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REVIEW ARTICLE

Sudden unexpected death in infancy: update and preventive measures

Muerte súbita inesperada en la infancia: actualización y medidas de prevención

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What do we know about the subject matter of this study?

Worldwide, sudden unexpected death in infancy is one of the leading causes of death in children under 1 year of age, which incidence has been significantly reduced following the introduction of the "Back to Sleep" campaign, promoting supine sleeping position.

What does this study contribute to what is already known?

This study provides an updated overview of the recently available evidence related to sudden unexpected infant death, focusing on the new terminology in use, pathophysiologic findings, and risk factors, as well as protective measures.

Abstract

Sudden unexpected death in infancy (SUDI) - defined as the death of a child under 1 year of age during sleep with no initially obvious cause - remains one of the most common causes of post-neonatal mortality. Approximately 3,500 infants die annually in the United States from sleep-related deaths. A complex and multifactorial origin is postulated in a vulnerable infant. However, the pathophysiology of SUDI has not been fully understood. Health care providers play a key role in promoting preventive measures described in the literature, which include sleeping in a supine position on a firm surface, avoiding smoking and co-sleeping, promoting breastfeeding, among others. The objective of this review is to summarize the main epidemiological and physiopathological characteristics of SUDI, and safe sleep-related factors.

Keywords:
Sudden Infant Death; Prone Position; Epidemiology; Safe Sleep; Childhood

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Introduction

The term sudden infant death syndrome (SIDS) refers to the sudden and unexpected death of an infant under 1 year of age, which apparently occurs during sleep and persists unexplained after a thorough investigation including clinical history, complete autopsy, and review of the circumstances of death[1]. This syndrome was initially defined in 1969 and has since been modified by different international expert consensuses[2].

Recently, the term sudden unexpected death in infancy (SUDI) has replaced SIDS which refers rather to those circumstances in which the cause of death is not initially apparent and therefore includes SIDS (ICD-10, code R95), but also other categories such as infections or anatomical and developmental anomalies not known before death (code R99), accidents due to unsafe sleep practices, and non-accidental injuries discovered later (code W75)[1,3].

In November 2018, the 3rd International Congress on Sudden Infant and Child Death was held at the Radcliffe Institute at Harvard University, motivated by the growing rejection of SIDS diagnosis among the medical community, which leads to a false decrease in its reporting, weakening its validity and reliability. The main recommendations proposed for the new ICD-11, to be implemented in 2022, were to change the term "SIDS" to "Sudden Unexplained Death of Infancy" in the MH11 category, avoiding the use of acronyms that can hinder its interpretation. For example, the "U" in the acronym SUDI may be confused by "unexpected", "undetermined", "unknown" or "unascertained". Likewise, the commonly used terms "unexpected", "explained", "undetermined", and "unexplained" were defined, reviewing, classifying, and recommending terminology related to the process of case determination[4].

The objective of this paper is to provide an updated literature review of recent definitions associated with the concept of SUDI, focusing on its epidemiology, pathophysiological findings, as well as risk and protective factors.

Methodology

A literature review was performed in PUBMED, LILACS, and EMBASE databases, combining the free terms and MESH: "Sudden infant death syndrome", "Bed sharing", "Prone position", "Epidemiology", "Sudden unexpected death in infancy".

The search period was between January 2000 and September 2020. Articles published in English and Spanish were included, limited to children under 1 year of age. On this basis, a total of 329 articles were reduced to 43, also excluding those in which it was not possible to access the full text of the article or there was no relationship between the article and the review. In addition, the search was extended to the references of the selected papers.

The selected articles were bibliographic reviews, clinical studies, and systematic reviews, which were analyzed by 4 authors. The final decision to include them in this review was based on the subjective decision of the authors.

Epidemiology

Historically, the growing evidence that sleep positioning was related to SIDS led the American Academy of Pediatrics (AAP) in 1992 to discourage prone positioning during sleep and subsequently to introduce the *Back to Sleep* campaign in 1994 (now *Safe to Sleep*) with the objective of to raise awareness of the major risk factors for SIDS.

This intervention marked a significant reduction in the incidence of SIDS in the United States, from 130 deaths per 100,000 live births (± 5,000) in 1990 to 35.4 deaths per 100,000 live births in 2017 (± 1400)[5,6]. In Europe, between 2005 and 2015, SUDI represented 9.7% of all deaths in children under 1 year of age, with an incidence of 34.9 per 100,000 live births, being the second most frequent cause of postneonatal mortality (death between 28 days - 11 months of life) in Eastern European countries, which is the leading cause of death in Belgium, Finland, France, and the United Kingdom[7].

In Chile, Brockmann et al. reported 1,442 cases of SIDS between 1997-2009, 81% of them were children under 2 months of age (younger than described in international literature), with a male to female ratio of 1.42:1. The national SIDS mortality rate was 0.45 per 1,000 live births, which is higher in the southern regions of Chile[8].

Globally, SUDI rates have remained virtually unchanged from 2006 to date. On the other hand, considering a greater consistency in the study of the scene of death, there has been a diagnostic shift with an increase in the incidence of deaths attributed to accidental suffocation and strangulation in bed, as well as well-defined pathology, keeping stable SUDI rates[9].

The incidence of SIDS is concentrated in the first 6 months of life, with a maximum between 2 and 4 months, affecting families of all social, economic, and ethnic groups. There is a higher incidence described in children born to mothers with inadequate prenatal care, mothers who smoked during pregnancy, male newborns (male:female ratio 3:2), prone and lateral position during sleep, preterm or low birth weight

newborns, and some ethnic groups such as Native Americans and non-Hispanic white infants[10].

SIDS is currently the fourth leading cause of death in infants in the United States and the leading cause in infants aged between 1 month and 1 year, with more than 1,300 deaths per year (0.35 deaths per 1,000 live births)[11].

The increased recognition of infant deaths related to suffocation and strangulation during sleep prompted the AAP to update its recommendations and focus on a safe sleep environment and not just SIDS[12].

Physiopathology

Considering that SIDS is a diagnosis by exclusion, there has been thorough research in the mechanisms that may underlie the known risk factors, in which the multifactorial origin is the most likely.

The most widely accepted model is the triple risk hypothesis which proposes that possibly SIDS can be triggered when a vulnerable infant, such as a preterm newborn or one exposed to maternal smoking, is in a critical and unstable period of homeostatic control development (2 to 4 months) and is exposed to an exogenous stress factor, such as prone positioning during sleep. The model proposes that SIDS could lead to death only if it meets these 3 factors. The final pathway of SIDS is largely related to the immaturity of cardiorespiratory control along with a failure of the arousal mechanism[13].

Numerous physiological studies support this hypothesis, suggesting a possible organ fragility in the arousal pathway, particularly in the periaqueductal gray matter of the midbrain, which is related to an autonomic arousal response. This autonomic response occurs in the ascending cholinergic pathways and the pedunculopontine tegmental nucleus (PTN). The PTN provides acetylcholine to the midbrain, and its deficiency could cause an imbalance in the monoaminergic and cholinergic systems in SIDS victims[14].

On the other hand, extrinsic factors are an environmental trigger to the vulnerable infant. The prone position remains the most important risk factor for SIDS by increasing the possibility of rebreathing of exhaled air, suffocation, overheating, and altered arousal mechanism[1,2,3,5]. Table 1 details the main pathophysiological mechanisms proposed.

Table 1. Physiopathology of SIDS[1,2,3,5]

Mecanism	Finding	Suggested physiopathology
Asphyxia	Autopsy finding of pulmonary edema	Rebreathing of exhaled carbon dioxide, potentially leading to hypercarbia and hypoxia
	Elevated levels of vascular endothelial growth factor, lactate and erytropoietin as a signs of chronic hypoxia	Decreased surfactant
		Decreased lung capacity and compliance which may lead to chronic hypoxia
Failure of the arousal mechanism	Higher arousal thresholds in prone sleeping position	Failure of the arousal mechanism to trigger the distressed infant to wake up
Decreased autonomic regulation	Elevated levels of 5- hydroxytryptamine metabolites, lower densities of serotonin receptor binding sites, polymorphism in the serotonin transporter protein 5-HTT	Impaired neuroexcitatory effect in the ventrolateral medulla
		Increased promoter activity of the transporter decreasing extracellular serotonin concentrations and reducing available concentrations at the synapse
	Impaired levels of neuropeptide orexin	Impaired thermostasis and cardiac rhythm dysregulation
		Failure of the arousal mechanism secondary to immunogenicity to orexin
Neuronal Inmaturity	Significant decreased neuronal nuclear antigen	Unknow
	Alteration in the myelination of neurons	
	Increased cell death rate in brainstems	
Cardiac Arrhytmias	Alterations in SCN5A	Prolonged QT syndrome secondary to sodium channelopathy
Infections	Increased interferon-γ and interleukin-6	Impaired cytokine response and inmune modulation in the central nervous system
	Higher probability to be colonized with S aureus in the respiratory tract of infant sleeping in prone position	

SIDS: Sudden infant death syndrome

Risk And Protective Factors

Knowledge regarding risk and protective factors comes mainly from case-control studies, which can determine associations but are not able to establish causality. Table 2 summarizes the main factors related to SIDS.

Sleeping position

In 1965, the first associations between SIDS and prone position were identified and subsequently confirmed by multiple case-control studies in Europe, Australia, and New Zealand. In the 1980s, multiple studies demonstrated that sleeping in the prone position increased the risk of SIDS by approximately 10 times[1,3].

The prone position is associated with an increased risk of hypercapnia with subsequent hypoxia, decreased cerebral oxygenation, increased body temperature, altered autonomic control of cardiovascular function, and increased arousal threshold[15,16]. The risk of developing sudden death by sleeping in prone (OR: 2.6 95% CI 1.5 - 4.5) and lateral position (OR: 2.0 95% CI 1.2 - 3.4) are similar since the instability of the lateral position has a high probability of turning towards the prone position[17]. A higher probability of placing the infant in the prone or lateral decubitus position has been described in new caregivers, as well as in nurseries where they tend to change the position of infants accustomed to supine sleep position[18].

Some parents have expressed concern about the possible risk of choking when the infant sleeps in the supine position. However, the anatomy of the airway and its relationship to the esophagus makes choking less likely in this position. This is because by lying in the supine position, the airway will be above the esophagus allowing any regurgitation to be quickly swallowed, thus avoiding aspiration[1,19].

In Chile, a pilot study conducted on 100 infants under 45 days of age showed that 80% sleep in the supine position and 20% in the prone or lateral position, with a co-sleeping rate of 30%. 90% of the families had received information on safe sleep measures, making this the main predictor of sleeping in the supine position[20].

Table 2. Risk and Protective Factors associated with SIDS

Factors	Odds ratio (95% confidence interval)
Risk Factors	
Birth before 37 week´s gestation[2]	11.67 (1.84 – 74.14)
Bed sharing at less than 12 weeks of age[23]	10.37 (4.44 – 24.21)
Bed sharing with a smoking mother[23]	6.27 (3.94 – 9.99)
Soft bedding[25]	5.1 (3.1 – 8.3)
Bed sharing[23]	2.89 (1.99 – 4.18)
Prone sleeping position[17]	2.6 (1.5 – 4.5)
Household smoke exposure[29]	2.44% (2.31 – 2.57)
Side sleeping[17]	2.0 (1.2 – 3.4)
Black race[9]	1.96 (NA)
Male sex[11]	1.7 (NA)
Poverty[2]	1.24 (1.15 – 1.34)
Protective factors	
Exclusive breastfeeding at one month of age[32]	0.6 (0.44-0.82)
Pacifier use[35]	0.5 (ND)

ND: Not available. SIDS: Sudden infant death syndrome

Bed Sharing

Case-control studies have shown that sleeping on the same surface next to another person is associated with an increased risk of SIDS and may be the most important risk factor in infants under 4 months of age[21]. This is due to the use of soft mattresses, the increased risk of overdressing the child, and the possibility of rolling over and covering the infant during sleep. On the other hand, advising against it may be controversial since bed sharing favors breastfeeding, which is a known protective factor for SIDS[22]. Considering the above, room sharing, i.e., sleeping close to the infant allowing adequate observation, being able to hear and touch the infant, without sharing the same bed, seems to be the most appropriate measure[1]. Additionally, the risk of death when sharing the same bed is higher when one of the parents is a smoker, the mother smoked during pregnancy, the newborn is premature or with low-birth-weight, the adult consumes alcohol or does drugs that alter arousal mechanisms, the infant sleeps on a sofa, the bed is soft, bed sharing is during the whole night, and if the infant is less than 11 weeks old[23,24].

Soft Bedding

When assessing the death scene, up to 25% of infant SIDS victims have their heads covered by bedding[25]. The use of soft bedding (blankets, pillows, sheepskins) and sleep positioners in the sleep environment has been associated with up to 5 times increase in the risk of SIDS regardless of sleeping position and more than 20 times if the infant sleeps in the prone position. In addition, sleep positioners predispose to an increased risk of overdressing, rebreathing, and can cover the head during sleep[26].

Studies have shown that the use of soft bed linens is the most important risk factor in children older than 4 months, as they can turn towards these surfaces but are unable to free themselves from them[21].

Although it is safer for an infant to sleep without a blanket, if blankets are used, they should be thin and infants should have their feet touching the lowest part of the crib, with the bed cover under the armpits.

Although this practice seems logical, as observed in cases of infants not affected by SIDS in case-control studies, there are still no studies that support it as a protective strategy[2].

Recently, the use of sleeping bags has been recommended by some SIDS organizations. A sleeping bag could be considered safe if it does not allow the infant to slide into it, nor does it allow the infant's head to be covered. The bag should be the correct size for each infant, with an adjustable collar and sleeves to keep the infant warm, but without a hood. However, there is little evidence that demonstrates a protective effect[27].

The practice of swaddling is used to help the infant fall asleep. If it is performed, it should be done with the infant in the supine position and should be discontinued immediately at any sign that the infant can turn. A recent meta-analysis assessed that the highest risk of SIDS is when placing the infant in the prone position (OR = 12.99 CI 95% 4.14 - 40.77), followed by the side position (OR = 3.16 CI 95% 2.08 - 4.81), and supine position (OR = 1.93 CI 95% 1.27 - 2.93). There is evidence to suggest that the risk of SIDS with this practice increases with age, doubling in those older than 6 months[28].

Maternal smoking

Numerous studies have shown that cigarette smoke can increase the risk of SIDS by up to 5 times. In a recent study, Anderson et al. analyzed the CDC infant mortality database between 2007 and 2011 demonstrating a linear increase in the risk of SIDS with smoking during pregnancy, which doubles smoking one cigarette per day (adjusted OR 1.98, 95% CI 1.73 - 2.28), and increasing by 0.07 for each smoked cigarette after the 1st one[29]. In addition to the reduction of lung distensibility and volumes, *in utero* exposure has a neurotoxic effect, leading to an alteration of the arousal mechanism and a decrease in heart rate variability in response to stress, which alters the capacity to respond to the environment[30].

Although it is difficult to separate the consequences of environmental exposure to cigarette smoke in infants from prenatal exposure, its influence on lung function and an increased risk of SIDS is also described as a dose-dependent effect[3].

A Chilean study estimated that prenatal smoking was related to 40% of all SIDS cases[31]. Therefore, parents, and especially the mother, should be encouraged to stop smoking completely during pregnancy and after delivery and not allow anyone to smoke in the environment surrounding the infant.

Prematurity

Prematurity and low birth weight increase the risk of SIDS by 4 times compared with term infants and the risk is inversely proportional to gestational age. This is largely due to an immature autonomic system, leading to altered arousal mechanisms and increased hypercapnia[32]. Despite prematurity is associated with apneas, there is no evidence that these apneas precede SIDS, so baby monitors are not routinely recommended in the prevention of SIDS[12].

Preterm infants are at equal or higher risk of being laid in the prone position, probably as a continuation of what is observed by parents in neonatal units. It is recommended that preterm infants be positioned supine as soon as clinically stable, preferably from 32 weeks postmenstrual age, in order to habituate the parents before hospital discharge[33].

Breastfeeding

Breastfeeding has a protective effect against SIDS. A recent meta-analysis which evaluated individual data from 8 case-control studies, with a total of 2,267 cases, demonstrated that breastfeeding of ≥ 2 months duration was a protective factor. There was a directly proportional relationship between the duration of breastfeeding and the degree of protection from SIDS[34].

Immunizations

Case-control studies and analyses of vaccine adverse event reports in the United States have not demonstrated a positive effect of immunizations in the prevention of SIDS[3]. However, a meta-analysis found that the risk of SIDS decreases by as much as 50% by adequately following a vaccination schedule, especially diphtheria-tetanus-pertussis (DTP) vaccine and oral polio vaccines[35]. Increased DTP coverage is inversely related to mortality from SUDI, with an incidence reduction rate of 0.92 per 100,000 for every 10% increase in population coverage[36]. Therefore, the subsequent fear of developing SIDS can never be an argument against regular immunization.

Pacifier use

Although its protective mechanism is unclear, its use is thought to promote arousal mechanisms, increase blood pressure during sleep, and improve autonomic control of heart rate. A recent literature review analyzed 59 publications, including 11 observational papers and 3 meta-analyses, demonstrating up to a 50% reduction in the risk of SIDS without interfering with the beginning of breastfeeding[37]. However, a 2017 Cochrane review found no selectable randomized studies to establish recommendations[38]. The AAP recommends its use whenever breastfeeding is fully established and at the time the infant is positioned for sleep without the need to reinsert it if it falls out of the mouth or force its use if the infant refuses[12].

The AAP expert guideline published in 2016 upda-

Table 3. Summary of AAP recommendations for Safe Sleep with SORT[37]

Recommendation	SORT by letter grave
Back to sleep for every sleep	A
Use of firm sleep surface	A
Breastfeeding	A
Room-sharing without bed-sharing	A
Avoid loose bedding	A
Offer pacifier at naptime and bedtime	A
Avoid smoke exposure during pregnancy and after birth	A
Avoid alcohol and illicit drug use	A
Avoid overheating	A
Regular prenatal care	A
Routine inmunization	A
Health care providers should endorse the SIDS risk-reduction recommendations from birth	A
Supervised and awake tummy time	B
Avoid use of commercial devices inconsistent with safe sleep recommendations	B
Avoid swaddling	C

SORT: strength of recomendation taxonomy. SIDS: Sudden infant death syndrome

tes recommendations aimed at reducing sleep-related deaths in infants, including SIDS. These are based on case-control studies in infants younger than 1 year and the strength of recommendation is based on the Strength of Recommendation Taxonomy (SORT) system. Table 3 describes the summary of the recommendations[12].

SIDS, apparent life-threatening events (ALTE), and brief resolved unexplained events (BRUE)

Except for the previously mentioned factors, there is no way to predict which infant will die from SIDS[39]. To date, ALTE/BRUE are not related to SIDS, where maternal smoking is the only risk factor that the two conditions have in common[40]. Studies searching for a relationship between ALTE and SIDS have determined that only 4-13% of SIDS patients have history of apnea, slightly higher than in controls[40,41]. Currently, the routine use of baby monitors is not recommended, as they are not beneficial in the prevention of SIDS[12].

Sudden unexpected postnatal collapse, SUDI, and skin-to-skin practice

Sudden unexpected postnatal collapse (SUPC) includes both cases of severe ALTE and SUDI that occur during the first week of life and corresponds to approximately 5% of the total. Regarding skin-to-skin practice, it refers to placing the naked newborn in the prone position on the mother's chest immediately or shortly after birth[42].

Multiple case series of SUPC related to suffocation or entrapment have been reported in apparently healthy newborns during skin-to-skin practice in the prone position, mainly during the first 2 hours of life. The AAP suggests that the way to perform safe skin-to-skin is to maintain visual contact between the newborn and the mother, place the newborn in a sniffing position, with shoulders and torso facing the mother, avoid covering the nose and mouth, turn the head to the side, avoid cervical flexion, and maintain continuous monitoring by health personnel in the delivery room and regularly in the postpartum period, allowing the mother to sleep, by placing the newborn in the crib and under the supervision of another alert and awake person[43].

Conclusions

SUDI is a complex and multifactorial disorder that requires continued study to establish its pathophysiological basis and interactions leading to infant vulnerability, critical periods of development, and environmental risk factors. To date, epidemiological variables, along with various evidence-based interventions, have reduced its incidence. Although it is unlikely to completely eliminate the risk of SUDI, it is hoped that with proper education and implementation of safe sleep measures, starting from the hospital to the home, this risk can be reduced as much as possible.

Health personnel must deliver a consistent message without contradictions, based on published recommendations. Particularly important are the recommen-

dations related to sleeping in the supine position on a firm surface, avoiding exposure to cigarette smoke, favoring breastfeeding, and avoiding bed sharing , as well as those without evidence, such as the use of home apnea monitors.

Finally, future research should focus on how pathophysiological variables alter the typical physiological response, as well as on establishing the best and most effective ways to carry out educational campaigns for the population.

Conflicts of Interest

Authors declare no conflict of interest regarding the present study.

References

1. Horne R. Sudden infant death syndrome: current perspectives. Intern Med J. 2019;49(4):433-8.
2. Adams S, Ward C, Garcia K. Sudden infant death syndrome. Am Fam Physician. 2015;91(11):778-83.
3. Carlin R, Moon R. Risk Factors, Protective Factors, and Current Recommendations to Reduce Sudden Infant Death Syndrome: A Review. JAMA Pediatr. 2017;171(2):175-80.
4. Goldstein R, Blair P, Sens M, et al. Inconsistent classification of unexplained sudden deaths in infants and children hinders surveillance, prevention and research: recommendations from The 3rd International Congress on Sudden Infant and Child Death. Forensic Sci Med Pathol. 2019;15(4):622-8.
5. Goldberg N, Rodriguez-Prado Y, Tillery R, et al. Sudden Infant Death Syndrome: A Review. Pediatr Ann. 2018;47(3):e118-e123.
6. Center for Disease Control and Prevention. About sudden unexpected infant death and sudden infant death syndrome. https://www.cdc.gov/sids/data.htm. Consultado en Julio, 2020.
7. de Visme S, Chalumeau M, Levieux K, et al. National Variations in Recent Trends of Sudden Unexpected Infant Death Rate in Western Europe. J Pediatr. 2020;226:179-85.
8. Brockmann P, Oyarzún M, Villarroel L, et al. Síndrome de muerte súbita del lactante: prevalencia y cambios en los últimos años en Chile. Rev Med Chile. 2013;141(5):589-94.
9. Matthews T, MacDorman M, Thoma M. Infant Mortality Statistics From the 2013 Period Linked Birth/Infant Death Data Set. Natl Vital Stat Rep. 2015;64(9):1-30.
10. Heron M. Deaths: Leading Causes for 2014. Natl Vital Stat Rep. 2016;65(5):1-96.
11. US Center for Disease Control and Prevention. Infant deaths: linked birth/infant death records. https://wonder.cdc.gov/lbd.html. Consultado en Julio, 2020.
12. Moon R; task force on sudden infant death syndrome. SIDS and Other Sleep-Related Infant Deaths: Evidence Base for 2016 Updated Recommendations for a Safe Infant Sleeping Environment. Pediatrics. 2016;138(5):e20162940.
13. Filiano J, Kinney H. A perspective on neuropathologic findings in victims of the sudden infant death syndrome: the triple-risk model. Biol Neonate. 1994;65(3-4):194-7.
14. Sawaguchi T, Franco P, Kato I, et al. From physiology to pathology: arousal deficiency theory in sudden infant death syndrome (SIDS)--with reference to apoptosis and neuronal plasticity. Forensic Sci Int. 2002;130 Suppl:S37-S43.
15. Kanetake J, Aoki Y, Funayama M. Evaluation of rebreathing potential on bedding for infant use. Pediatr Int. 2003;45(3):284-9.
16. Wong F, Witcombe N, Yiallourou S, et al. Cerebral oxygenation is depressed during sleep in healthy term infants when they sleep prone. Pediatrics. 2011;127(3):e558-e565.
17. Li D, Petitti D, Willinger M, et al. Infant sleeping position and the risk of sudden infant death syndrome in California, 1997-2000. Am J Epidemiol. 2003;157(5):446-55.
18. Moon R, Patel K, Shaefer S. Sudden infant death syndrome in child care settings. Pediatrics. 2000;106(2 Pt 1):295-300.
19. Jeffery H, Megevand A, Page H. Why the prone position is a risk factor for sudden infant death syndrome. Pediatrics. 1999;104:263-9.
20. Sanchez T, Peirano D, Pipino C, et al. Bad Sleeping habits in infants: risk factors for sudden infant death syndrome. Rev Chil Pediatr. 2020;91(4):529-35.
21. Colvin J, Collie-Akers V, Schunn C, et al. Sleep environment risks for younger and older infants. Pediatrics. 2014;134(2):e406-e412.
22. Hauck F, Thompson JM, Tanabe K, et al. Breastfeeding and reduced risk of sudden infant death syndrome: a meta-analysis. Pediatrics. 2011;128(1):103-10.
23. Carpenter R, Irgens L, Blair P, et al. Sudden unexplained infant death in 20 regions in Europe: case control study. Lancet. 2004;363(9404):185-91.
24. Vennemann M, Hense H, Bajanowski T, et al. Bed sharing and the risk of sudden infant death syndrome: can we resolve the debate? J Pediatr. 2012;160(1):44-8.e2.
25. Blair P, Mitchell E, Heckstall-Smith EM, et al. Head covering - a major modifiable risk factor for sudden infant death syndrome: a systematic review. Arch Dis Child. 2008;93(9):778-83.
26. Hauck F, Herman S, 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;111(5 Pt 2):1207-14.
27. Finlay F. Can infant sleeping bags be recommended by medical professionals as protection against sudden infant death syndrome? Arch Dis Child. 2019;104(3):305-7.
28. Pease A, Fleming P, Hauck F, et al. Swaddling and the risk of sudden infant death syndrome: a meta – analysis. Pediatrics 2016; 137:e20153275.
29. Anderson T, Lavista Ferres J, Ren S, et al. Maternal Smoking Before and During Pregnancy and the Risk of Sudden Unexpected Infant Death. Pediatrics. 2019;143(4):e20183325.
30. Richardson H, Walker A, Horne R. Maternal smoking impairs arousal patterns in sleeping infants. Sleep. 2009;32(4):515-21.
31. Cerda J, Bambs C, Vera C. Infant morbidity and mortality attributable to prenatal smoking in Chile. Rev Panam Salud Publica. 2017;41:e106.
32. Ostfeld B, Schwartz-Soicher O, Reichman N, et al. Prematurity and sudden unexpected infant deaths in the United States. Pediatrics 2017;140: e20163334.
33. American Academy of Pediatrics Committee on Fetus and Newborn. Hospital discharge of the high-risk neonate. Pediatrics. 2008;122(5):1119-26.
34. Thompson J, Tanabe K, Moon R, et al. Duration of Breastfeeding and Risk of SIDS: An Individual Participant Data Meta-analysis. Pediatrics. 2017;140(5):e20171324.
35. Vennemann M, Höffgen M, Bajanowski T, et al. Do immunisations reduce the

risk for SIDS? A meta-analysis. Vaccine. 2007;25(26):4875-9.
36. Muller-Nordhorn J, Hettler-Chen C, Keil T, et al. Association between suddent infant death syndrome and diphtheria-tetanus-pertussis inmunisation: an ecology study. BMC Pediatr. 2015;15(1):1.
37. Alm B, Wennergren G, Möllborg P, et al. Breastfeeding and dummy use have a protective effect on sudden infant death syndrome. Acta Paediatr. 2016;105(1):31-8.
38. Psaila K, Foster JP, Pulbrook N, et al. Infant pacifiers for reduction in risk of sudden infant death syndrome. Cochrane Database Syst Rev. 2017;4(4):CD011147.
39. Tieder J, Altman RL, Bonkowsky J, et al. Management of apparent life-threatening events in infants: a systematic review. J Pediatr. 2013;163(1):94-9.e96.
40. Behnam-Terneus M, Clemente M. SIDS, BRUE, and Safe Sleep Guidelines. Pediatr Rev. 2019;40(9):443-55.
41. Zenteno Araos D, Díaz Silva J, Brockmann Veloso P. Aplicación de una nueva terminología "BRUE: eventos breves, resueltos e inexplicados". Definiciones y recomendaciones. Rev Chil Pediatr. 2020;91(3):424-31.
42. Herlenius E, Kuhn P. Sudden unexpected postnatal collapse of newborn infants: a review of cases, definitions, risks, and preventive measures. Transl Stroke Res. 2013;4(2):236-47.
43. Feldman-Winter L, Goldsmith J; Committee on Fetus And Newborn; Task Force on Sudden Infant Death Syndrome. Safe Sleep and Skin-to-Skin Care in the Neonatal Period for Healthy Term Newborns. Pediatrics. 2016;138(3):e20161889.