

Effects of Maternal Education, Age, and Parity on Fatal Infant Accidents

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Abstract: Accidents are a major cause of death among children. Using computerized linked birth and death record information, this study examined the relationship of selected parental factors to the risk of infant accidental death. The analyses suggest that maternal age and education are inversely related to infant accident mortality while mother's parity is directly related. Accident mortality rate differentials by educational level were more evident for certain categories of accidents. (*Am J Public Health* 1984; 74:1150-1152.)

Accidents are a major cause of death to children under the age of 20. A number of risk factors have been identified as influencing the distribution of fatal childhood accidents. These include host factors such as age and sex; environmental factors such as hazardous play equipment, flammable clothing, and accessible poisons; and parental characteristics such as socioeconomic status.

This study examines the relationship of selected parental factors with accident mortality rates for children under one year of age. An attempt is made to determine the independent effects of three variables—maternal education, age, and parity. These factors may be of utmost importance in understanding accidental deaths to children less than one year of age, since infants depend almost entirely upon parental care for their safety and well-being.

Methods

Our data consist of linked birth and death records from North Carolina and Washington State for the years 1968 through 1980. Overall infant accident mortality rates were calculated for both states, stratified by race and year of birth. Causes of death were identified according to the 8th revision, International Classification of Diseases, Adapted (ICDA-8), for deaths between 1968-1978. The 9th revision of the International Classification of Diseases was used for 1979-1980 deaths. Inclusion of the educational level of the mother on the North Carolina birth certificates enabled North Carolina accident mortality rates to be calculated for each of three maternal educational groups: 8 years or less of schooling, 9 through 12 years, and more than 12 years. Birth certificates in Washington State did not include information on maternal educational level.

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To determine the independent effects of maternal age and parity on infant accident mortality, unconfounded summary accident mortality rates for maternal age groups and parity groups were obtained using a convergent iterative procedure developed by Mantel and Stark.¹ The procedure provided maternal age-specific mortality rates standardized for parity, as well as parity-specific mortality rates standardized for maternal age. Twenty separate mortality rates were provided by stratifying maternal age into five groups (under 20, 20-24, 25-29, 30-34, and 35 and older) and parity into four groups (1, 2, 3, and 4 and over). This procedure was conducted with North Carolina data for Blacks and Whites in each educational group and with Washington State data only for Whites.

Results

The overall accident mortality rates among children during the first year of life were 5.48 per 10,000 live births in North Carolina, and 3.12 per 10,000 live births in Washington, from 1968-80 (Table 1). In North Carolina, the rates were higher among Black children than among White children. A fairly steady and dramatic decline in fatal accident rates is evident in both states. The particularly large decline in fatal accidents among North Carolina Black infants has sharply narrowed the differential between Blacks and Whites.

The risk of a fatal accident among infants during the first year of life was directly related to the level of the mother's schooling for White as well as Black children (Table 2). Infants whose mothers completed 8 or fewer years of education had nearly double the rate of fatal accidents as infants whose mothers had some high school education.

The independent effects of maternal age and parity on infant accident mortality were considered within each educational group for White and Black children in North Carolina (Tables 3 and 4). Among White women of each educational group and Black women who had completed 9-12 years of schooling, maternal age was inversely related to the child's risk of a fatal accident, while parity was directly related. In Washington, a three-fold increase in accident rates was evident with decreasing maternal age and a two-fold increase in rates was observed with increasing parity (Table 5).

The two leading causes of infant accident mortality in North Carolina were suffocation by inhalation and/or ingestion of food, and suffocation by mechanical means (e.g., in bed or cradle, by plastic bag, etc.). Transport accidents followed closely as the third leading cause of accidental death. For all types of accidents, an inverse relationship existed between mortality and mother's educational level (Table 6). Suffocation rate, either by ingestion of food and

objects or by mechanical means, showed particularly large differences by maternal education, as did risk of death by fire. Rates of transport accidents, poisonings, and falls demonstrated smaller differences when stratified by mater-

nal education. In Washington, transport accidents were the leading cause of accidental infant mortality, followed by mechanical suffocation and food suffocation. Of the 37 mechanical suffocation deaths, 16 were the result of an

TABLE 1—Accident* Mortality Rates† (Deaths) for Infants during the First Year of Life, North Carolina and Washington 1968–1980, by Year and Race

| | North Carolina | | | Washington‡ | |
|---------|----------------|------------|------------|--------------|------------|
| | All Children | White | Black | All Children | White |
| 1968 | 9.89 | 7.08 | 16.84 | 4.20 | 4.32 |
| 1969 | 8.04 | 5.35 | 14.75 | 5.22 | 4.54 |
| 1970 | 7.54 | 5.10 | 13.64 | 4.63 | 3.58 |
| 1971 | 6.61 | 4.53 | 12.03 | 4.52 | 4.54 |
| 1972 | 6.20 | 4.14 | 11.74 | 3.32 | 3.39 |
| 1973 | 4.71 | 4.50 | 5.61 | 2.52 | 2.07 |
| 1974 | 4.80 | 3.40 | 7.76 | 2.99 | 3.07 |
| 1975 | 5.00 | 4.29 | 6.68 | 2.16 | 1.73 |
| 1976 | 3.91 | 2.32 | 6.37 | 2.64 | 2.50 |
| 1977 | 4.42 | 3.92 | 5.17 | 2.10 | 2.33 |
| 1978 | 2.98 | 1.76 | 5.99 | 3.07 | 2.28 |
| 1979 | 3.17 | 2.94 | 3.55 | 1.86 | 1.74 |
| 1980 | 2.79 | 2.56 | 3.17 | 1.47 | 1.55 |
| 1968–80 | 5.48 (631) | 4.04 (323) | 8.80 (289) | 3.12 (228) | 2.83 (188) |

*Accidents: ICDA-8 E8000–9299, E9400–9499, ICD-9 E8000–9299.

†Rates per 10,000 live births.

‡The number of Black infants was too small to calculate rates.

TABLE 2—Accident* Mortality Rates† (Deaths) for Infants during the First Year of Life, North Carolina 1968–1980 by Maternal Education and Race

| | Maternal Education (years) | | |
|----------------|----------------------------|------------|-----------|
| | <8 | 9–12 | >12 |
| All Children | 11.96 (99) | 5.85 (480) | 2.12 (52) |
| White Children | 9.57 (48) | 4.24 (232) | 1.75 (43) |
| Black Children | 16.38 (47) | 9.10 (235) | 2.50 (7) |

*Accidents ICDA-8 E8000–9299, 9400–9499; ICD-9 E8000–9299.

†Rates per 10,000 live births.

TABLE 3—Maternal Age-Specific Accident* Mortality Rates (Deaths) Standardized for Parity, North Carolina, 1968–1980 by Race and Maternal Education**

| Mother's Education | Maternal Age (years) | | | | |
|-----------------------|----------------------|-------------|------------|------------|-----------|
| | <20 | 20–24 | 25–29 | 30–34 | 35+ |
| WHITE CHILDREN | | | | | |
| ≤8 years† | 1.253 (15) | 1.392 (21) | 0.521 (7) | 0.315 (3) | 0.214 (2) |
| 9–12 years† | 0.735 (70) | 0.467 (106) | 0.212 (38) | 0.136 (13) | 0.104 (5) |
| >12 years† | 0.820 (2) | 0.206 (11) | 0.243 (23) | 0.138 (6) | 0.080 (1) |
| BLACK CHILDREN | | | | | |
| ≤8 years | 1.458 (21) | 2.414 (12) | 1.965 (7) | 1.407 (4) | 0.891 (3) |
| 9–12 years† | 1.143 (105) | 0.524 (95) | 0.274 (27) | 0.135 (7) | 0.030 (1) |
| >12 years | 0.663 (2) | 0.119 (2) | 0.197 (2) | 0.084 (1) | 0.000 (0) |

*Accidents: ICDA-8 E8000–9299, 9400–9499, ICD-9 E8000–9299.

**Rates per 10,000 live births.

†For educational group ≤8 yrs:

Test for independent effect of maternal age: $G^2=40.0$, 16df, $p<0.001$

Test for interaction of maternal age and parity: $G^2=8.0$, 12df, $p>0.05$

†For educational group 9–12 yrs:

Test for independent effect of maternal age: $G^2=70.0$, 16df, $p<0.001$

Test for interaction of maternal age and parity: $G^2=6.0$, 12df, $p>0.05$

†For educational group >12 yrs:

Test for independent effect of maternal age: $G^2=28.0$, 16df, $p<0.05$

Test for interaction of maternal age and parity: $G^2=6.0$, 12df, $p>0.05$

†Test for independent effect of maternal age: $G^2=144.0$, 16df, $p<0.001$

Test for interaction of maternal age and parity: $G^2=52.0$, 12df, $p<0.001$

TABLE 4—Parity-Specific Accident* Mortality Rates (Deaths) Standardized for Maternal Age, North Carolina, 1968–1980 by Race and Maternal Education**

| Mother's Education | Parity | | | |
|-----------------------|------------|------------|------------|------------|
| | 1 | 2 | 3 | 4+ |
| WHITE CHILDREN | | | | |
| ≤8 years† | 0.516 (12) | 0.631 (11) | 0.891 (9) | 1.869 (16) |
| 9–12 years† | 0.240 (89) | 0.419 (79) | 0.539 (32) | 1.215 (32) |
| >12 years† | 0.171 (19) | 0.258 (18) | 0.153 (3) | 0.499 (3) |
| BLACK CHILDREN | | | | |
| ≤8 years | 1.787 (17) | 2.421 (12) | 0.242 (1) | 1.612 (17) |
| 9–12 years‡ | 0.303 (80) | 0.474 (63) | 1.234 (44) | 1.942 (48) |
| >12 years | 0.223 (6) | 0.000 (0) | 0.000 (0) | 0.551 (1) |

*Accidents: ICDA-8 E8000–9299, 9400–9499, ICD-9 E8000–9299.
 **Rates per 10,000 live births.
 †For educational group ≤8 yrs:
 Test for independent effect of maternal age: $G^2=34.0$, 15df, $p<0.001$
 Test for interaction of maternal age and parity: $G^2=8.0$, 12df, $p>0.05$
 †For educational group 9–12 yrs:
 Test for independent effect of maternal age: $G^2=60.0$, 15df, $p<0.001$
 Test for interaction of maternal age and parity: $G^2=6.0$, 12df, $p>0.05$
 †For educational group >12 yrs:
 Test for independent effect of maternal age: $G^2=28.0$, 15df, $p<0.05$
 Test for interaction of maternal age and parity: $G^2=6.0$, 12df, $p>0.05$
 ‡Test for independent effect of maternal age: $G^2=152.0$, 15df, $p<0.001$
 Test for interaction of maternal age and parity: $G^2=52.0$, 12df, $p<0.001$

TABLE 5—Maternal Age-Specific Accident* Mortality Rates (Deaths) and Parity-Specific Accident Mortality Rates (Deaths), Washington, 1968–1980, White Children**

| Maternal Age-Specific Rates Standardized for Parity† | Maternal Age (years) | | | | |
|---|----------------------|-----------|-----------|-----------|----------|
| | <20 | 20–24 | 25–29 | 30–34 | 35+ |
| White Children | .665 (51) | .320 (76) | .153 (36) | .149 (16) | .208 (8) |
| Parity-Specific Rates Standardized for Maternal Age‡ | | | | | |
| | Parity | | | | |
| | 1 | 2 | 3 | 4+ | |
| White Children | .213 (80) | .235 (47) | .547 (39) | .433 (21) | |

*Accidents: ICDA-8 E8000-9299, E9400-9499, ICD-9 E8000-9299.
 **Rates per 10,000 live births.
 †Test for independent effect of maternal age: $G^2 = 57.3$, 16df, $p < 0.001$.
 ‡Test for interaction of maternal age and parity: $G^2 = 16.5$, 12df, $p > 0.05$.
 †Test for independent effect of parity: $G^2 = 36.2$, 15df, $p < 0.005$.
 ‡Test for interaction of maternal age and parity: $G^2 = 16.5$, 12df, $p > 0.05$.

infant's head/neck being caught in crib slats or between the mattress and slats. Five infants died from falling out of a crib and being caught between the crib and the wall. Four others suffocated while sleeping with parents. Of the 34 infants who died as a result of food suffocation, all aspirated vomitus or mucous, most often in bed.

Discussion

Our analyses suggest that three parental factors have an effect on infant accident mortality. An inverse relationship was demonstrated with maternal education and age, while a direct relationship was observed with mother's parity.

Limited to data on death certificates, we were unable to pursue other variables of interest related to our findings. The declining rates of accident mortality may reflect the extensive work of the Consumer Product Safety Commission in

TABLE 6—Type-Specific* Mortality Rates (Deaths) for Infants during the First Year of Life, North Carolina 1968–1980, by Maternal Education, All Races**

| Type of Accident | Maternal Education (years) | | | |
|------------------------|---------------------------------|------|------|------|
| | All Educational Groups (Deaths) | <8 | 9–12 | >12 |
| Transport | 1.00 (115) | 1.09 | 1.11 | 0.61 |
| Poisoning | 0.20 (23) | 0.48 | 0.19 | 0.12 |
| Falls | 0.23 (26) | 0.24 | 0.23 | 0.20 |
| Fire | 0.72 (83) | 1.81 | 0.77 | 0.20 |
| Drowning | 0.22 (25) | 0.60 | 0.23 | 0.04 |
| Food Suffocation | 1.14 (131) | 2.66 | 1.19 | 0.45 |
| Object Suffocation | 0.47 (54) | 1.09 | 0.54 | 0.04 |
| Mechanical Suffocation | 1.08 (124) | 2.66 | 1.15 | 0.33 |
| Other | 0.44 (50) | 1.33 | 0.44 | 0.12 |

*Accidents: ICDA-8 E8000-9299, 9400-9499; ICD-9 E8000-9299.
 **Rates per 10,000 live births.

forcing the redesign of cribs, the child-proofing of bottle caps, and the recall of unsafe toys. Limited access to medical care, and exposure to environmental hazards associated with poverty and isolation may, in part, explain why maternal educational differentials are observed with the rates of specific types of accidents. As an example, improper use of portable heaters in crowded living quarters may contribute to the differential in infant deaths due to fires.

Although the causes for the relationships are speculative, mothers whose children are at high risk of fatal accidents have been identified. An approach to prevention can focus on the environmental hazards that endanger the underprivileged and on educational efforts and social supports directed particularly toward young mothers with little formal education.

REFERENCE

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