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Association Between Sudden Infant Death Syndrome and Prone Sleep Position, Bed Sharing, and Sleeping Outside an Infant Crib in Alaska

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ABSTRACT. *Objective.* To determine the contribution of prone sleeping, bed sharing, and sleeping outside an infant crib to sudden infant death syndrome (SIDS).

Methods. We conducted a retrospective descriptive study of all SIDS cases in Alaska from January 1, 1992, through December 31, 1997. Reviewed data sources included maternal and infant medical records, autopsy reports, birth and death certificates, police and state trooper death scene investigations, and occasionally home interviews.

Results. The death certificate identified SIDS as a cause of death for 130 infants (cause-specific infant mortality rate: 2.0 per 1000 live births). Among infants for whom this information was known, 113 (98%) of 115 were found in the prone position, sleeping outside an infant crib, or sleeping with another person. By contrast, 2 (1.7%) were found alone and supine in their crib (1 of whom was found with a blanket wrapped around his face). Of 40 infants who slept with a parent at the time of death, only 1 infant who slept supine with a non-drug-using parent on an adult nonwater mattress was identified.

Conclusion. Almost all SIDS deaths in Alaska occurred in association with prone sleeping, bed sharing, or sleeping outside a crib. In the absence of other risk factors, SIDS deaths associated with parental bed sharing were rare. *Pediatrics* 2001;108:923–927; *Alaska, bed sharing, drug use, prone sleeping, sudden infant death syndrome.*

ABBREVIATIONS. SIDS, sudden infant death syndrome; AMIMR, Alaska Maternal-Infant Mortality Review; CI, confidence interval.

Sudden infant death syndrome (SIDS) has been defined as “the sudden death of an infant less than 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.”¹ A variety of factors, including parental drug use and infant physiologic abnormalities, have been implicated in SIDS.^{2–6} More recently, investigators have identified associations between SIDS and prone sleeping position,^{7,8} bed sharing with an adult,^{9–13} and inappropriate bedding.^{13–16} Despite these ad-

vances in the understanding of SIDS, the individual and collective contribution of multiple sleep-related risk factors for a statewide cohort of infant deaths remains undetermined. This information is important for designing, funding, and estimating the impact of public health interventions.

For the current study, we hypothesized that in Alaska (where SIDS rates are consistently among the highest in the United States^{17,18}), regardless of the presence of other risk factors, the majority of SIDS deaths occurred in association with prone sleeping position, sleeping with another person, or sleeping outside an infant crib. To test this hypothesis, we conducted a retrospective descriptive analysis of medical and other records collected as part of the Alaska Maternal-Infant Mortality Review (AMIMR) for infant deaths that occurred from January 1, 1992, through December 31, 1997.

METHODS

Data Sources

Our data source consisted of all records gathered as part of the AMIMR process. Infant deaths were identified through matched birth and death certificates from the Bureau of Vital Statistics. For each infant, a file was created that included birth and death certificates, infant and maternal medical records, autopsy reports, police and state trooper death scene investigations, and, if agreed to by the guardians of the deceased child, a home interview. Trained public health nurses conducted home interviews. Occasionally, the home interview provided the only source of information for sleep-related or other risk factors; usually, though, home interviews were either redundant or not available. Data from each of these sources were abstracted using a standard form and entered into a computer database.

Unlike infant mortality reviews conducted by most other states, AMIMR attempts to identify, collect information for, and review all—rather than a subset of—resident infant deaths. For the current study, 97% of the known deaths were included. The remaining deaths were excluded because complete medical records were not available, usually because the deaths occurred in another state or because of pending litigation.

Case Identification

An infant was considered to have died of SIDS when the death certificate reported SIDS as the underlying or a contributing cause of death. We identified cases by reviewing death certificates for all infant deaths that occurred during the study period.

Background Characteristics of SIDS Cases

To provide a context for our investigation, we evaluated several factors associated with SIDS by other investigators, including maternal characteristics, infant physiologic abnormalities, and parental drug use. We determined the risk of SIDS associated with maternal demographic characteristics—including age, Alaska Native status, and educational attainment—by comparing birth certificate information for cases with all other live births in Alaska using a birth file provided by the Alaska Bureau of Vital Statistics.

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Infant physiologic abnormalities included only substantial abnormalities, such as congenital anomalies, serious infections, and low birth weight. It was not known whether any of these abnormalities was necessary or sufficient to cause death. We present them here because previous studies documented an association between some abnormalities and SIDS deaths. Minor anomalies and mild infections, such as upper respiratory tract infection or mild gastroenteritis, were not included.

Parental drug use included prenatal or postnatal tobacco cigarette, alcohol, or illicit substance use. Because information on drug use was rarely available for caregivers other than parents, we limited this part of the analysis to infants who died while under parental care. Few of the records quantified the amount of drug use, so this information was not included. The medical records generally documented alcohol use only when it involved binge or chronic drinking, but this was not necessarily the case for every record.

Sleep-Related Factors

We determined the presence at the time of death of 3 sleep-related risk factors: infant sleep position, bed type, and the presence of other people in the infant's bed (bed sharing). Alaska is implementing a standard infant death scene investigation reporting form. At the time of the study, however, no standard form was used. Despite this limitation, for most SIDS cases information on the 3 risk factors of interest was available from the death scene investigation, home interview, or emergency department records. Infant sleep position was identified at the time the infant was found because the position when put down to sleep usually was not available and because the position at the time that the infant was found may reflect more accurately the position at the time of death. Because of the historically high SIDS rates among Alaska Natives, we present the prevalence of sleep-related risk factors by Alaska Native status.

Statistical Analysis

Rate ratios and their associated Taylor series 95% confidence intervals (CI) and exact 95% CIs for proportions were calculated with EpiInfo version 6.04 computer software (Centers for Disease Control and Prevention, Atlanta, GA).

RESULTS

Background Characteristics of SIDS Cases

Between January 1, 1992, and December 31, 1997, 501 Alaska resident infant deaths occurred (infant mortality rate: 7.9 per 1000 live births). Of the 488 deaths included in the study database, the death certificate reported the cause of death as SIDS for 130 (SIDS-specific infant mortality rate: 2.0 per 1000 live births). An autopsy was performed for 128 infants with 12 different pathologists completing the death certificates. Compared with other live births in Alaska, infants who died of SIDS were more likely to

have mothers who were young, poorly educated, and of Alaska Native race (Table 1).

Of the 130 infants for whom the death certificate listed SIDS as a cause of death, 29 (22%) had 1 or more substantial physiologic abnormalities. Sixteen infants were born at <2500 g, 6 had pneumonia identified at autopsy, 3 had congenital heart disease identified at autopsy (1 infant each had an anomalous right coronary artery, ventricular septal defect, or pulmonary artery stenosis with right ventricular hypertrophy), and 1 infant each had an unspecified neurologic disorder, urinary tract infection, massive cerebral edema, severe malnutrition associated with renal anomalies, and severe malnutrition alone. For 4 infants, the death certificate reported 1 of the physiologic abnormalities described above, as well as SIDS, as a cause of death. Among Alaska Natives, 24% had a substantial physiologic abnormality compared with 19% of non-Natives.

Among infants who died of SIDS, parental drug use was common, including cigarette smoking (61% of infants), alcohol use (29%), and illicit substance use (15%); overall, 68% of infants had a parent with a documented history of any drug use. Most of the documented drug use occurred among mothers. Paternal drug use was documented for 8% of infants; paternal drug use in the absence of maternal drug use was documented for 1 infant. Among Alaska Natives, 94% of SIDS deaths occurred in association with a documented record of parental drug use, including 66% with a record of parental alcohol or illicit substance use. This compares with 50% and 19%, respectively, for non-Natives.

Sleep-Related Risk Factors

Bed Type

Among 114 infants for whom bed type was known, 32% slept in an infant crib, 43% slept on an adult nonwater mattress, and the remainder slept on another surface (Table 2). Additional description of the specific type of adult nonwater mattresses used was not available. Most children who slept outside an infant crib slept with 1 or more other people, usually a parent. Among Alaska Natives, 82% slept outside an infant crib at the time of death compared with 59% of non-Natives.

TABLE 1. SIDS-Specific Infant Mortality Rates for 130 Infants* by Maternal Characteristics, Alaska, 1992–1997

Maternal Characteristic	SIDS Deaths	SIDS Mortality Rate (per 1000 Live Births)	Rate Ratio (95% CI)
Maternal age (y)			
<20	21	3.0	2.2 (1.2, 3.8)
20–29	78	2.2	1.6 (1.1, 2.5)
≥30	30	1.4	Reference
Maternal education (y)			
<12	36	4.0	3.2 (2.0, 5.2)
12	51	2.0	1.6 (1.0, 2.5)
≥12	34	1.2	Reference
Maternal race			
Alaska Native	50	3.4	2.1 (1.5, 3.1)
Non-Native	78	1.6	Reference

* Not all risk factor information was known for all infants.

TABLE 2. Bed Type at the Time of Death and Sleeping Partners for 130 Infants Who Died of SIDS, Alaska, 1992–1997

Bed at Time of Death	Sleeping Partners						Total
	Alone	1 Parent	2 Parents	Sibling(s)	Other	Unknown	
Crib	29	0	0	3	0	4	36
Adult mattress	8	21	12	2	4	2	49
Waterbed	2	2	0	0	0	0	4
Couch	5	2	0	0	1	1	9
Other	10	1	2	0	0	3	16
Unknown	6	0	0	0	0	10	16
Total	60	26	14	5	5	20	130

Bed Sharing

Among 110 infants for whom bed sharing information was known, 45% slept with at least 1 other person the night of death, usually 1 or both parents (Table 2). Two infants were found underneath a parent, and a third had a fabric impression on his face. Among Alaska Native infants, 60% slept with another person the night of death compared with 35% of non-Natives.

A history of parental drug use differed by whether an infant slept with his or her parent or alone the night of death. Of the 60 infants who slept alone, 57% had a parent with a documented history of drug use. By contrast, among the 40 infants who slept with their parent, 93% had a parent with a documented history of drug use.

In addition to drug use, infants who slept with a parent had a high prevalence of other examined risk factors. Eleven infants were found in the prone position; 9 had a substantial physiologic abnormality; and 7 slept on a waterbed, a couch, or the floor with a blanket or a sleeping bag. In sum, 1 infant (2.5% of all infants who slept with a parent) who slept with a non-drug-using parent on an adult nonwater mattress was identified.

Sleep Position

Among infants for whom sleep position was known, 2 of 33 (6.1%) deaths that took place in an infant crib occurred in association with the supine or side sleep position (Fig 1). By contrast, 23 of 57 (40%) deaths that occurred outside an infant crib involved the supine or side sleep position. Among Alaska

Natives, 68% were found in the prone position compared with 76% of non-Natives.

Summary

Of the 115 infants for whom risk factor information was known, 2 (1.7%; exact 95% CI: 0.21%–6.1%) occurred to infants who slept alone, in the side or supine position, and in a crib. Of these 2 infants, 1 was found with a blanket wrapped around his head. The remaining 113 deaths occurred to infants who slept outside an infant crib, in the prone position, or with another person. For 15 deaths, adequate information on sleep-related risk factors did not exist. For these deaths, no sleep-related risk factor information could be found for 9 infants, whereas 6 had information available for 1 or 2 but not all risk factors. When analysis included only infants for whom all sleep-related risk factor information was known, 2 of 84 (2.4%; exact 95% CI: 0.29–8.3) were found alone, in the side or supine position, and in a crib at death.

DISCUSSION

We evaluated all cases of SIDS from an entire state over an extended period using a comprehensive collection of data sources. As with other studies, SIDS deaths frequently occurred in association with infant physiologic abnormalities and parental drug use. Despite this, we found that all but 2 cases of SIDS for whom this information was known occurred in the context of prone sleep position,^{7,8} bed sharing,^{9–12} or sleeping outside an infant crib.^{14,16} Both non-Natives and Alaska Natives had high prevalences of all 3 risk

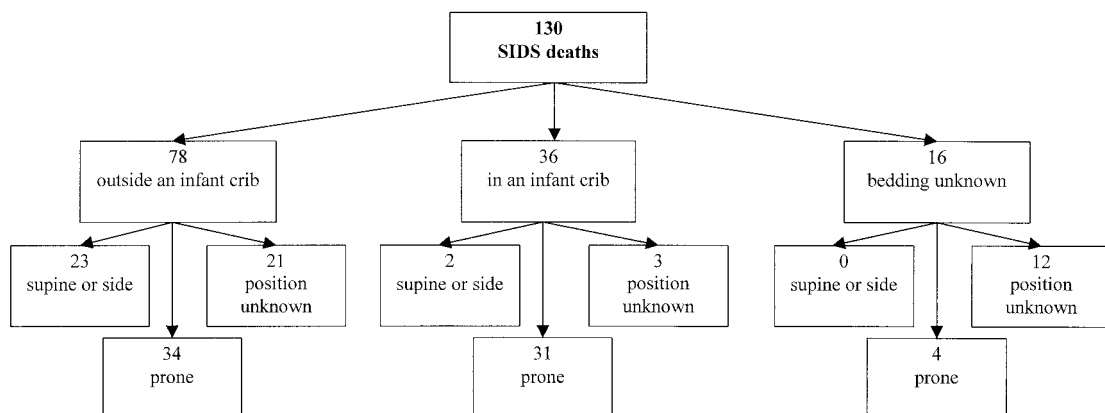


Fig 1. Bedding and sleep position at the time of death for 130 infants with SIDS, Alaska, 1992–1997.

factors, although a substantially higher proportion of Native infants died while bed sharing.

The current study was descriptive and hence uncontrolled. Nevertheless, some background information is available from the Alaska Pregnancy Risk Assessment Monitoring System, a population-based mail survey of Alaska resident women who recently delivered a live infant.^{19,20} The Pregnancy Risk Assessment Monitoring System found that in Alaska during 1996 to 1998, 66% of infants sometimes or never slept with their mother (possible survey responses include always, usually, sometimes, or never), 83% usually were placed in the supine or side position, and a combined 55% had both characteristics (Alaska Division of Public Health, unpublished data). Consequently, if drug use or physiologic abnormalities in the absence of sleep-related factors frequently caused SIDS, then we should have identified more than 2 deaths among infants sleeping supine in their crib (1 of whom had an obvious cause of death).

SIDS deaths among infants who slept in an infant crib occurred almost exclusively in association with prone sleep position. If the evaluated sleep-related risk factors formed part of the causal chain of death, this is a necessary finding because infants who slept alone in their crib by definition were not exposed to the other 2 risk factors. By contrast, for infants who were found outside an infant crib, prone position should be of less importance because such potential mechanisms as overlying or suffocation as a result of inappropriate bedding materials do not require the presence of a prone infant. As predicted, the current study found that 40% of deaths that occurred outside an infant crib involved the side or supine position. This result also supports studies that found that programs that promote supine sleeping have been associated with a decrease but not an elimination of SIDS deaths.^{21–23}

Recently, researchers using Consumer Product Safety Commission data—with limited information on some pertinent risk factors, such as parental drug use—have recommended against bed sharing of any kind.^{13,24} Our data do not support this recommendation. Almost all SIDS deaths associated with parental bed sharing occurred in conjunction with a history of parental drug use^{9,12} and occasionally in association with the prone sleep position or sleeping on surfaces such as couches or waterbeds. We found just 1 death of an infant whose only risk factor was sleeping with a non-drug-using parent on an adult nonwater mattress. In our population, this was true regardless of the specific characteristics of the adult mattress used. Because of these findings, the State of Alaska does not counsel caregivers to avoid bed sharing with their infants. Instead, a simple public health message that is consistent with the existing data has been developed: infants should sleep in the supine position and in their crib or with an unimpaired caregiver on an adult nonwater mattress.

At least 3 limitations affect the interpretation and generalizability of our results. We collected sleep position at the time the infant was found rather than

at the time of sleep. Neither time may reflect accurately the position of the infant at the moment of death because infants may change position during sleep, including as a result of bed sharing. We relied on a retrospective evaluation of a variety of records to identify the outcomes of interest rather than using a prospective standardized interview form. The unique characteristics of Alaska—including cold winters, large rural populations, and a large aboriginal population with a high risk of SIDS—may support different risk factors than other areas of the world.

Because of the above limitations, the current study does not provide definitive support for a causal association between sleep-related risk factors and SIDS. Future controlled studies examining the 3 sleep-related risk factors of interest may provide stronger evidence. Until that time, however, the available data suggest that in Alaska, sleep-related factors may form part of the chain of events that lead to SIDS. This finding has important implications because sleep-related factors are more amenable to public health interventions than many of the other factors—such as low birth weight, parental drug use, race, and socioeconomic status—previously associated with SIDS.

Building on the success of the Back to Sleep campaign, the American Academy of Pediatrics Task Force on Infant Positioning and SIDS recently issued recommendations that infants be placed to sleep in infant cribs and not on sofas, waterbeds, or soft mattresses and that bed sharing with a drug-impaired caregiver is hazardous to infants.²³ Our data suggest that promotion and implementation of these recommendations will lead to a decrease in SIDS cases. Our data do not support avoiding bed sharing of any kind or the need for a specific type of adult nonwater mattress for parents who choose to bed share. The public health message adopted by Alaska is that infants should sleep in the supine position and either in an infant crib or with a nonsmoking, unimpaired caregiver on an adult nonwater mattress.

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