

Infant Mortality in the United States

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INFANT mortality has often been termed one of the most sensitive indices of the healthfulness of environment. This characterization was particularly apt because infant mortality was found to vary so markedly with variations in social and economic conditions. Beginning with the year 1933 we now have, with the extension of the birth registration area to cover the entire area of continental United States (excluding Alaska), a measure of the infant mortality rate for the entire country, for each state, and for each important subdivision of states. We are thus in position now, as never before, to test the healthfulness of the environment and the "social and economic conditions" of the United States as a whole and of each subdivision, to the extent that the infant mortality rate is a good index of these conditions. To this point we return below; but be that as it may, it is still and always has been true that the infant mortality rate is an index of the health and vitality of infants during the first year of life, and this primary function of the rate will first engage our attention.

The United States has been relatively backward in developing adequate statistics of registration of births and deaths. English figures on births and deaths go back to 1838, and Swedish to 1749; our data for the birth registration area have been published in continuous series only since 1915, though for the individual states we have data that in a few cases date from before the War between the States. So, for example, Massachusetts has records from 1842 and Rhode Island from 1852-53. In 1915 the birth

registration area comprised 31.1 per cent of the population and included 10 states—the New England States, New York, Pennsylvania, Michigan, and Minnesota—and the District of Columbia. In that year for that area the infant mortality rate was 99.9 per 1,000; one infant in ten died before reaching his first birthday. In 1934 the infant mortality rate for the entire country had been reduced to 60.1 per 1,000; an apparent reduction of two fifths, or 40 per cent.

MEASURING INFANT MORTALITY

Before entering into the discussion of the change in the rate, a few remarks should be made in regard to the technical methods of measuring infant mortality.

The method of measuring mortality at other ages is to compare the total number of deaths of each age to the population of the same age in the middle of the year, or the average number of persons exposed to the risk of dying at that particular age—both the numerator and the denominator referring to the same area. Under one year of life, the usual method is to compare the deaths under one year of age with the number of births for the same area to determine the probability of a live-born infant's dying within the first year of life. The mortality decreases so rapidly during the first months of life that the probability of dying within the first year is used instead of the average death rate during the first year.

A correct method of calculating this probability of dying within the first year of life would be to follow each



infant born in a calendar year until he died or reached his first birthday. This would include, however, some deaths that occurred in the next calendar year, and to that extent the mortality would not be the mortality of the calendar year of birth, but would reflect in part that of the succeeding calendar year. If the deaths under one year of age occurring in a single calendar year are taken, the mortality conditions are related to the particular year; but a comparison of this figure with the births in the same year may lead to a slight error, since the comparison is not exactly with the births from which the deaths are derived. Some of the infants who died were born during the preceding year, and if this contingent of births was markedly larger than that for the succeeding year, there will be too large a quota of deaths to correspond with the diminished number of births used in the denominator of the rate fraction.

In practice, however, the error is not great, first because the numbers of births do not vary greatly from year to year, and secondly because only a small proportion of the deaths under one year of age in each year belongs to the births in the preceding calendar year. Under present conditions of mortality, 78 per cent of deaths under one year of age in a given calendar year are of infants born during the same year. In general, therefore, this method of measuring infant mortality may be accepted as reasonably accurate.

INCOMPLETE REGISTRATION

A more serious difficulty arises from failure to register births and deaths. If 2 per cent of the infant deaths are omitted, the infant mortality rate is obviously 2 per cent too low; if 10 per cent of births are omitted, the rate is 11 per cent too high. The net excess

of omission of births over omission of deaths from registration is thus a measure of the overstatement of the infant mortality rate. Little evidence is available as to the extent of failure to register deaths under one year of age. The Census Bureau has recently published an estimate that some 3 per cent of all deaths are not registered, but this figure did not distinguish between omissions at different ages. The proportion of unregistered deaths of infants might be expected to be higher than the proportion of unregistered deaths of adults, partly because of the relatively less strict control over registration of stillbirths, and partly because deaths of infants are less likely than the fatal illnesses of adults to be attended by physicians,¹ and hence may more easily escape the notice of the registration officials of the community. Low average death rates, such as 4.6 per 1,000 for the rural white population of Utah, 6.2 per 1,000 for the rural white population of North Dakota, and 6.5 per 1,000 for the rural white population of South Dakota (1933) suggest that possibly many deaths are omitted in these states.

Evidence of omission in registration of births indicates that some 8 per cent of the births are unregistered. A study made for the year 1919, when the registered births less deaths among them before the date of the census—January 1, 1920—could be compared with the census of children under one year of age, indicated that for the states then in the birth registration area approximately 8 per cent of births

¹ According to figures for the Netherlands, 6.1 per cent of the deaths under one year of age were without medical attendance before death, as compared with 3.0 per cent of deaths at all ages without such attendance. *Statistiek van Nederland. Statistiek van de Sterfte naar den Leeftijd en de Oorzaken van den Dood over het jaar 1924, waaran zijn toegevoegt gegevens over 1923, p. LXI.*

were omitted. The Census Bureau has recently published an estimate that in the United States in 1934, 7.8 per cent of all births were unregistered. The percentage varies greatly in the different states. According to Whelpton's estimates,² registration of white births varied from practically complete in Massachusetts, New York, and Delaware to 75 per cent for Oklahoma, 80 per cent for Tennessee, 81 per cent for Colorado, and 84 per cent for South Carolina, Georgia, Louisiana, and Nevada, and intermediate figures for other states. For the states in the birth registration area of 1919 an estimate for 1929 indicated that birth registration improved in the ten-year period by about 3 per cent. This improvement in the states in the 1919 area has probably been offset by the relatively less complete registration in states that have since been admitted into the area.

INTERPRETATION OF TRENDS

In interpreting trends in infant mortality, the question of changes in completeness of registration must be considered. The effect of an improvement in birth registration of 3 per cent would appear in an apparent lowering of the infant mortality rate by 3 per cent. If the conclusion is accepted that birth registration in the expanding area was approximately 92 per cent complete both at the beginning and at the end of the period, the fall in mortality shown by the figures may be accepted as being approximately a measure of the decrease in infant mortality during these nineteen years.

The infant mortality rate fell from 99.9 per 1,000 in 1915 to 60.1 in 1934. On the average, the rate of infant mor-

tality has decreased two points per year. Figures for 1935 available for some twenty-three states show a still further decline. For these states, infant mortality in 1935 averaged only 52.

Besides the difficulties arising from incomplete registration, another source of error must be taken into account in interpreting these trend figures, namely, the effect of adding new states to the birth registration area. The differences in mortality in successive years in the expanding area may be due either to real changes in mortality or to the addition of new states with lower or higher rates.

Three methods are available to avoid this difficulty: (1) limiting the comparison to the original area, (2) comparing the rates in the entire United States for 1934 with an estimated rate in 1915 for the entire area, and (3) comparing rates in successive years in identical areas and forming a series of link relatives for each pair of years, and by this means comparing 1915 with the link relative adjusted rate for 1934. The first method shows a decrease in the original area to 52.9 in 1933, or 47.1 per cent, or considerably more than in the expanding area (41.9). The second would probably show less reduction, since the rate of 100 for the Northeast, with its high industrialization and comparatively small proportion of rural areas, was probably in excess of the rates for the rest of the country. The third indicates a decrease from 99.9 in 1915 to 59.3 in 1933 and 61.3 in 1934, or slightly less than is indicated by the direct figure of 99.9 to 60.1 in 1934. Of course, these three methods measure different declines: the first, the decline in the relatively urban Northeast where the decline has been greatest; the second, the decline in the whole country; and the third, the decline,

² P. K. Whelpton, "The Completeness of Birth Registration in the United States," *Journal American Statistical Association*, Vol. 29 (June 1934), pp. 128-129.

after eliminating the effect of addition of new territory, in the expanding area.

URBAN VERSUS RURAL RATES

Comparing urban and rural areas in 1915, the urban rate was 103 and the rural rate was 94. The urban rate was 10 per cent higher than the rural rate. In 1934 their relative positions were reversed, the rural being 62 and the urban 58, the rural being 5 per cent higher than the urban. Before accepting this conclusion as a fact, the question of the influence upon the relative rates of the tendency of mothers in rural areas to go for their confinements to city hospitals must be considered. The births of their children would then be recorded as occurring in cities, whereas if death occurred after return to the place of residence, the deaths would be recorded in and ascribed to the rural areas. So far as this factor alone is concerned, the urban rates would appear reduced and the rural enhanced by this transfer, and correction would raise the urban and lower the rural relatively. But another factor to be considered is the tendency of parents in rural areas to bring their sick children to the cities for the better care available in city hospitals; deaths in the city of these non-residents would tend to increase urban and diminish rural mortality. Correction for this error would tend to lower the urban rates relatively and raise the rural. In practice, the effect of the correction for residence varies. In New York State the correction has been applied since 1927; in some years the resident urban rates have been up to 1 or 2 per cent higher, and in other years 1 or 2 per cent lower than the recorded rates. An analysis of the situation in Memphis, Tennessee, where the Children's Bureau made an intensive study, indicated that the net effect of the correction for non-residence applied both

to births and to infant deaths was to lower the urban infant mortality rate by as much as 13 or 14 per cent.³

The explanation of this change is probably to be made in terms of the superior hospital facilities of the cities and the possibilities of the use of them by parents in rural areas. Memphis has the only hospital facilities for a very considerable area, and the correction for residence is large. In New York State, on the other hand, the hospital facilities of the cities are perhaps not so far above the medical facilities available in rural areas. Another factor of perhaps greater importance is that often the children are brought to the Memphis Hospital in a moribund or dying condition and there is little hope of saving them, whereas in New York State the children taken to the hospitals may be brought more promptly, with the result that fewer deaths of such infants occur to swell the death roll of the cities.⁴

The change in the relative position of rural and urban and the gains made in the urban rates must be ascribed to the relatively greater improvement that has taken place in the conditions surrounding the lives of children in the cities. In this connection, mention must be made of the general pasteurization of milk, the development of health centers in which mothers in the cities can learn the most approved techniques for caring for their children, and particularly the special campaigns for control of diphtheria and other communicable diseases.

INTERSTATE AND INTERNATIONAL COMPARISONS

Individual states in the country have marked differences in rates.

³ Data from unpublished study by Dr. Ella Oppenheimer, used by permission.

⁴ The explanation of the reversal of the effects of transfers in New York is not clear. From

The lowest rates for 1934 were in Connecticut, 49; Kansas, 48; Massachusetts, 49; Minnesota, 47; Nebraska, 45; New Jersey, 49; Oregon, 40; Utah, 45; Washington, 43; and Wisconsin, 49. The highest rates were for Arizona, 104; New Mexico, 126; and South Carolina, 83. In New Mexico and Arizona particularly, there is a large Mexican population, and it may be presumed that birth registration—and perhaps death registration also—in these states is relatively poor.

The rate of 58 for 1933 for the United States is lower than that of most other countries for which figures are available. Only five countries had lower rates. New Zealand with a rate of 32 is the lowest; Australia is a not too close second with 40; Netherlands had 44; Norway and Switzerland, 48.

DECLINE IN RATES

The mortality rates from practically every cause have diminished since 1915.

The most striking gain is exhibited by the group of gastric and intestinal diseases, which showed a decrease of 75 per cent, from 24.9 to 6.2. The reduction was even more striking in the urban than in the rural areas. The decrease in the birth registration area of 1917, exclusive of Rhode Island, from that year to 1933 was 82 per cent in the urban areas, as compared with only 67 per cent in the rural. In this group of causes the change in relative incidence here is especially marked, from an excess of urban over rural of 40 per cent in 1917 to an excess of rural over urban in 1933 of 30 per cent.

Death rates under 1 year from communicable diseases indicate that in many cases the disease has been nearly wiped out. Diphtheria decreased

1927 to 1929 the effect of the correction was to raise the urban rate, while in 1930 and 1931 it was to reduce the urban figure.

from 0.6 to 0.2. In the urban areas of the registration area of 1917 (exclusive of Rhode Island) the rate fell in sixteen years from 0.6 to 0.1, a decrease of five sixths; in the rural areas the decrease was three fifths. Measles and whooping cough show marked de-

TABLE I—INFANT MORTALITY RATES FOR SELECTED COUNTRIES, 1933^b

Country	Infant Mortality Rate (1933)
Australia	40
Belgium	92
British India	171
Bulgaria	146
Canada	73
Chile	258
Czechoslovakia	127 ^a
Denmark	68
Egypt	163
England and Wales	64
Estonia	94
Finland	76
Germany	77 ^a
Hungary	136
Irish Free State	65
Italy	100
Japan	121
Latvia	76
Lithuania	121
The Netherlands	44
New Zealand	32
Northern Ireland	80
Norway	48
Scotland	81
Sweden	50 ^a
Switzerland	48
Uruguay	93
United States	58

^a Provisional figures.

creases, from 0.7 to 0.2 and from 1.9 to 1.0 respectively. Tuberculosis shows a reduction of 75 per cent in mortality since 1915, from 1.6 to 0.4. In this case the gain has been greater in the rural than in the urban areas in the birth registration area of 1917 (exclusive of Rhode Island): five sixths

^b Source: Figures furnished by the U. S. Children's Bureau.

in the former as compared with two thirds in the latter.

The group of causes combined as

TABLE II—DECLINE IN INFANT MORTALITY RATES BY CAUSE OF DEATH, 1915-1933: EXPANDING UNITED STATES BIRTH REGISTRATION AREAS⁶

Causes and Cause Groups	Infant Mortality Rates	
	1915	1933
All causes	99.9	58.1
Natal and prenatal causes . .	42.2	30.7
Congenital malformations . . .	6.4	5.1
Congenital debility	11.7	4.3
Premature birth	18.5	15.8
Injuries at birth	4.3	4.6
Syphilis	1.2	0.8
Tetanus	0.1	0.1
Gastro-intestinal diseases . . .	24.9	6.2
Diseases of the stomach	1.5	0.3
Diarrhea and enteritis	23.2	5.6
Dysentery	0.2	0.4
Respiratory diseases	17.3	9.7
Bronchitis	2.6	0.3
Broncho-pneumonia	9.8	5.4
Pneumonia	4.2	2.2
Influenza	0.6	1.9
Epidemic and communicable diseases	6.4	2.5
Measles	0.7	0.3
Scarlet fever	0.1	...
Whooping cough	2.0	1.3
Diphtheria	0.6	0.2
Erysipelas	0.6	0.3
Meningococcus-meningitis . . .	0.9	0.1
Tuberculosis of the respiratory system	0.5	0.2
Tuberculosis of the meninges	0.8	0.1
Other forms of tuberculosis	0.3	0.1
External causes	1.0	1.0
All other causes	7.4	4.1
Ill-defined and unknown diseases	0.7	3.8

respiratory diseases decreased from 17.3 to 9.7, a reduction of 44 per cent. Except for the increase of influenza in

⁶ Source: Compiled from *Birth Statistics, 1915, and Birth, Stillbirth, and Infant Mortality Statistics, 1933*, Bureau of the Census, Wash-

ington: Government Printing Office, 1936.

1933, the reduction would have been over half. The group of causes grouped under natal and prenatal causes shows a decrease from 42.2 to 30.7, a reduction of well over one fourth, but in view of the difficulties in control of these causes, perhaps especially significant. Of these causes the mortality from congenital debility decreased nearly two thirds and from prematurity nearly one sixth, while injuries at birth increased 12 per cent. Syphilis showed a reduction of nearly 60 per cent in the cities, and of only 16 per cent in the rural areas. Almost alone among the causes of death, injuries at birth showed an increase from 4.1 in 1915 to 4.6 in 1933. This is usually ascribed to an increase in the use of instruments.

Diseases ill-defined and unknown increased from 0.7 to 3.8, probably indicating the poorer certification of causes in the states added to the birth registration area since 1915.

FACTORS INFLUENCING MORTALITY

Besides the analysis by causes of death, underlying causes having their roots in the physical constitutions of the infants, methods of infant care, and the social and economic conditions of life should be considered. These fall into three principal groups of physical factors, the type of feeding, and the social and economic factors.

Among the physical factors which influence mortality rates are sex, prematurity, and type of birth—whether single or multiple. Male infants show

ington: Government Printing Office, 1936. Certain changes in the cause-of-death classification have been made; in particular, congenital debility as given here includes the rubrics "congenital debility, icterus, sclerema" and "other diseases of early infancy." Meningococcus-meningitis is epidemic cerebro-spinal meningitis. In general, only those diseases which are listed are included in the totals of the groups of causes.

a mortality of approximately 25 per cent higher than that of female infants. This is true for practically every cause of death. Whooping cough, however, is an exception, for this disease shows a higher mortality rate for female chil-

the survey method for small sample communities or by hospitals and physicians' records show a greater incidence of mortality for this group. In the Children's Bureau study of infants in eight cities, the prematurely

TABLE III—DECLINE OF INFANT MORTALITY RATES BY CAUSE OF DEATH, IN URBAN AND RURAL AREAS; 1917 TO 1933. U. S. BIRTH REGISTRATION AREA OF 1917 EXCLUSIVE OF RHODE ISLAND ⁷

Causes and Cause Groups	Infant Mortality Rates ^a			
	Urban ^b		Rural	
	1917	1933	1917	1933
All causes	99.4	54.4	87.8	55.0
Natal and prenatal causes	41.7	33.3	36.6	30.6
Congenital malformations	6.5	6.2	6.1	5.6
Premature birth	20.1	16.8	18.1	15.6
Congenital debility	8.7	3.7	8.7	4.8
Injuries at birth	4.6	5.9	3.0	4.0
Syphilis	1.7	0.7	0.6	0.5
Tetanus	0.1	...	0.1	0.1
Gastro-intestinal diseases	25.1	4.5	18.1	5.9
Diseases of the stomach	1.0	0.1	1.5	0.3
Diarrhea and enteritis	23.9	4.2	16.1	5.3
Dysentery	0.2	0.2	0.5	0.3
Respiratory diseases	17.5	9.1	13.4	9.1
Bronchitis and broncho-pneumonia	12.4	6.3	8.6	4.9
Influenza and pneumonia	5.1	2.8	4.8	4.2
Epidemic and communicable diseases	6.2	2.0	6.3	2.0
Measles	1.0	0.2	1.4	0.2
Scarlet fever	0.1	...	0.1	...
Whooping cough	2.1	0.9	2.7	1.2
Diphtheria	0.6	0.1	0.5	0.2
Erysipelas	0.6	0.3	0.4	0.2
Tuberculosis (all forms)	1.8	0.5	1.2	0.2
External causes	1.3	0.8	1.4	1.1
All other causes	7.1	4.5	6.9	3.7
Ill-defined and unknown diseases	0.6	0.4	5.2	2.3

^a Totals in each group are the sum of the rates for diseases listed.

^b Urban includes cities of 10,000 population and over.

dren. Female children are also somewhat more likely to have the disease.

Prematurity causes a considerably higher mortality than is found among full-term births. No statistics are available for the country as a whole on this point, but various data given by

⁷ Source: Rearranged from *Birth, Stillbirth, and Infant Mortality Statistics, 1933, op. cit.*, p. 28, Table A C.

born had a mortality rate some six times that of infants born at term.

Twins and triplets and other multiple births have a very much increased hazard of dying during the first year of life. This is partly due to their being prematurely born in an unusually large proportion of cases, and partly to their artificial feeding in larger numbers than other children, and partly to

other causes. The wide publicity given to the success of medical science in saving the Dionne quintuplets has effectively popularized the advances made by the medical profession in the care of multiple births.

A very important factor in infant mortality is the type of feeding. In the detailed study of types of feeding among infants in eight cities made by the Children's Bureau, those artificially fed for the first nine months had a mortality on the average from three to four times that of breast fed children. This excessive mortality among the artificially fed was higher the earlier the artificial feeding began. Infants who were breast fed during the first six to nine months and were then transferred to artificial feeding showed the lowest mortality rate. These data, it should be remembered, were based upon the conditions of breast fed and artificially fed as they actually existed in the sample populations studied at the time of the survey. They do not necessarily reflect the relative rates of mortality that might be obtained under the best possible conditions. The hazards of artificial feeding may be due in considerable part to infection, to lack of care in preparing the feeding, or perhaps to failure to adapt the feeding formula to the requirements of the individual case.

An interesting study by Dr. Grulee and his associates, of infants under care of welfare agencies in Chicago, shows a markedly better record for breast fed children than for artificially fed children, in both morbidity and mortality from respiratory, gastrointestinal, and other diseases.⁸

⁸ Clifford G. Grulee, Heyworth N. Sanford, and Paul H. Harrow, "Breast and artificial feeding: Influence on morbidity and mortality of 20,000 infants," *Journal American Medical Association*, Vol. 103, No. 10 (Sept. 8, 1934), pp. 735-738.

Analysis by age of mothers and order of birth shows that infant mortality rates, while higher for first than for second births, tend to increase with the subsequent orders. Births to the youngest and the oldest mothers show higher mortality rates than births to mothers of intermediate ages. The study made by the Children's Bureau of mortality in eight cities shows also the great importance of the interval between births. Where the interval between births was one year as measured by the difference in the mother's age in whole years at successive births, the infant mortality rate was 147 as compared to 99 for infants born after an interval of 2 years, and 87 and 85 for intervals of 3 years and 4 years and over, respectively. These figures emphasize the need for proper spacing between births.

RACIAL DIFFERENCES

The infant mortality rates among the white and the Negro population of the United States in 1933 were 52.8 for white and 91.3 for colored respectively. In 1934 they were 54.5 and 94.4. The colored population is largely concentrated in the Southern States, with considerable groups also in the urban centers in the North. The decrease in mortality since 1915 was from 98.6 for whites and from 181.2 for colored. The rate for colored was thus practically halved in the eighteen-year period, a decrease of 49 per cent, and the rate for white nearly halved, a decrease of 47 per cent. If compared by means of link relatives, however, the decrease appears substantially less, or 43 per cent for each group. The addition of large areas with lower rates tended to overstate the apparent improvement in mortality conditions, especially among the Negroes.

As to whether the difference in relative mortality is due to differences in physical vitality or to differences in social and economic conditions, to health habits, and to other than physical factors, it is difficult to bring conclusive evidence. Many studies suggest the importance of differences in number of children in the family, illegitimacy, and economic status as factors helping to explain the higher mortality among Negro infants.⁹ So far as type of feeding is concerned, the greater prevalence of breast feeding among Negroes should, other things being equal, tend to reduce their mortality.¹⁰ The study made by the Children's Bureau tended to indicate that the elimination of the specific influences of differences in economic status and type of feeding, so far as the data at hand permitted, did not account for all the differences in mortality in the two race groups.

Infant mortality rates for white infants according to nationality (as shown by country of birth of mother) are exhibited for the expanding birth registration area for three years, 1916, 1921, 1932. These show very marked variations in 1916 from a low of 68.4 for infants of mothers born in Scandinavia to a high of 148.2 for infants of mothers born in Poland—a range of 80 points from the highest to the lowest. All the rates fell during the period un-

⁹ See J. V. DePorte, "Inter-Racial Variations in Infant Mortality," *American Journal of Hygiene*, Vol. 5 (1925), p. 454. Of colored births in 1933, 15.6 per cent were illegitimate, as compared with 2.1 per cent of white births; see *Birth, Stillbirth, and Infant Mortality Statistics, 1933, op. cit.*, p. 13.

¹⁰ See U. S. Children's Bureau Publication No. 142 (Washington: Government Printing Office, 1925), p. 114. Of the months lived by Negro infants up to the end of the first nine months of life, 19.7 per cent were months of exclusively artificial feeding, as compared with 25.2 per cent of those lived by white children, according to the study of infant mortality in eight cities.

der review, the higher rates relatively more than the lower. The range of rates in 1932 was much narrower, only 20 points, from the low of 43.1 for infants of mothers born in Russia (largely Jews) to a high of 61.5 for infants of mothers born in Poland. The highest rate was only 50 per cent above the lowest rate. The relative position of certain nationality groups was materially bettered, notably that of the Germans and the Russians, which moved from eighth and fifth to second and first (in order of rank from lowest mortality to highest) respectively.

It is difficult to draw definite conclusions on the question of whether or not there are racial differences in vitality. So far as the evidence goes, it strongly suggests that the differences in mortality are due to differences in environmental conditions such as standards and habits of living, type of feeding given to infants, custom of calling in medical assistance, and similar factors, rather than to differences in physical constitution. Certainly no safe conclusion as to the latter can be drawn until after differences in environmental conditions have been eliminated. If it is true that differences in infant mortality among different nationalities in this country are primarily a matter of the quality of infant care, this points directly to the importance of the different standards and the different traditions prevailing in the different nationality groups.¹¹

SOCIAL AND ECONOMIC FACTORS

Among the important factors influencing mortality rates are social and

¹¹ The above material does not show clearly the situation among Jews, since in the table where they are classified according to their country of birth rather than according to their race. The studies of the Children's Bureau in eight cities indicated that infant mortality was lower among Jews than in any other nationality.

economic conditions, as measured by economic status, income of the father, family income, and mother's employment. The Children's Bureau studies already mentioned showed a marked decrease of infant mortality rates as the earnings of the father increased. This decrease in mortality rates as earnings increased was found to be independent of other factors, such as

groups were respectively 44, 35, 38, 37, 30, 36, and 32.

More recent studies have confirmed this general conclusion. Howard W. Green's survey of infant mortality rates in Cleveland, Ohio, in 1928, classified according to economic status based on the rental value (if not owned) or market value (if owned) of the dwelling occupied by the family,

TABLE IV—DECLINE IN INFANT MORTALITY, BY COUNTRY OF BIRTH OF MOTHERS: WHITE INFANTS—U. S. EXPANDING BIRTH REGISTRATION AREA, 1916, 1921, AND 1932¹²

Country of Birth of Mother	Infant Mortality Rates		
	1916	1921	1932
White (total).....	99.0	72.5	53.3
United States.....	89.8	68.4	52.5
Austria.....	140.4	93.6	} 58.4
Hungary.....	85.7	84.1	
Canada.....	121.2	89.1	54.4
Scandinavia.....	68.4	59.9	45.0
Great Britain.....	86.6	69.7	43.7
Ireland.....	103.1	76.0	51.2
Germany.....	103.5	71.1	43.1
Italy.....	99.0	73.9	53.4
Poland.....	148.2	100.6	61.5
Russia.....	94.7	61.9	42.1

nationality and type of feeding. The rates for seven cities studied by the Children's Bureau showed a decrease as follows:

Under \$ 450.....	167
450-\$ 549.....	106
550- 649.....	117
650- 849.....	108
850- 1,049.....	83
1,050- 1,249.....	64
1,250 and over.....	59

Similar decreases in rates appear in practically all causes of death, including diseases of early infancy, the rates from which for the different income

¹² Source: First two columns from J. V. DePorte, *op. cit.*, p. 459. Last column from U. S. Bureau of the Census, *Birth, Stillbirth, and Infant Mortality Statistics for the Birth Registration Area of the United States, 1932* (Washington: Gov't Printing Office, 1935), p. 33.

showed rates varying from 35.7 per 1,000 for the highest economic group to 86.6 per 1,000 for the lowest.¹³ Other studies in New York and Chicago relate the infant mortality rates in particular districts to general economic conditions of the district, such as average rental paid, and show a correspondence between higher rates and poorer economic conditions.¹⁴

¹³ Quoted by Edgar Sydenstricker, *Health and Environment* (New York and London: McGraw-Hill Book Co., 1933), p. 100.

¹⁴ Data for Chicago, from unpublished study by Philip M. Hauser. Data for New York in mimeographed bulletin *Health Center Districts* (New York City), Statistical Reference Data, Five-Year Period 1928-1932. Compiled by Godias J. Drolet and Marguerite Prudence Potter. For general references, see also Edgar Sydenstricker, *op. cit.*, pp. 84-108; and Friedrich Prinzing, *Handbuch der medizinischen Statistik*,

These studies show similar relationships between economic conditions and rates of mortality from specific causes, neonatal mortality rates, and stillbirth rates. Dr. Dublin has emphasized that the differences between the neonatal mortality and early infancy rates in different cities are significant as suggesting that these rates, which have responded as yet comparatively little to public health efforts, are susceptible of control.¹⁵

Study of the influence of mothers' employment showed that employment of the mother during pregnancy was accompanied by a somewhat higher infant mortality rate, according to the data gathered by the Children's Bureau. Where the mother was employed away from home the rate was 175; where employed at home, 115; and where not employed, 98. The employment of the mother during the infant's first year of life was likewise accompanied by a higher mortality, particularly for the group of infants whose mothers were employed away from home. In these cases the excess mortality of these infants was accounted for in part by their being artificially fed in somewhat greater proportions than other infants, but other elements of infant care were doubtless also lacking.

Legitimacy has a direct relation to infant mortality rates. Unfortunately in this country we do not have infant mortality rates classified by legitimacy, but data from other countries show that the legitimate infants have much lower rates.

EFFECTS OF THE DEPRESSION

Returning to the dictum cited at the beginning of the paper, an interesting

2nd ed. (Jena: Gustav Fischer, 1931), pp. 413-417.

¹⁵ See Louis I. Dublin, "The Mortality of Early Infancy," *Am. J. of Hygiene*, Vol. 3,

question is raised as to the effect of the depression upon infant mortality. On the one hand, we have the evidence of the relation between economic status or income and the infant mortality rate, and the relation shown between housing conditions or types of living areas in such cities as New York, Chicago, and Cleveland; on the other, the facts that all the infant mortality rates are decreasing and tending to reduce their spread, and that the depression, with its general lowering of economic conditions and of income has not been accompanied by marked increases of infant deaths. It is true that from 1932 to 1934 the rates increased slightly, but the course of the rates from 1929 to 1932 shows a marked decrease, and the slight increase in 1932-1934 is negligible or may perhaps be interpreted as a mere brief interlude in the downward trend of the rates.

The failure of the rates to rise promptly and strikingly is doubtless to be attributed not so much to the failure of economic conditions to influence the rates as to the fact that public health measures and private care practices learned by mothers in all classes through well-baby or health centers, clinics, and literature do not lose their effectiveness during a depression. The gains once achieved are held. The problem is primarily one of public education in the health field. In particular, one of the important elements of child care is the matter of feeding, and precisely in this respect highly significant developments in methods and techniques have occurred, including the feeding of vitamins and protective foods, such as fish liver oils, orange juice, and so forth. Such information popularized and assimilated by the public is not affected immediately by the ups and

No. 3 (May 1923), pp. 211-223. Also Edgar Sydenstricker, *op. cit.*, pp. 100-101.

downs of periods of prosperity and depression. It remains true that the better situated classes have much readier access to this information and are in better position to learn the best methods of child care than those less well off, and, of course, are in a much better position to make use of their information. However, the free distribution of all kinds of leaflets and pamphlets on child care, and the establishment of health centers and well-baby clinics have done much to lessen the handicaps of the less fortunately placed.

The primary handicap remains, however, the sheer lack of means to obtain the vitamins, particular foods, medical care, and all the other things that money is needed to buy. So far as the reduction in income or economic position means a worsening of the conditions surrounding infant life and an increase in the dangers to which it is exposed, an increase in the infant death rate might be expected. On the other hand, there is a considerable leeway in the application of income in its effects upon the conditions of infant life, so that temporary changes in money income may not be immediately reflected in higher rates. And in particular, as has been often pointed out, increased unemployment, especially unemployment of mothers, has resulted in lowered infant mortality because of the increased prevalence of breast feeding, with its markedly lower hazard to infant life.

The point deserves emphasis that temporary changes in money income do not have the same effect as established differences in economic status. A very significant analysis by Perrott and Collins of child mortality and morbidity during the depression years in cases of families which had lost economic position indicates that in the families which had dropped from high

to low economic position the habits of life characteristic of the higher economic position carried along by these families with their lowered status apparently kept their children from acquiring the ordinary children's diseases at the very early ages common to the poorest economic group; they acquired them, if at all, at the relatively later ages characteristic of the economic class to which they had belonged.¹⁶

The question of the selective effect of infant mortality has received considerable attention. The consensus of the best critical opinion seems to be that infant mortality, and especially such part of infant mortality as is preventable, does not operate selectively to weed out the "unfit." It is generally agreed that the elimination and control of the communicable diseases, for example, operates to eliminate at the same time a great mass of unnecessary impairments of vital organs which formerly claimed a heavy toll of morbidity and mortality at older ages.¹⁷

PROSPECT OF FURTHER ACCOMPLISHMENT

An estimate of the possible further reduction of infant mortality during the next few decades is of interest. Since 1915 the United States has reduced its rate from 100 to 60; during the same period New Zealand reduced its rate from 52 to 32. Our rate is thus still about twice the New Zealand rate. By 1915 New Zealand had reduced her rates from gastric and intestinal diseases¹⁸ to 5.4 per 1,000.

¹⁶ G. St. J. Perrott and Selwyn D. Collins, "Sickness and the Depression: A Preliminary Report upon a Survey of Wage Earning Families in 10 Cities," *Milbank Memorial Fund Quarterly*, Vol. 12, No. 3, July 1934 (p. 7 of reprint).

¹⁷ See Edgar Sydenstricker, *op. cit.*, pp. 191-192, for an excellent statement on this problem.

¹⁸ Including only diseases of the stomach and diarrhea and enteritis.

Now this cause is practically wiped out (0.9). Our rate in 1915 from the same causes was in the neighborhood of 25 per 1,000 (24.6). Now it is 5.9. Our rate from diseases peculiar to early infancy was 34.3 in 1915. Now it is reduced to 24.7. New Zealand's rate in 1915 was 24.9. Now it is 18.3. Similar comparisons can be made with other causes of death. New Zealand's rate clearly indicates possibilities of attainment which should not be too difficult.

Dublin and Lotka in *Length of Life* place as an attainable goal in infant mortality a rate of 25 per 1,000—somewhat less than New Zealand's present rate.¹⁹ It is surely not too much to hope that in the not distant future our techniques for infant care will have advanced to the point where we shall save half the infants who now die. In numbers, this means a saving of approximately 60,000 infants a year. The saving of these infant lives and the

¹⁹ Pp. 191-193, New Zealand's rate for females in 1931 was 25.5.

safeguarding of the health of those who survive become an important goal.

Measures available for obtaining this hoped-for goal include the extension of those already in operation in many areas, in particular the extension of health centers and well-baby clinics, the continued dissemination of information so that it reaches all mothers, the extension of the program for better prenatal and confinement care, and continuation of programs against specific diseases, such as tuberculosis, diphtheria, scarlet fever, and syphilis. These are obvious lines of development. Further advances may be hastened by measures making possible or providing for adequate medical care for all families. Need for special work is particularly urgent in case of diseases of early infancy, stillbirths, and neonatal mortality. There is need also for a continual critical appraisal of the results derived from specific measures in order to accomplish the maximum result with the least expenditure in effort.

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