devices marketed to make bed-sharing "safe", such as in-bed co-sleepers.

#### **Breastfeeding**

Breastfeeding is associated with a lower risk of SIDS. It is not clear if co-sleeping among mothers who breastfeed without any other risk factors increased SIDS risk.

#### **Pregnancy and infant factors**

SIDS rates decrease with increasing maternal age, with teenage mothers at greatest risk. Delayed or inadequate prenatal care also increases risk. Low birth weight is a significant risk factor. In the United States from 1995 to 1998, the SIDS death rate for infants weighing 1000–1499 g was 2.89/1000, while for a birth weight of 3500–3999 g, it was only 0.51/1000. Premature birth increases the risk of SIDS death roughly fourfold. From 1995 to 1998, the U.S. SIDS rate for births at 37–39 weeks of gestation was 0.73/1000, while the SIDS rate for births at 28–31 weeks of gestation was 2.39/1000.

Anemia has also been linked to SIDS (note, however, that per item 6 in the list of epidemiologic characteristics below, extent of anemia cannot be evaluated at autopsy because an infant's total hemoglobin can only be measured during life. SIDS incidence rises from zero at birth, is highest from two to four months of age, and declines toward zero after the infant's first year. Baby boys have a ~50% higher risk of SIDS than girls.

#### **Genetics**

Genetics plays a role, as SIDS is more prevalent in males. There is a consistent 50% male excess in SIDS per 1000 live births of each sex. Given a 5% male excess birth rate, there appears to be 3.15 male SIDS cases per 2 female, for a male fraction of 0.61. This value of 61% in the US is an average of 57% black male SIDS, 62.2% white male SIDS and 59.4% for all other races combined. Note that when multiracial parentage is involved, infant race is arbitrarily assigned to one category or the other; most often it is chosen by the mother. The X-linkage hypothesis for SIDS and the male excess in infant mortality have shown that the 50% male excess could be related to a dominant X-linked allele, occurring with a frequency of  $\frac{1}{3}$  that is protective of transient cerebral anoxia. An unprotected male would occur with a frequency of  $\frac{2}{3}$  and an unprotected female would occur with a frequency of  $\frac{4}{3}$ .

About 10 to 20% of SIDS cases are believed to be due to channelopathies, which are inherited defects in the ion channels which play an important role in the contraction of the heart.

### Alcohol

Drinking of alcohol by parents is linked to SIDS. A particular study found a positive correlation between the two during New Years celebrations and weekends.

### Epidemiology

Globally SIDS resulted in about 22,000 deaths as of 2010, down from 30,000 deaths in 1990. Rates vary significantly by population from 0.05 per 1000 in Hong Kong to 6.7 per 1000 in American Indians.

SIDS was responsible for 0.54 deaths per 1,000 live births in the US in 2005. It is responsible for far fewer deaths than congenital disorders and disorders related to short gestation, though it is the leading cause of death in healthy infants after one month of age.

SIDS deaths in the US decreased from 4,895 in 1992 to 2,247 in 2004. But, during a similar time period, 1989 to 2004, SIDS being listed as the cause of death for sudden infant death (SID) decreased from 80% to 55%. According to John Kattwinkel, chairman of the Centers for Disease Control and Prevention (CDC) Special Task Force on SIDS "A lot of us are concerned that the rate (of SIDS) isn't decreasing significantly, but that a lot of it is just code shifting".

### Prevention

A number of measures have been found to be effective in preventing SIDS including changing the sleeping position, breastfeeding, limiting soft bedding, immunizing the infant and using pacifiers. The use of electronic monitors has not been found to be useful as a preventative strategy. The effect that fans might have on the risk of SIDS has not been studied well enough to make any recommendation about them. Evidence regarding swaddling is unclear regarding SIDS.<sup>[9]</sup> A 2016 review found tentative evidence that swaddling increases risk of SIDS, especially among babies placed on their stomachs or side while sleeping.

### Sleep positioning

Sleeping on the back has been found to reduce the risk of SIDS.<sup>[5,7]</sup> It is thus recommended by the American Academy of Pediatrics and promoted as a best practice by the US National Institute of Child Health and Human Development (NICHD) "Safe to Sleep" campaign. The incidence of SIDS has fallen in a number of countries in which this recommendation has been widely adopted. Sleeping on the back does not appear to increase the risk of choking even in those with gastroesophageal reflux disease. While infants in this position may sleep more lightly this is not harmful. Sharing the same room as one's parents but in a different bed may decrease the risk by half.

### Pacifiers

The use of pacifiers appears to decrease the risk of SIDS although the reason is unclear. The American Academy of Pediatrics considers pacifier use to prevent SIDS to be reasonable. Pacifiers do not appear to affect breastfeeding in the first four months, even though this is a common misconception.

### Bedding

Product safety experts advise against using pillows, overly soft mattresses, sleep positioners, bumper pads (crib bumpers), stuffed animals, or fluffy bedding in the crib and recommend instead dressing the child warmly and keeping the crib "naked."

Blankets or other clothing should not be placed over a baby's head.

### Sleep sacks

In colder environments where bedding is required to maintain a baby's body temperature, the use of a "baby sleep bag" or "sleep sack" is becoming more popular. This is a soft bag with holes for the baby's arms and head. A zipper allows the bag to be closed around the baby. A study published in the *European Journal of Pediatrics* in August 1998 has shown the protective effects of a sleep sack as reducing the incidence of turning from back to front during sleep, reinforcing putting a baby to sleep on its back for placement into the sleep sack and preventing bedding from coming up over the face which leads to increased temperature and carbon dioxide rebreathing. They conclude in their study, "The use of a sleeping-sack should be particularly promoted for infants with a low birth weight." The American Academy of Pediatrics also recommends them as a type of bedding that warms the baby without covering its head.

### Vaccination

A large investigation into diphtheria-tetanus-pertussis vaccination and potential SIDS association by Berlin School of Public Health, Charité – Universitätsmedizin Berlin concluded: "Increased DTP immunisation coverage is associated with decreased SIDS mortality. Current recommendations on timely DTP immunisation should be emphasised to prevent not only specific infectious diseases but also potentially SIDS."

Many other studies have also reached conclusions that vaccinations reduce the risk of SIDS. Studies generally show that SIDS risk is approximately halved by vaccinations

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