Factors Affecting Postneonatal Mortality

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INFANT MORTALITY in the United States has caused increasing concern in recent years. Since the early 1950's, the decline in infant mortality rates has continued but at a lesser rate than previously (*1–3*). In a study comparing infant mortality rates of the United States with those of six Western European countries, the United States dropped from fourth position in 1935–50 to sixth in 1962 and to seventh, and last, in 1964 (*4*). In 1959–61 the United States ranked 10th among the developed countries with an infant mortality rate of 25.9 per 1,000 live births (*1*). The 1964 rate of 24.8 compares unfavorably to rates of 14.2 to 18.7 for six Scandinavian and Northern European countries.

The United States seems to be steadily losing ground in the reduction of infant mortality as compared with other developed nations. The continued attainment of decreasing infant mortality rates in other countries argues against any contention that infant mortality has reached an "irreducible minimum" (*4*). Since infant mortality rates are commonly regarded as an index of the health status of a population (*1, 5–7*), there is much concern over the implications of this country's relatively elevated rate of recent years.

The postneonatal mortality rate (number of deaths of infants aged 28 days through 11 months per 1,000 live births), both in the United States and in California, also experienced a leveling off in the 1950's (*8, 9*), and the U.S. rate now ranks close to the highest among developed countries (*10*). This leveling off occurred earlier and at a higher level in certain areas and populations than in others.

The difference that existed between the postneonatal mortality rates of different areas of the country has increased in recent years (*11*). This differential in postneonatal as well as infant mortality rates existed between white and nonwhite populations as well as between urban and rural areas (*1, 4*). The implication of these epidemiologic findings is that within a given population at risk (for example, postneonates in a State or group of counties) there are subsets of the total population with mortality rates that differ for any risk factor being studied.

In our study we investigated the status of postneonatal mortality in the San Joaquin Valley of California—a dry, hot, and predominantly rural region. Included in this valley are counties with some of the highest postneonatal death rates in the State. The combined postneonatal mortality rate

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for the valley for the years 1964–65 was significantly higher ($P<0.001$) than the State rate (table 1). The postneonatal death rates for the valley have been higher than the State rates every year since 1949. In recent years the neonatal rates for the valley have rarely been higher than the State rates (see chart). Thus it seems that infant deaths in the San Joaquin Valley occur to a great extent during the postneonatal period.

Because of the persistence of this problem and because the postneonatal mortality rate for the entire valley might mask smaller groups at higher risk, we decided to examine this phase of infant mortality in greater detail than had been possible in an earlier study (*5*). Specifically, the objective of this study was to determine and describe high risk groups or factors associated with postneonatal mortality in the San Joaquin Valley.

Materials and Methods

Population. Death certificates for the study population were obtained from the bureau of vital statistics, California State Department of Public Health. Included were infants who died during the postneonatal interval in 1964 and 1965 and who were residents of counties (table 1) of the San Joaquin Valley at the time of death. Of the 437 registered postneonatal deaths, three were recorded in error (more than 1 year old), which left a population of 434.

Data collection. From identifying information on the death certificates, birth indexes of the State for 1963–65 were used to obtain file numbers of the matching birth certificates. Thirty-one of the 434 infants were born outside of California; for three others, matching birth certificates could not be located. Therefore, birth information was known for only 400 deceased infants. Occupation of father, trimester of care, and number of live births were available only for the year 1965; in these instances the 1965 proportions were extrapolated to 1964 for the denominators in the computation of death rates. In testing the significance of differences for these three items, however, the data for 1965 only were used. The chi-square test was used with $P = 0.05$ as the level of significance unless otherwise specified.

Table 1. Number of live births and postneonatal deaths and mortality rates, by place of residence, California and San Joaquin Valley counties, 1964–65

Place of residence	Live births	Postneonatal deaths	Mortality rate per 1,000 live births
California	729,661	4,226	5.8
San Joaquin Valley	63,885	434	6.8
Fresno	16,703	116	6.9
Kern	13,374	85	6.4
Kings	3,168	25	7.9
Madera	1,733	14	8.1
Merced	4,851	43	8.9
San Joaquin	9,899	59	6.0
Stanislaus	6,621	34	5.1
Tulare	7,536	58	7.7

SOURCE: Bureau of vital statistics, California State Department of Public Health.

Factors Associated With High Rates

In addition to the factors of color, prematurity, age of mother, and number of live births—previously examined as associated with variations in infant mortality—the investigators for this study also looked at the socioeconomic status of the family as measured by occupation of the father, prenatal care of the mother according to trimester of first care, and type of hospital where birth occurred.

Socioeconomic status is often measured by ratings of the census tracts of residence (*12, 13*), a method that ascribes to each family the average values of occupation, education, and income in the area. Obviously, this method is not as precise as one that rates the individual family on the basis of one characteristic; in this instance, occupation of father. Because of the importance of this factor and the fact that it has not been used often in this context, table 2 presents all the other factors cross-tabulated by occupation of father to determine how socioeconomic status interacts with other variables. When cross-tabulated in this way the numbers in individual cells become too small to yield statistically significant differences in mortality rates, but the pattern by occupation is so consistent that it can hardly be attributed to chance.

Color of child and prematurity were strongly associated with risk of death in the postneonatal period. The rate for black children was 12.4 per 1,000, more than twice as high as that for whites (5.9). The rate for children of farm laborers was nearly three times the rate for offspring of the highest occupational group (9.0 compared with 3.3). Within the occupational groups, the differential between blacks and whites persisted and was even intensified among laborers and farm la-

borers. In the higher occupational levels, however, the rate for blacks, although based on such small numbers that it was not statistically significant, was very close to that of the whites.

Prematurity, as measured by birth weight, was strongly associated with risk of death in the postneonatal period. The rate for premature infants was 13.3 per 1,000 live births as compared with 5.7 for mature infants, a differential of 2⅓, which was apparent in each occupational group.

Infants of mothers under 20 years of age had the highest postneonatal death rate (8.5) as compared with that of mothers aged 25–29 (4.4). And if in addition to being young the mother was the wife of a laborer or farm laborer, the risk was increased to 11.5. With minor exceptions, the gradient of increasingly higher postneonatal mortality rates with lower levels of occupational status was maintained for each age group.

The differences by number of live births to the mother were not significant, and this factor showed a less pronounced association with variations in postneonatal death rates than any of the others examined. Rates among the offspring of the laboring groups in all instances were two to three times as high as those of the professional-technical group. Since there were proportionally many more mothers with four or more children in the farm laborer category, the high rate of 9.7 contributed substantially to the overall rate of 7.5 for all mothers with four or more children.

The factors of prenatal care and hospital of

Table 2. Postneonatal mortality rates, by occupation of father and 6 factors, San Joaquin Valley, Calif., 1964–65

Factors	Total rate [1]	Rate by occupation of father					
		Professional, technical, administrative, managerial	Clerical, sales, skilled, military	Semi-skilled	Laborers, except farm	Farm laborers and foremen	All other
Number of live births	63,885	7,205	19,091	11,061	7,332	14,309	4,887
Total [2]	[3] 6.3	3.3	4.5	7.0	8.0	9.0	5.3
Color of child: [4]							
White	5.9	3.4	4.6	6.7	6.7	8.1	5.1
Black	12.4	*6.1*	*2.5*	11.7	14.3	23.8	*10.1*
Other	5.9	--	*2.0*	*4.9*	*20.7*	*13.7*	...
Birth weight: [4]							
More than 5½ lb.	5.7	2.9	4.2	6.5	7.0	8.1	4.7
5½ lb. or less (premature)	13.3	*9.6*	7.3	12.0	19.7	19.3	13.3
Age of mother: [4]							
Under 20	8.5	*2.1*	5.2	8.7	11.6	11.5	7.7
20–24	6.7	5.3	5.0	7.1	7.5	10.0	4.5
25–29	4.4	*1.6*	4.0	4.9	4.4	6.7	*4.7*
30–34	4.8	*3.2*	2.3	5.6	7.2	8.1	*1.9*
35 and over	5.4	*3.7*	3.9	7.8	*5.7*	6.1	*6.8*
Number of live births:							
1	5.0	3.1	3.3	4.9	8.3	7.7	4.5
2	6.6	3.8	3.6	9.0	9.9	9.2	7.2
3	5.9	3.2	5.1	5.9	8.4	8.9	*2.9*
4 or more	7.5	3.1	6.8	8.0	6.0	9.7	6.8
Trimester of first care: [5]							
1st	4.8	3.3	3.5	6.5	5.5	7.6	4.0
2d	7.4	*2.2*	6.3	6.5	7.6	10.1	8.4
3d	8.0	*9.2*	4.4	8.2	14.8	7.5	*3.4*
No known care	13.8	*17.5*	*13.6*	14.8	*11.1*	13.9	*16.0*
Type of hospital of birth: [4]							
Private	4.6	3.0	4.3	5.3	5.7	6.8	4.1
City-district-Federal-State	4.6	4.5	3.2	6.5	6.8	5.8	*4.4*
County	9.9	*5.4*	8.7	10.1	10.3	10.2	9.6
Not in hospital	12.1	.....	.....	*36.6*	*19.6*	11.9	...

[1] Deaths of infants aged 28 days through 11 months per 1,000 live births.
[2] Chi-square test, $P < 0.01$, on 1965 data.
[3] The difference between this rate and that shown in table 1 is due to elimination of 34 infants born outside of California for whom birth certificates could not be obtained. Since many of these infants were children of migrant workers, their inclusion probably would increase the rates for farm laborers more than for other occupational groups.
[4] Chi-square test, $P < 0.001$, on 1964 and 1965 data.
[5] Chi-square test, $P < 0.001$, on 1965 data.
NOTE: Rates in italics are based on less than 5 deaths.

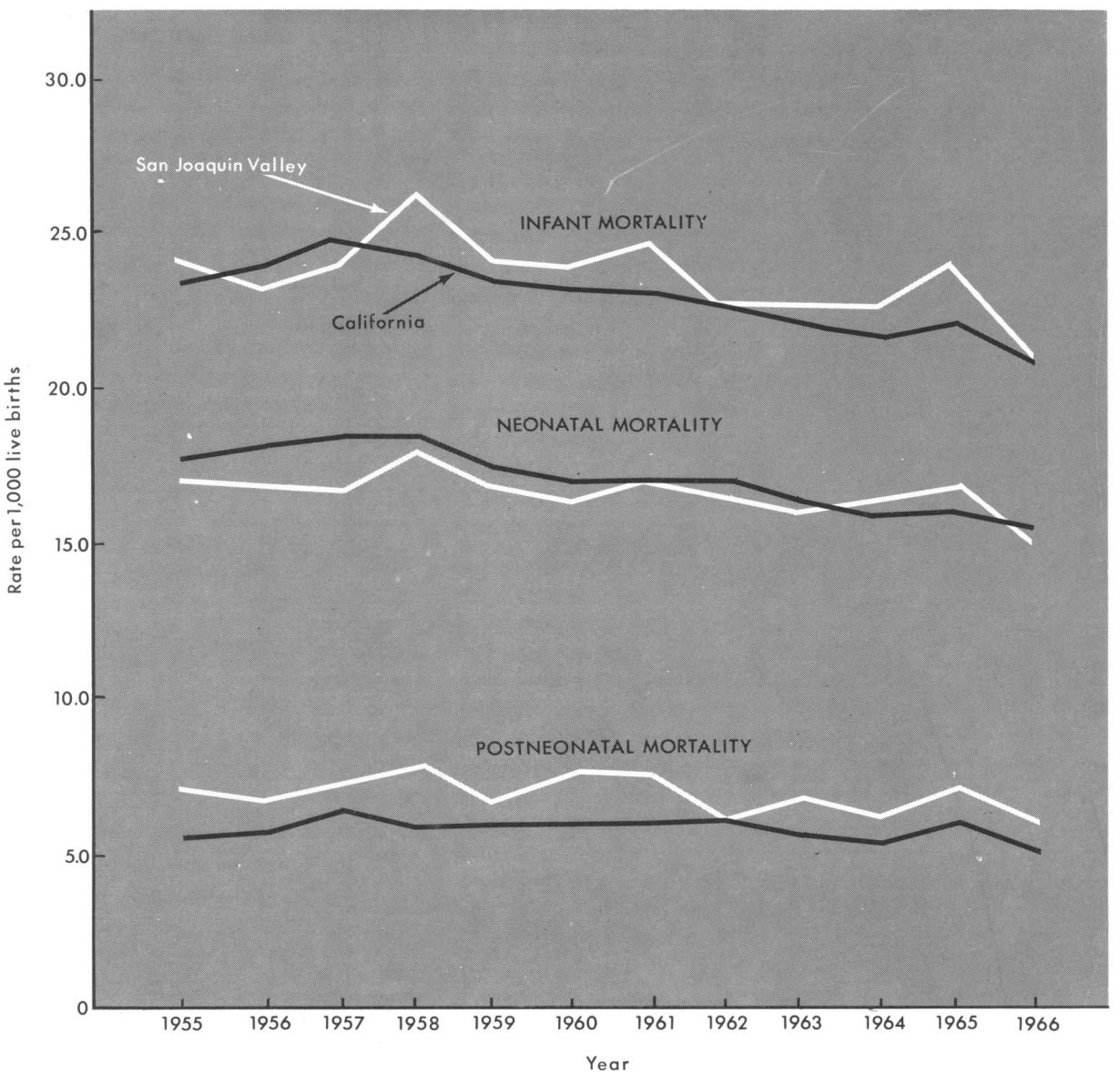
delivery are pertinent to quality of medical care and most amenable to intervention; therefore, they offer some opportunity for action in efforts to lower the infant death rate.

Prenatal care was a strong factor in its association with the postneonatal death rates. Mothers who had their first care in the first trimester showed a rate of 4.8 per 1,000 live births compared with 13.8 for mothers who had no known care before delivery.

Perhaps the most striking thing in table 2, showing the relationship between prenatal care and occupation of father, is the fact that higher socioeconomic status apparently does not reduce the risk when the mother has had no prenatal care, as it had done in all other factors examined. The rates for mothers with no known care remained high in each occupational group. For those with some prenatal care, there was still a difference between the occupational groups, although the effect of socioeconomic status did not appear to be as strong.

Infants born in a county hospital had a substantially greater risk of dying (9.9 rate) in the post-

Infant, neonatal, and postneonatal mortality rates, by place of residence, California and San Joaquin Valley counties, 1955–66



neonatal period than those born in other hospitals (4.6 rate), but the highest risk was attached to the 747 infants who were not born in a hospital (12.1 rate). Again, the high risk associated with county hospital births was uniform for the lowest occupational groups and only slightly improved for higher ones. So few infants of professional-level fathers were born in the county hospitals that the rate of 5.4 was subject to a wide sampling error.

Infants of laborers who were born in private or public hospitals other than county had significantly lower postneonatal death rates than those born in county hospitals or outside a hospital. Whether the lower rate was reflected by the care received in the county hospitals is a matter for conjecture. Possibly the families in lower occupational groups who managed to provide themselves with private medical care had higher or more stable incomes and enjoyed other benefits of life that affected the risk of postneonatal deaths to their infants.

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This study is based on 400 postneonatal deaths in 63,885 live births in eight counties of the San Joaquin Valley in 1964 and 1965. Death certificates were matched to birth certificates so that birth characteristics could be utilized as factors influencing the postneonatal death rates.

Black children, premature infants, children born to very young mothers, and children born to mothers who had no known prenatal care had a greatly increased risk of dying in the postneonatal period. Although the association was less marked, infants of high birth order (four or more) were also at greater risk, as were infants who were born in county hospitals or outside any hospital.

An increase occurred in the postneonatal death rate by occupational status of the father, ranging from 3.3 per 1,000 live births for the children of professional workers to 9.0 for the children of farm laborers. These differentials by occupational group persisted when examined in relation to color of child, prematurity, age of mother, and number of live births. When mothers in the lower occupational levels delivered their babies in private or community hospitals, the risk of postneonatal death, while still higher than that for the highest occupational groups, was substantially reduced.