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Risk Factors for Sudden Infant Death Syndrome: A CDC WONDER Analysis

Elise Hoy
Wright State University - Main Campus, hoy.17@wright.edu

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Elise E. Hoy

Mentor: Jeannette Manger, Ph.D., Department of Medical Education

Clinical Science and Research Track

Scholarship in Medicine Report

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Abstract

Objective. By definition, there is no known cause of Sudden Infant Death Syndrome (SIDS).[1] The best information currently available comes from studies investigating infant sleep habits. Thus far, researchers agree that in regards to sleep, infants are safest, and at lowest risk for SIDS, when sleeping in a supine rather than prone or lateral position, when sleeping on hard, rather than soft, bedding with no pillows or blankets, and when sleeping in a crib rather than sharing a bed with a parent.[1–4] In an effort to better understand what additional factors might predispose an infant to dying of SIDS, this project investigates the potential physiologic risk factors of age, birth weight, gestational age at birth, and the month of pregnancy during which prenatal care was initiated.

Methods. This study is a descriptive analysis using data from the CDC. I collected data from the Linked Birth/Infant Death Records subset of the CDC WONDER public use database for statistical analysis. I analyzed the data with descriptive statistics, with z-scores assigned to each category within each of the four potential risk factors.

Results. Results indicate that with regards to age, the rate of death from SIDS was greatest in infants between one month and one year of age, as opposed to younger than one month of age. Limited data prevents a further breakdown of that eleven-month span. Infants with low birth weights (specifically 1000 – 1499 or 1500 – 1999 grams) had greater death rates than infants with higher birth weights. In regard to gestational age, infants born preterm (prior to 34 weeks' gestation) had greater death rates than infants born at or post term or late preterm. Lastly, infants born to mothers who had no prenatal care or only received prenatal care post term, in the tenth month of pregnancy, experienced greater death rates than other infants. Thankfully, SIDS is relatively rare, and data is limited regarding instances of SIDS. As such, statistical significance to these increased death rates cannot be confidently assessed. However, parents of infants experiencing one or more of these potential risk factors may be more strongly advised to follow existing guidelines regarding infant sleep habits and safe environmental procedures.

Key words: SIDS, age, birth weight, gestational age, prenatal care, sleep

Introduction/Literature Review

As hard as it is to lose an infant, it is exponentially more devastating to lose an infant and have no idea why. Sudden Infant Death Syndrome (SIDS) is, by definition, the death of an infant under the age of one year with no known cause.[1] Research indicates that there are numerous possible factors that may predispose an individual to SIDS. Prominently, research over the past decade has determined that infant sleep habits can increase or decrease the risk of SIDS. Infants are safest when sleeping in a supine rather than prone or lateral position, when sleeping on hard, rather than soft, bedding with no pillows or blankets, and when sleeping in a crib, rather than sharing a bed with a parent.[1–4] Additional known risk factors include living in a home with exposure to tobacco smoke.[5]

In addition to environmental risk factors, there may be physiological factors that lead to a predisposition for SIDS. Several studies from 2013 have investigated the potential link between premature birth and SIDS.[6,7] However, there is a conspicuous dearth of research focusing on the aspects of prematurity that may lead to this link. There are no prominent studies from the last decade focusing on a potential association between SIDS rates and birth weight, between SIDS rates and prenatal care, or even between SIDS rates and age of infant at death. Such studies could indicate whether risk of sudden death in high-risk pregnancies may be ameliorated by promoting early engagement in prenatal care. It could even be possible that after birth, once an infant reaches a certain age, he or she is "out of the woods," or reduces his or her risk of death from SIDS.

In an effort to fill the void of information, this study looks for associations between SIDS and each of these factors: gestational age, birth weight, month during which prenatal care began,

and age at death. Perhaps one or more of these factors will provide new insight into SIDS, and how to prevent parents from experiencing the pain of losing their child.

Research Questions

What are risk factors for Sudden Infant Death Syndrome (SIDS)? Specifically, what is the relationship of 1) age at death, 2) birth weight, 3) gestational age, and 4) month of gestation during which prenatal care began with SIDS?

Methods

Context/Protocol

Between the years of 1995 and 2017, inclusive, the CDC collected information about SIDS from death certificates of infants born to mothers residing in the United States who died in the first 365 days of life.[8] The death certificate data was linked with birth certificates for comprehensive information. Information not included on birth or death certificates, including statistics regarding gestational age and month that prenatal care began, was collected from death reports from associated health care providers.

Data Collection

Data was obtained from the Linked Birth/Infant Death Records subset of the CDC WONDER public use database at the beginning of this analysis.[9] I pulled data regarding SIDS in relation to each of the four research questions: infant age at death, birth weight, gestational age based on obstetric estimate, and month during which prenatal care began. The pulled data spans the years of 2015 through 2017, rather than 1995 through 2017, as gestational age based on obstetric estimate was not used prior to 2015.[10]

Data Analysis

The four potential risk factors that this study investigates are infant age at death, birth weight, gestational age, and month during which prenatal care began. Using descriptive statistics, z-scores were assigned to each category within the four risk factors.

Infant age at death is noted as under 1 hour, 1-23 hours, 1-6 days, 7-27 days, and 28-364 days. Limited incidences of SIDS prevent further breakdown of the final 11-month span.

Birth weight is categorized as 499 grams or less, 500-999 grams, 1000-1499, 1500-1999, 2000-2499, 2500-2999, 3000-3499, 3500-3999, 4000-4499, 4500-4999, 5000-8165 grams, and unknown or not stated.

Gestational age is given by obstetric estimate guidelines, delineated as 20-27 weeks, 28-31 weeks, 32-33, 34-36, 37-38, 39, 40, 41, 42+ weeks, and unknown.

Month during which prenatal care began is identified as no care, 1st month, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th, 10th month, unknown, and not reported.

SIDS is relatively rare, so data is limited regarding instances of SIDS. As such, statistical significance to these increased death rates cannot be confidently assessed. Instead, z-scores greater than 1.0, and especially greater than 1.5, were used to indicate greater death rates within a variable. Using descriptive statistics, I am unable to identify any causative relationships between risk factors and an outcome of SIDS, but I can identify associations.

Results

The z-scores associated with these data are outlined in Tables 1-4. Infants are more likely to die of SIDS at an age of 28 through 364 days, or during months 2 through 12 of life, as opposed to during the first month of life ($z = 1.78$, Table 1).

Table 1: Infant Death Rates by Age at Death

Age of Infant at Death	Number of Deaths	Number of Births	Death Rate	Z-Score
Under 1 hour	1	11 779 872	0.0000085	-0.50
1-23 hours	3	11 779 872	0.000025	-0.50
1-6 days	69	11 779 872	0.00059	-0.46
7-27 days	321	11 779 872	0.0027	-0.32
28-364 days	4 031	11 779 872	0.034	1.78

Table 2: Infant Death Rates by Birth Weight

Birth Weight (grams)	Number of Deaths	Number of Births	Death Rate	Z-Score
499 or less	1	19 270	0.0052	-1.16
500-999	53	61 423	0.086	0.70
1000-1499	120	86 951	0.14	1.89
1500-1999	208	188 469	0.11	1.26
2000-2499	542	608 626	0.089	0.77
2500-2999	1 135	2 181 921	0.052	-0.085
3000-3499	1 430	4 565 428	0.031	-0.56
3500-3999	734	3 130 027	0.023	-0.74
4000-4499	173	804 445	0.022	-0.79
4500-4999	20	113 577	0.018	-0.88
5000-8165	2	13 385	0.015	-0.94
Unknown/Not Stated	5	6 350	0.079	0.53

Infants with low birth weights, specifically 1000-1499 grams or 1500-1999 grams, had increased death rates compared to infants with higher birth weights ($z = 1.89$, and $z = 1.25$, respectively, Table 2). Conversely, infants born with an extremely low birth weight of 499 grams or fewer were less likely than other infants to die of SIDS ($z = -1.16$, Table 2).

Regarding gestational age at birth, infants born preterm, specifically at weeks 28-31 or 32-33, were at greater risk of dying of SIDS than infants born at term or late preterm ($z = 1.81$, and $z = 1.09$, respectively, Table 3). Infants born at week 41 were less likely to die of SIDS ($z = -1.06$, Table 3).

Table 3: Infant Death Rates by Gestational Age at Birth

Gestational Age[a] (weeks)	Number of Deaths	Number of Births	Death Rate	Z-Scores
20-27	50	75 376	0.066	0.071
28-31	146	107 864	0.14	1.81
32-33	147	137 522	0.11	1.09
34-36	635	828 817	0.077	0.33
37-38	1 274	2 999 424	0.042	-0.53
39	1 365	4 387 182	0.031	-0.82
40	622	2 436 674	0.026	-0.96
41	162	751 537	0.022	-1.06
42 or more	13	42 186	0.031	-0.82
Unknown	9	9 139	0.098	0.88

[a]According to updated guidelines, gestational age is estimated using obstetric estimate as opposed to last menstrual period.[10]

Table 4: Infant Death Rates by Month of Gestation During Which Mother Began Receiving Prenatal Care

Month Prenatal Care Began	Number of Deaths	Number of Births	Death Rate	Z-Score
No prenatal care	177	183 110	0.097	1.63
1st	273	743 154	0.037	-0.96
2nd	1 250	4 476 989	0.028	-1.35
3rd	1 013	3 387 910	0.030	-1.26
4th	500	1 027 446	0.049	-0.45
5th	347	521 854	0.066	0.33
6th	231	317 844	0.073	0.59
7th	154	250 057	0.062	0.11
8th	133	182 506	0.073	0.60
9th	44	69 387	0.063	0.19
10th	1	1 042	0.096	1.60
Unknown/Not Stated	211	341 037	0.062	0.12
Not Reported	89	277 536	0.032	-1.17

Infants born to mothers who obtained no prenatal care or only received care post term, in the tenth month of pregnancy, had higher death rates than other infants ($z = 1.63$ and $z = 1.60$, respectively, Table 4). On the contrary, infants whose mothers obtained care starting in the

second or third month of pregnancy, and infants whose records did not report information about prenatal care, demonstrated decreased rates of death from SIDS ($z = -1.35$, $z = -1.26$, and $z = -1.17$, respectively, Table 4).

Overall, the factors found to be associated with greatest risk of SIDS, with a z-score of greater than 1.50, included age of 28-364 days at death, birth weight between 1000 and 1499 grams, gestational age of 28 to 31 weeks, and infants born after a pregnancy with no prenatal care, or prenatal care beginning in the tenth month of pregnancy.

Discussion

Analysis shows that infants who die of SIDS are more likely to be aged 28-364 days at their time of death, than 1-27 days. Infants up to 4 weeks (28 days) of age are considered neonates. The leading causes of neonatal death, according to the World Health Organization, are infection, prematurity, and birth asphyxia.[11] Infants who die in the first month of life are more likely to die of these complications, rather than SIDS. When looking at infant mortality beyond the first month of life, SIDS is added as a leading cause of death, according to the Centers for Disease Control and Prevention.[12] These data support a greater death rate due to SIDS in post-neonatal infants than in neonates.

Reflecting the understanding that prematurity often leads to infant death, this study finds that SIDS occurs more in infants with a low birth weight. While we are unable to directly link SIDS and low birth weight, studies have linked several complications with low birth weight. Shaikh and colleagues found that in a cohort of infants born with low birth weight (less than 2500 grams), 40.1% experienced jaundice, 25.7% experienced birth asphyxia, 21.1% experienced Respiratory Distress Syndrome, 19.8% experienced hypothermia, and 19.0%

experienced hypoglycemia.[13] Each of these complications could place an infant at risk for SIDS (perhaps the focus of a future study).

With regards to gestational age, we find that infants born at 32-33 weeks, and especially those born at 28-31 weeks, experienced higher death rates due to SIDS than other cohorts. Infants born earlier, at 20-27 weeks' gestation, did not experience an increased rate of death from SIDS. As above, it is possible that infants in this category died of some of the more prominent causes of death for young and particularly premature infants, including lung disease like Respiratory Distress Syndrome. Fetuses develop alveoli and surfactant, which are essential for air exchange and ultimately, breathing, around 24-26 weeks of gestation. Infants born prior to the development of sufficient surfactant are likely to die of respiratory failure.[14] As such, SIDS is not as prominent in seriously premature infants.

Infants born nearly post term, at 41 week's gestation also had a slightly lower risk of death from SIDS than other cohorts. While there are other risks associated with post term births, particularly asphyxia, which can lead to cell damage and intellectual disability, death from SIDS is less common among infants who have fully matured.[15]

The results regarding prenatal care are two-fold. Infants whose mothers did not receive prenatal care, or who received prenatal care only in the tenth, post term, month of pregnancy, experienced higher rates of SIDS. Numerous studies delineate the importance of prenatal care: preventing and treating complications of pregnancy; a greater understanding of medications that are safe or unsafe for fetuses; educating women about pregnancy, birth, and child development; promoting relationships with health care providers; and more.[16,17] A lack of prenatal care certainly has the potential to predispose an infant to SIDS.

Meanwhile, infants whose mothers sought prenatal care beginning in the second and third months of pregnancy demonstrated lower rates of SIDS. Many women first realize they are pregnant during weeks four through seven of pregnancy, which would place them in their second month when they first seek health care. Other women may seek care during the third month when they begin experiencing more exhaustion due to the major growth of the fetus occurring during organogenesis. Seeking prenatal care as soon as possible ensures that the developing fetus has as many beneficial nutrients from prenatal vitamins, and that the mother engages in as many safe practices as possible, likely reducing the likelihood of occurrences of SIDS.

By nature of the CDC WONDER data coming from death certificates and birth, one limitation of this study is the possibility of confounding factors. Death certificates only list the cause of death, SIDS, without mentioning any other conditions that may have affected the infant, or the mother during pregnancy. Additionally, the sample size is relatively small, with only about 4,425 deaths reported among well over 11 million births. As such, each category within the four risk factors had a limited number of SIDS deaths, and consequently a very small death rate. While it is reassuring that death from SIDS is relatively uncommon, it does limit the statistical analyses that can be performed for SIDS studies.

Conclusion

Analysis shows that the age of infant, infant birth weight, gestational age, and month during which prenatal care began are all potential risk factors for SIDS, though the degree to which they affect death rates remains a source for future investigation. What we do know is that premature birth, and the low birth weight that often accompanies prematurity, are associated with an increased rate of SIDS. A lack of prenatal care, with its other associated risks, may also contribute to an increased rate of death from SIDS. Lastly, while SIDS is more prominent after

the neonatal period, the risk of death from other factors diminishes after the first month of life. It is fortunate that in the United States, SIDS is relatively uncommon, and the sample size for this study was small enough to prohibit the determination of statistical significance. Future studies may expand upon data from the CDC WONDER database to feature a larger population size, as well as investigate different risk factors, including complications of pregnancy and infant medical conditions prior to and following birth. However, studies with small population sizes like this one may still prove beneficial. Parents of infants experiencing one or more of these potential risk factors may be more strongly advised to follow existing guidelines regarding infant sleep habits and safe environmental conditions. With precautions and hopefully prompt improved understanding, perhaps parents will no longer have to experience the pain of SIDS.

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