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INEQUALITY AND INFANT AND CHILDHOOD MORTALITY IN THE UNITED
STATES IN THE TWENTIETH CENTURY

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Inequality and Infant and Childhood Mortality in the United States in the Twentieth Century
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ABSTRACT

This paper deals with the issue of using infant and childhood mortality as an indicator of inequality. The case is that of the United States in the 20th century. Using microdata from the 1900 and 1910 Integrated Public Use Microsamples (IPUMS), published data from the Birth Registration Area in the 1920s, results from a number of surveys, and the Linked Birth & Infant Death Files from the National Center for Health Statistics for 1991, infant and child mortality can be related to such other variables as occupation of father or mother, education of father or mother, family income, race, ethnicity, and residence. The evidence shows that, although there have been large absolute reductions in the level of infant and child mortality rates and also a reduction in the absolute levels of differences across socioeconomic groups, relative inequality has not diminished over the 20th century.

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INTRODUCTION

The issue of inequality has been, and remains, a central concern for social science and public policy. For instance, despite dramatic increases in income, wealth, and standard of living in developed, industrial nations, segments of the populations in those nations have remained disadvantaged. In the United States, the real consumption wage remained relatively stagnant from the mid 1980s to the mid 1990s. Real median family and individual incomes were stagnant or declining over that period [Council of Economic Advisers, 1996, pp. 61, 314]. The share of money income going to the top 5% of households increased from 15.8% in 1980 to 21.4% in 1998. [Carter, et al., 2006, Table Be 1-18]. Some nations and regions in the developing world have stagnated or even experienced deterioration of living standards [United Nations, 1999, pp. 37-41]. In the study of inequality and distribution, the focus has often been on inputs, such as income, although the historical statistics on income distribution are considered quite deficient [Kuznets, 1966, ch. 4]. Nevertheless, it is often better to focus rather on outcomes, such as health and mortality. This is the essence of the World Bank's Basic Needs Indicators [Hicks and Streeten, 1975], which include such things as nutrition, health, housing, sanitation, and education.¹ The expectation of life at birth and the infant mortality rate are among the measures used. Some of the more frequently used development indicators include similar outcome variables, notably demographic ones. The Physical Quality of Life Index [Overseas Development Council, 1979] uses the expectation of life at age one, the infant mortality rate, and the literacy rate. The Human Development Index of the United Nations Development Program [United Nations, 1994, ch. 5] includes the expectation of life at birth (which is heavily influenced by the infant mortality rate), adult literacy, mean years of schooling, and real GDP per capita adjusted for purchasing power parity.

The infant mortality rate has frequently been used as a social indicator. So, for example, Sir Arthur Newsholme in Britain wrote in 1910: "Infant Mortality is the most sensitive index we possess of social welfare and of sanitary administration, especially under urban conditions" [cited in Titmuss, 1943, p. 12]. The Physical Quality of Life Index uses the IMR explicitly. In the United States, early efforts by the Children's Bureau focused on collection of demographic statistics and studies of

¹ Some of these features of basic needs are both inputs and intermediate outputs. Education and health are goods in and of themselves, but also increase labor productivity.

infant mortality [Lindenmeyer, 1997, ch. 3; Woodbury, 1926; Bremner, 1971, pp. 958-965; Meckel, 1990, ch. 4].

In this paper an effort is made to trace trends in inequality over the 20th century in the United States using infant and childhood mortality as a social indicator of an important outcome.² At various points, appeal is made to social class. This complex concept can be made measurable in a variety of ways: by occupation, by income, by wealth and property, by education (human capital), by residence. Some use is made of all these dimensions, although, at basis, the issue is really one of "life chances". [Weber, 1963 [1920]; Dahrendorf, 1979].

TRENDS IN INEQUALITY IN INFANT MORTALITY IN THE UNITED STATES: the 1890S to the 1990s

The starting point for this study is the United States Census of 1900, which asked questions on the number of children ever born, the number of children surviving, and the duration of current marriage of married, adult women.³ Nothing was ever tabulated from those questions, but a public use microsample (of about 100,000 individuals) has been created which permits use of these data. This census has been used by Preston and Haines [Preston and Haines, 1991; Haines and Preston, 1997] to make estimates of childhood mortality. The methodology of indirect estimation is described in detail elsewhere [United Nations, 1983, ch. III; Preston and Haines, 1991, ch. 2; Haines and Preston, 1997]. The same techniques were also applied to the microsample of the 1910 United States Census (of about 366,000 individuals) which also asked the same questions [Preston, Ewbank, and Hereward, 1994; Haines and Preston, 1997]. The fundamental intuition is that the proportion of children dead for a certain age group or marriage duration group of women can be adjusted with a model to yield a life table parameter, namely $q(x)$, which is the proportion of children dying before reaching exact age "x". The "x" depends on the age or duration group of women. Each of these estimated $q(x)$ values can also be dated to a specific point in time prior to the census date. A great advantage of this method is that it allows tabulation of mortality differentials by characteristics of the parents - in this case occupation of father.

The starting point is the federal censuses of 1900 and 1910 (Tables 1 and 2). Child mortality is summarized in these tables as a mortality index. The index is

² For an overview of the history of inequality and distribution in the United States, see Williamson and Lindert [1980].

³ These questions had been asked before in 1890, but nothing was tabulated using these questions and the manuscripts of that census were largely destroyed.

approximately 1.0 for all women in the sample at each date. An index value below one indicates lower than average childhood mortality of that group of women, while an index value above one points to the opposite. In both tables the sample is restricted to women aged 14 to 49 who were married 0-24 years, once married with husband present, and for whom children ever born and children surviving were known.⁴ This resulted in a total sample of 12,624 women with 23,073 children ever born in 1900 and 39,305 women with 61,636 children ever born in 1910. The mortality index itself is calculated at the ratio of actual children dead (computed as the difference of children ever born and children surviving) to expected children dead for each group of women. Expected children dead is calculated by multiplying the children ever born in each marriage duration group (0-4 years, 5-9 years, ..., 20-24 years) by the expected proportion dead for that marriage duration group using the Trussell/United Nations model and the Coale and Demeny [1966] Model West life tables [see United Nations, 1983, ch. III; Haines and Preston, 1997, Table A1]. For 1900, the West Model life table chosen for the standard was level 13 for both sexes combined, and for 1910 it was level 13.5. The results for 1900 apply approximately to the year 1895 and those for 1910 to approximately to the year 1904.

Husband's occupation is used as an indicator of social status for the 1900 and 1910 census estimates. The detailed occupations were organized into the tenfold classification of the 1950 United States Census.⁵ For the black population, relatively few cases were found in the higher socioeconomic status groups, so that Professional and Technical; Managers, Officials, and Proprietors; Clerical; and Sales were combined together. In general, the least well off groups (usually non-farm laborers) had childhood mortality 40-100% higher than the most favored groups. The baseline in the last three columns was set at 100 for the Professional and Technical group, but farmers (agricultural except laborers), clerical and sales often did better in 1900. This was usually not true in 1910. Inequality across occupational groups in childhood mortality was mostly great among foreign-born whites and among blacks than among native-born whites. A rural-urban breakdown is also provided in Tables 1 and 2. In 1900, inequality was usually worse in urban areas than in rural places, but the effect was not pronounced. This had changed a bit by 1910 - urban areas were still worse off

⁴ The imputed cases of children ever born and children surviving in the IPUMS samples were not used. They produced erratic results.

⁵ The IPUMS provides a mapping between the occupations in 1900 and 1910 and the 1950 census stratification scheme.

for foreign-born whites and blacks but not for native-white women.

The next point in the twentieth century for which national level data are available is the 1920s. During that period, the United States Bureau of the Census, which had the responsibility for collecting vital statistics from state and local governments and for published them, was tabulating statistics on births, children ever born, children surviving, and number of women by age of woman and detailed occupation of husband for the Birth Registration Area. The entire nation was not covered by vital statistics reporting until 1933. Prior to that, a Death Registration Area (1900-1932) and a Birth Registration Area (1915-1932) were gradually built up to the national system by incorporating only those states and cities which had vital statistics collection which met certain minimum standards. These birth data are reported for 1924 in Table 3 and for 1929 in Table 4 [U.S. Bureau of the Census, 1926, Table 10; 1932, Table 10].⁶ In 1924, the Birth Registration area covered about 76% of the American population. The coverage was at about 95% in 1929 [Carter, et al., 2006, Table Ab1-37]. The detailed occupations of husband from the birth and infant mortality statistics volumes were re-aggregated into the same 1950 U.S. Census groupings as used for 1900 and 1910. While the published tables did not cover all occupations of husband, they did encompass 90.9% of all registered births in 1924 and 91.6% in 1929. The Trussell/United Nations age model of indirect child mortality estimation was applied to calculate $q(2)$ (the probability of dying before reaching exact age 2) based on women aged 20-24 years and $q(5)$ (the probability of dying before reaching exact age 5) based on women aged 30-34 years [United Nations, 1983, pp. 76-81]. The estimates for 1924 apply to about the year 1919 for $q(2)$ and to approximately 1916-1917 for $q(5)$. Similarly, the dating was approximately 1924 for the $q(2)$ calculated from the 1929 data and about 1921-1922 for the $q(5)$ from the 1929 information. No breakdown by nativity, race, or residence was available.

Looking at the results in Tables 3 and 4, inequality in the 1920s was, if anything, worse than it had been in 1900 and 1910. Interestingly, farmers and agricultural laborers no longer enjoyed a favorable situation with respect to child mortality. The health advantage of rural residence was disappearing as the urban mortality penalty was being eliminated [see Haines, 1999]. By the 1920s many cities were healthier than surrounding rural areas, especially because of more rapid and extensive improvements in urban water supplies, sewerage disposal, food and milk

⁶ These data were first utilized by Ewbank and Preston [1990].

protection, and other aspects of public health. The 1920s were also a decade of worsening income and wealth distribution in general [Williamson and Lindert, 1980, pp. 75-82]. The mortality gradients in the 1920s were now more regular with Professional and Technical have the lowest child mortality, passing up through Clerical, Sales, and Managers-Officials-Proprietors and finally up through skilled manual workers, operatives, and both farm and non-farm laborers. By 1929, non-farm laborers now had a q(5) level two to three times as high as that for women with husbands having professional or technical occupations.

During that same era, the Children's Bureau came into existence (1912) [Lindenmeyer, 1997]. One of its first efforts was to undertake studies of infant mortality. Over the period 1912 to 1915, eight cities were studied (Johnstown, PA; Manchester, NH; New Bedford, MA; Waterbury, CT; Akron, OH; Saginaw, MI; Brockton, MA; and Baltimore, MD) and samples were taken totaling 22,967 live births and 2,555 infant deaths. The infant deaths were matched to the birth certificates, and the birth certificates were traced to the families who were, in turn, interviewed. The results were summarized later by Woodbury [1926]. These were extraordinary studies in that elicited information on breast feeding, income, and birth intervals, as well as the standard demographic information (e.g., age, race, nativity, family relationships). Selected results are given in Table 5. There was a clear gradient from low to high incomes with the highest infant mortality rate occurring in families with the husband reporting no earnings. The penalty for having a male family head without work was tragic - it raised the infant mortality rate by 357% over the highest income group (\$1,250 and over). The risk of having a child death was decreased by 26% by just moving into the lowest income category (\$450 and below). This accords with the finding of Preston and Haines [1991, chs. 3 and 4, especially tables 3.1 and 4.1] for the 1900 census that unemployment of the husband had a consistent and considerable negative impact on child survival. If the husband reported some unemployment in the year prior to the census, it raised the mortality index by about 26% (and by about 16% when controlling for a number of other variables). In the 1912-15 surveys, at any given income level, native white women usually did better than foreign-born white women, but not consistently so and not by too much. Tabulations by income show that both blacks and foreign-born whites had higher infant mortality rates because they were, on average, poorer than native whites. Nevertheless, the lower panels of Table 5 show that breast feeding could make a difference for some groups. Ethnic groups with a higher incidence of breast feeding (e.g., Italian, Polish, and Jewish women)

but with a higher proportion of lower income families (percent with incomes below \$650) did better in terms of child survival than did similar groups with a low incidence of breast feeding (e.g., Portuguese women). Even groups with higher income but a lower incidence of breast feeding (e.g., German, French Canadian, and native white women) did not fare as well as income would suggest.

Two additional tables (7 and 8) provide results for the 1950s and 1960s. Table 6 presents data for single births to white mothers in New York State in 1950-1952. They are organized by the standard 1950 U.S. Census categories of husband's occupation. The results are both unadjusted and adjusted for birth weight and age of mother. They are also tabulated for different ages at death fetal, infant (0-365 days), neonatal (0-27 days), and post-neonatal (28-365 days). The gradients for the infant mortality rate by socioeconomic group are now smaller than previously, and they are also quite regular. The differences between the highest and the lowest groups are considerably smaller - about 60% for infant mortality and 33% for neonatal mortality. The differences are largest for the post-neonatal period when the influence of environmental circumstances is much more likely to affect the outcome.

Table 7 gives some data from the large matched birth and infant death study undertaken for the period 1964-1966 by the National Center for Health Statistics [see MacMahon, Kovar, and Feldman, 1972]. In this case, education of the father is used as the indicator of socioeconomic status., since birth and death certificates did not report occupation of the father. They still do not report that useful piece of information [NCHS, 1995, Section 4, pp. 1-3; NCHS, 1996a, Section 7, pp. 2-5]. By the 1960s, infant mortality rates had fallen considerably - from about 100 infant deaths per 1,000 live births for the Birth Registration Area in 1915, to about 72 for the Birth Registration Area in 1925, to about 56 in 1935, 34 in 1945, 26 in 1955 and 25 in 1965 (and 21 for the white population) [Carter, et al. 2006, Table Ab912-927]. But differentials by education and socioeconomic status were still considerable: a 78% penalty for women with husband's with 8 or fewer years of education relative to women with husbands with a college education or more. The penalty was 49% for neonatal mortality and 303% for post-neonatal mortality.

A similar study can be undertaken for the United states for a later period. The National Center for Health Statistics has been releasing the data from the "Linked Birth/Infant Death Studies" for birth cohorts from 1985 onwards. Table 8 reports

tabulations made from those data for the birth cohort of 1991 [NCHS, 1996].⁷ This data set contains information on 4,115,494 births and 35,520 infant deaths. Again the measure of socioeconomic status is the education level of the father.⁸ The results are reported by race (using the 1990 Office of Management and Budget categories) and for infant, neonatal, and post-neonatal mortality rates. The gradients are still present, despite the drop in the overall infant mortality rate to 8.6 per 1,000 live births (7.0 for whites and 16.6 for blacks). Those with no formal education had infant mortality rates over twice as high as those who had some graduate education. The differences were also again larger for post neonatal mortality, though not dramatically so. It is unrealistic, however, to look at those results. Couples with a husband having no formal education contributed only .7% of all births in the United States in 1991. The results are less dramatic for husband's with 1-7 years and with completed primary education (8 years of schooling). Quite large differences appear across racial and ethnic categories: Whites and Asian/Pacific Islanders do well. Blacks and American Indians, Eskimos, and Aleuts do poorly. The socioeconomic status gradients within groups remain and look similar. It is the concentration of blacks and Amerindians in low educational categories that relegates them to this harsh mortality penalty.

CONCLUDING COMMENTS

The studies and data sets surveyed in this paper are summarized in Table 9. Several additional studies (taken from Antonovsky and Bernstein [1977]) are also reported. The mortality ratios are the common measure, which give the ratio of the mortality rate for infants or children for the lowest socioeconomic status group to the mortality rate for the highest socioeconomic status group. The table shows some tendency for inequality to worsen from the 1890s to the 1920s. There was likely some improvement from the 1930s to the 1950s, in parallel with a general improvement in income distribution [Williamson and Lindert, 1980, pp. 82-94]. But differentials seem to have opened again, despite the overall decline in infant and child mortality. Social status gradients in infant mortality continue to exist and to be relatively large in relative terms (though now much smaller in absolute terms). There is currently a 50% to 150% penalty in infant mortality for being in the lowest

⁷ The CD-ROM versions are not especially easy to use for analytical purposes. The ASCII data are available from the National Center for Health Statistics. For an example of the application of these data, see Hummer, et al. [1999].

⁸ This was the last year for which education of the father was reported.

socioeconomic status group relative to the highest one.

But race and ethnicity must be considered whenever looking at the American population and society. The serious disadvantage of the nonwhite population is traceable significantly to their low average levels of education and income. This is true especially for blacks but also for the Amerindian population. It also holds for the Hispanic population (both white and nonwhite), although that group is not analyzed here. The Asian/Pacific Islander population as a whole does not suffer from this mortality penalty. On two counts, the U.S. lags many other developed nations -- the level of health and medical care provided to the poor, and the standard of living of the poor. In 2005, the United States ranked 42nd in the world in infant mortality. But even if all Americans has the same infant mortality rate as the white population (5.7), the United States would still only be tied for 38th place [U.S. Bureau of the Census, 2008, Table 1295]. A wealthy and technologically advanced society surely can and should do more. As Antonovsky and Bernstein [1977, p. 459] note: "Low social class *per se* does not cause high infant mortality...however,...social class does subsume a large set of more directly causative biological and behavioral variables." Some of those causative variables may be amenable to direct policy intervention (e.g., universal child immunization programs), but some may be address by more general improvements in the living standards of the society, particularly among its poor.

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Table 1. Child Mortality Index by Race, Residence, & Occupation of Father. United States, 1900.

	Total	(CEB)	Urban	(CEB)	Rural	(CEB)	Ratio to Professional/Technical		
							Total	Rural	Urban
All Women	1.0007	39326	1.1231	16253	0.9149	23073	1.057	1.132	1.054
Professional, Technical	0.9465	943	0.9919	601	0.8678	342	1.000	1.000	1.000
Agricultural (excluding Laborers)	0.8651	15762	1.0917	678	0.8548	15084	0.914	1.101	0.985
Managers, Officials, Proprietors	0.9358	2341	0.9421	1657	0.9207	684	0.989	0.950	1.061
Clerical	0.9135	712	0.9169	598	0.8959	114	0.965	0.924	1.032
Sales	0.8325	905	0.8478	771	0.7440	134	0.880	0.855	0.857
Craftsmen, Foremen	1.1225	5676	1.1776	4266	0.9564	1410	1.186	1.187	1.102
Operatives	1.0474	3916	1.0380	2656	1.0660	1260	1.107	1.047	1.229
Service Workers	1.0025	868	0.9904	724	1.0639	144	1.059	0.998	1.226
Agricultural Laborers	1.1467	1702	0.8515	154	1.1770	1548	1.212	0.858	1.356
Laborers	1.2482	5947	1.3652	3732	1.0485	2215	1.319	1.376	1.208
Miscellaneous	1.0065	554	1.0341	416	0.9253	138	1.063	1.043	1.066
White Women	0.9359	34320	1.0725	15267	0.8271	19053	0.992	1.077	0.976
Professional, Technical	0.9432	907	0.9959	587	0.8474	320	1.000	1.000	1.000
Agricultural (excluding Laborers)	0.7726	13190	1.0523	617	0.7588	12573	0.819	1.057	0.895
Managers, Officials, Proprietors	0.9422	2293	0.9457	1635	0.9333	658	0.999	0.950	1.101
Clerical	0.8835	695	0.9071	592	0.7441	103	0.937	0.911	0.878
Sales	0.8366	893	0.8459	765	0.7809	128	0.887	0.849	0.922
Craftsmen, Foremen	1.0985	5507	1.1479	4175	0.9442	1332	1.165	1.153	1.114
Operatives	1.0044	3650	1.0091	2550	0.9938	1100	1.065	1.013	1.173
Service Workers	0.9472	762	0.9600	642	0.8778	120	1.004	0.964	1.036
Agricultural Laborers	0.9287	1035	0.7792	109	0.9465	926	0.985	0.782	1.117
Laborers	1.1671	4880	1.2364	3210	1.0324	1670	1.237	1.241	1.218
Miscellaneous	0.9556	508	0.9580	385	0.9483	123	1.013	0.962	1.119
Native White Women	0.8682	25333	0.9727	9090	0.8103	16243	0.929	1.015	0.907
Professional, Technical	0.9348	768	0.9588	486	0.8938	282	1.000	1.000	1.000

Table 1 (cont.)

	Total	(CEB)	Urban	(CEB)	Rural	(CEB)	Ratio to Professional/Technical		
							Total	Rural	Urban
Agricultural (excluding Laborers) Managers, Officials, Proprietors	0.7529	11238	0.9714	396	0.7449	10842	0.805	1.013	0.833
Clerical	0.8857	1744	0.8645	1172	0.9290	572	0.947	0.902	1.039
Sales	0.8466	577	0.8642	483	0.7541	94	0.906	0.901	0.844
Craftsmen, Foremen	0.7659	634	0.7559	517	0.8095	117	0.819	0.788	0.906
Operatives	1.0119	3627	1.0523	2467	0.9268	1160	1.082	1.098	1.037
Service Workers	0.9830	2243	0.9990	1470	0.9516	773	1.052	1.043	1.065
Agricultural Laborers	0.9261	501	0.9767	400	0.7248	101	0.991	1.019	0.811
Laborers	0.8917	862	0.7280	88	0.9106	774	0.954	0.759	1.019
Miscellaneous	1.0466	2833	1.0481	1412	1.0452	1421	1.120	1.093	1.169
Foreign White Women	0.8045	306	0.8530	199	0.7173	107	0.861	0.890	0.802
Professional, Technical\1	1.1247	8941	1.2163	6163	0.9237	2778	1.133	1.033	1.769
Agricultural (excluding Laborers) Managers, Officials, Proprietors	0.9929	138	1.1777	100	0.5294	58	1.000	1.000	1.000
Clerical\1	0.8867	1922	1.1960	221	0.8466	1701	0.893	1.016	1.622
Sales\1	1.1202	549	1.1492	463	0.9625	86	1.128	0.976	1.844
Craftsmen, Foremen	1.0586	118	1.0902	109	0.6350	58	1.066	0.926	1.000
Operatives	1.0041	259	1.0267	248	0.5294	58	1.011	0.872	1.000
Service Workers	1.2606	1873	1.2813	1701	0.5294	172	1.270	1.088	2.027
Agricultural Laborers	1.0314	1401	1.0160	1076	1.0823	325	1.039	0.863	2.073
Laborers	0.9880	261	0.9322	242	*	*	0.995	0.792	*
Miscellaneous	1.1046	173	*	*	1.1208	152	1.113	*	2.147
Black Women	1.3312	2047	1.3822	1798	0.9609	249	1.341	1.174	1.841
Professional, Technical\2	1.1948	200	1.0807	184	*	*	1.203	0.918	*
Agricultural (excluding Laborers) Managers, Officials, Proprietors\2	1.4440	4870	1.9582	963	1.3210	3907	1.722	2.051	1.766
	0.8388	100	0.9550	46	0.7478	54	1.000	1.000	1.000
	1.3281	2529	1.5156	61	1.3237	2468	1.583	1.587	1.770
	0.8388	100	0.9550	46	0.7478	54	1.000	1.000	1.000

Table 1 (cont.)

	Total	(CEB)	Urban	(CEB)	Rural	(CEB)	Ratio to Professional/Technical		
							Total	Rural	Urban
Clerical\2	0.8388	100	0.9550	46	0.7478	54	1.000	1.000	1.000
Sales\2	0.8388	100	0.9550	46	0.7478	54	1.000	1.000	1.000
Craftsmen, Foremen	1.9214	166	2.6456	91	1.0766	75	2.291	2.770	1.440
Operatives	1.6330	266	1.7393	106	1.5633	160	1.947	1.821	2.090
Service Workers	1.3668	88	1.2491	82	*	*	1.629	1.308	*
Agricultural Laborers	1.4926	643	1.0198	45	1.5306	598	1.779	1.068	2.047
Laborers	1.6456	1032	2.2338	501	1.0938	531	1.962	2.339	1.463
Miscellaneous	1.5575	46	*	*	*	*	1.857	*	*

Source: IPUMS sample of census enumerators' manuscripts, U.S. 1900.

Note: Sample consists of currently married women, married 0-24 years. The mortality index is the ratio of actual to expected child deaths. See text for the calculation of the expected child deaths. Unknown categories not reported. Only women with husband present are eligible for the calculation.

\1 Combined Professional and Technical; Clerical; and Sales.

\2 Combined Professional and Technical; Managers, etc.; Clerical; and Sales.

* Fewer than 40 children ever born in the category.

Table 2. Child Mortality Index by Race, Residence, & Occupation of Father. United States, 1910.

	Total	(CEB)	Urban	(CEB)	Rural	(CEB)	Ratio to Professional/Technical		
							Total	Rural	Urban
All Women	1.0000	115198	1.0706	53562	0.9389	61636	1.168	1.265	1.063
Professional, Technical	0.8564	2700	0.8467	1980	0.8832	720	1.000	1.000	1.000
Agricultural (excluding Laborers)	0.8962	40290	0.8962	1234	0.8962	39056	1.046	1.059	1.015
Managers, Officials, Proprietors	0.9260	11231	0.9555	8519	0.8331	2712	1.081	1.128	0.943
Clerical	0.8613	3106	0.9013	2548	0.6780	558	1.006	1.064	0.768
Sales	0.8171	3371	0.8471	2845	0.6517	526	0.954	1.000	0.738
Craftsmen, Foremen	0.9836	17441	1.0055	13547	0.9074	3894	1.149	1.188	1.027
Operatives	1.1499	15411	1.1307	11065	1.1988	4346	1.343	1.335	1.357
Service Workers	1.1878	3268	1.1979	2851	1.1177	417	1.387	1.415	1.266
Agricultural Laborers	1.1261	6788	1.2698	806	1.1060	5982	1.315	1.500	1.252
Laborers	1.2673	11592	1.3687	8167	1.0205	3425	1.480	1.617	1.155
White Women	0.9467	102730	1.0325	50713	0.8634	52017	1.164	1.298	1.001
Professional, Technical	0.8130	2544	0.7952	1875	0.8628	669	1.000	1.000	1.000
Agricultural (excluding Laborers)	0.8200	33580	0.7788	1075	0.8214	32505	1.009	0.979	0.952
Managers, Officials, Proprietors	0.9189	11096	0.9497	8425	0.8211	2671	1.130	1.194	0.952
Clerical	0.8402	3050	0.8810	2499	0.6540	551	1.033	1.108	0.758
Sales	0.8135	3363	0.8437	2842	0.6458	521	1.001	1.061	0.748
Craftsmen, Foremen	0.9695	17036	0.9933	13258	0.8856	3778	1.192	1.249	1.026
Operatives	1.1168	14572	1.1070	10617	1.1420	3955	1.374	1.392	1.324
Service Workers	1.1179	2798	1.1167	2419	1.1256	379	1.375	1.404	1.305
Agricultural Laborers	0.9842	4909	1.2361	664	0.9433	4245	1.211	1.555	1.093
Laborers	1.1770	9782	1.2798	7039	0.9080	2743	1.448	1.609	1.052
Native White Women	0.8813	75614	0.9203	30138	0.8557	45476	1.141	1.265	0.972
Professional, Technical	0.7723	2216	0.7276	1567	0.8800	649	1.000	1.000	1.000

Table 2 (cont.)

	Total	(CEB)	Urban	(CEB)	Rural	(CEB)	Ratio to Professional/Technical		
							Total	Rural	Urban
Agricultural (excluding Laborers) Managers, Officials, Proprietors	0.8224	30063	0.7331	844	0.8250	9219	1.065	1.008	0.938
Clerical	0.8391	7559	0.8524	5186	0.8100	2373	1.086	1.171	0.920
Sales	0.7871	2571	0.8262	2062	0.6278	509	1.019	1.136	0.713
Craftsmen, Foremen	0.8006	2680	0.8260	2218	0.6763	462	1.037	1.135	0.769
Operatives	0.8997	11115	0.9052	7910	0.8863	3205	1.165	1.244	1.007
Service Workers	1.0259	8533	1.0112	5756	1.0560	2777	1.328	1.390	1.200
Agricultural Laborers	0.9939	1730	0.9635	1397	1.1218	333	1.287	1.324	1.275
Laborers	0.9626	4040	1.2616	350	0.9333	3690	1.246	1.734	1.061
Foreign White Women	1.0558	5107	1.1474	2848	0.9383	2259	1.367	1.577	1.066
Professional, Technical	1.1271	27099	1.1952	20561	0.9160	6538	1.041	1.056	0.846
Agricultural (excluding Laborers) Managers, Officials, Proprietors	1.0827	328	1.1322	308	1.0827		1.000	1.000	1.000
Clerical	0.8002	3515	0.9424	231	0.7901	3284	0.739	0.832	0.730
Sales	1.0874	3536	1.1041	3239	0.9090	297	1.004	0.975	0.840
Craftsmen, Foremen	1.1170	479	1.1339	437	0.9491	42	1.032	1.002	0.877
Operatives	0.8638	683	0.9066	624	0.4096	59	0.798	0.801	0.378
Service Workers	1.0988	5912	1.1224	5339	0.8820	573	1.015	0.991	0.815
Agricultural Laborers	1.2433	6035	1.2186	4857	1.3463	1178	1.148	1.076	1.243
Laborers	1.3169	1068	1.3244	1022	1.1524	46	1.216	1.170	1.064
Black Women	1.0818	868	1.2111	313	1.0074	555	0.999	1.070	0.930
Professional, Technical\1	1.3073	4675	1.3690	4191	0.7695	484	1.208	1.209	0.711
Agricultural (excluding Laborers) Managers, Officials, Proprietors\1	1.4427	11800	1.7714	2600	1.3514	9200	0.971	1.077	1.762
Clerical\1	1.4859	281	1.6446	230	0.7670	51	1.000	1.000	1.000
Agricultural (excluding Laborers) Managers, Officials, Proprietors\1	1.2729	6525	1.2957	114	1.2725	6411	0.857	0.788	1.659
Clerical\1	1.4859	281	1.6446	230	0.7670	51	1.000	1.000	1.000
Clerical\1	1.4859	281	1.6446	230	0.7670	51	1.000	1.000	1.000

Table 2 (cont.)

	Total	(CEB)	Urban	(CEB)	Rural	(CEB)	Ratio to Professional/Technical		
							Total	Rural	Urban
Sales\1	1.4859	281	1.6446	230	0.7670	51	1.000	1.000	1.000
Craftsmen, Foremen	1.4992	359	1.4446	251	1.6287	108	1.009	0.878	2.123
Operatives	1.7903	798	1.7487	432	1.8393	366	1.205	1.063	2.398
Service Workers	1.6705	447	1.7257	409	1.0322	38	1.124	1.049	1.346
Agricultural Laborers	1.5199	1717	1.4403	132	1.5268	1585	1.023	0.876	1.990
Laborers	1.7896	1673	1.9810	1032	1.4771	641	1.204	1.205	1.926

Source: IPUMS sample of census enumerators' manuscripts, U.S. 1910.

Note: Sample consists of currently married women, married 0-24 years. The mortality index is the ratio of actual to expected child deaths. See text for the calculation of the expected child deaths. Unknown categories not reported. Only women with husband present are eligible for the calculation.

\1 Value for rural taken as the average for all foreign-born white women with spouses in Professional and Technical occupations.

\2 Combined Professional and Technical; Managers, etc.; Clerical; and Sales.

* Fewer than 40 children ever born in the category.

Table 3. Estimated $q(2)$ and $q(5)$ by Occupation of Father. U.S. Birth Registration Area. 1924. (a)

OCCUPATION	$q(2)$ Prof/Tech	CEB	Ratio to		Ratio	
			Prof/Tech	$q(5)$ to CEB		
All Occupations	0.05800	958423	2.043	0.12909	1406406	1.462
Professional, Technical	0.02839	18060	1.000	0.08827	36042	1.000
Farmers	0.06067	210679	2.137	0.11324	375007	1.283
Managers, Officials, Proprietors	0.04165	49396	1.467	0.10678	101513	1.210
Clerical	0.03471	42624	1.223	0.09472	46904	1.073
Sales	0.03296	5633	1.161	0.10376	11541	1.175
Craftsmen, Foremen	0.04984	170193	1.756	0.12473	244569	1.413
Operatives	0.05760	183208	2.029	0.13939	227309	1.579
Service Workers	0.06136	24967	2.162	0.14167	33655	1.605
Agricultural Laborers	0.07799	54190	2.747	0.15316	59908	1.735
Laborers	0.07320	199473	2.579	0.16276	269958	1.844

(a) Estimated by indirect methods described in United Nations, Manual X, Indirect Techniques for Demographic Estimation (NY: United Nations, 1983), ch. III. $q(2)$ is the probability of dying before reaching age 2. $q(5)$ is the probability of dying before reaching age 5.

Source: U.S. Bureau of the Census, Birth, Stillbirth, and Infant Mortality Statistics for the Birth Registration Area of the United States, 1924 (Wash, DC: GPO, 1926), Table 10.

Table 4. Estimated $q(2)$ and $q(5)$ by Occupation of Father. U.S. Birth Registration Area. 1929. (a)

YEAR/OCCUPATION	$q(2)$	CEB	Ratio to Prof/Tech	to $q(5)$	CEB	Ratio Prof/Tech
All Occupations	0.04812	1155931	2.249	0.10325	1434700	1.605
Professional, Technical	0.02140	23476	1.000	0.06434	39479	1.000
Farmers	0.05336	280794	2.494	0.09461	426099	1.470
Managers, Officials, Proprietors	0.03074	52286	1.437	0.07987	100529	1.241
Clerical	0.02580	46700	1.206	0.07493	50220	1.165
Sales	0.02420	6132	1.131	0.06653	12757	1.034
Craftsmen, Foremen	0.03904	184939	1.824	0.09814	227050	1.525
Operatives	0.04723	215705	2.207	0.10796	226252	1.678
Service Workers	0.04676	33351	2.185	0.10916	39412	1.697
Agricultural Laborers	0.06382	62814	2.982	0.12680	58225	1.971
Laborers	0.06130	249734	2.865	0.13737	254677	2.135

(a) Estimated by indirect methods described in United Nations, Manual X, Indirect Techniques for Demographic Estimation (NY: United Nations, 1983), ch. III. $q(2)$ is the probability of dying before reaching age 2. $q(5)$ is the probability of dying before reaching age 5.

Source: U.S. Bureau of the Census, Birth, Stillbirth, and Infant Mortality Statistics for the Birth Registration Area of the United States, 1929 (Wash, DC: GPO, 1932), Table 10.

TABLE 5. INFANT MORTALITY. EIGHT AMERICAN CITIES, 1911-1915. (a)

 INFANT MORTALITY RATES BY INCOME OF FATHER & PER CAPITA FATHER'S INCOME.

FATHER'S INCOME	IMR	RATIO	FATHER'S INCOME PER CAPITA	IMR	RATIO
Less than \$450	166.9	151.7	Less than \$50	215.9	196.3
\$450-\$550	125.6	114.2	\$50-\$100	141.8	128.9
\$550-\$650	116.6	106.0	\$100-\$200	123.2	112.0
\$650-\$850	107.5	97.7	\$200-\$400	96.1	87.4
\$850-\$1,050	82.8	75.3	\$400 & over	60.5	55.0
\$1,050-\$1,250	64.0	58.2	\$1,250 & over	59.1	53.7
\$1,250 & over	59.1	53.7	No earnings	210.9	191.7
No earnings	210.9	191.7	Not reported	139.7	127.0
TOTAL	110.0	100.0	TOTAL	110.0	100.0

 INFANT MORTALITY RATES BY INCOME OF FATHER & NATIVITY OF MOTHER

FATHER'S INCOME	TOTAL		NATIVE WHITE		FOREIGN- BORN WHITE		COLORED	
	IMR	RATIO	IMR	RATIO	IMR	RATIO	IMR	RATIO
< \$450	166.9	151.7	170.0	181.0	167.1	135.1	162.7	106.8
\$450-\$550	125.6	114.2	121.0	128.9	118.4	95.7	163.7	107.5
\$550-\$650	116.6	106.0	110.8	118.0	121.8	98.5	122.8	80.6
\$650-\$850	107.5	97.7	99.5	106.0	119.6	96.7	102.7	67.4
\$850-\$1,050	82.8	75.3	76.4	81.4	94.9	76.7		
\$1,050-\$1,250	64.0	58.2	62.6	66.7	68.4	55.3		
\$1,250 & over	59.1	53.7	57.6	61.3	60.0	48.5		
No earnings	210.9	191.7	187.5	199.7	234.2	189.3		
TOTAL	110.0	100.0	93.9	100.0	123.7	100.0	152.3	100.0

 INFANT MORTALITY RELATED TO BREASTFEEDING & ETHNICITY.

	% ARTIFICIAL FEEDING	% WITH INCOME <\$650	IMR	RATIO ACTUAL/EXPECTED DEATHS	
				PARTLY BREASTFED	ENTIRELY ARTIFICIAL
ALL MOTHERS	24.9	42.4	111.2	129.5	400.8
WHITE	25.2	39.6	108.3	139.2	410.5
NATIVE	28.3	27.4	93.8	170.7	534.5
FOREIGN-BORN	21.2	55.3	127.0	125.1	327.4
ITALIAN	13.1	70.5	103.8	85.9	219.0
JEWISH	11.3	44.5	53.5	46.9	290.9
FRENCH-CANADIAN	44.0	43.2	171.3	182.7	241.1
GERMAN	21.5	41.2	103.1	125.0	564.5
POLISH	11.1	78.3	157.2	159.8	487.8
PORTUGUESE	31.9	78.5	200.3	237.6	429.4
OTHER	23.2	45.0	129.6	102.3	325.4
COLORED	19.7	81.9	154.4	82.2	315.8

Table 5 (cont.)

 TYPES OF FEEDING BY COLOR AND ETHNICITY OF MOTHER.

	TOTAL MONTHS LIVED FROM BIRTH TO END OF 9th MONTH	% OF MOS. EXCLUSIVELY BREASTFED	% OF MOS. PARTLY BREASTFED	% OF MOS. ARTIFICIALLY FED
ALL MOTHERS	192212.5	57.4	17.6	24.9
WHITE	180397.5	57.6	17.1	25.2
NATIVE	102285.5	56.2	15.4	28.3
FOREIGN-BORN	78112.0	59.4	19.3	21.1
ITALIAN	11943.0	68.6	18.3	13.1
JEWISH	10688.0	61.5	27.1	11.3
FRENCH-CANADIAN	8666.0	42.7	13.3	44.0
GERMAN	6514.0	56.5	22.0	21.5
POLISH	10391.5	65.9	22.7	11.1
PORTUGUESE	5410.5	48.8	19.3	31.9
OTHER	24471.0	60.3	16.5	23.2
NOT GIVEN	18.0	27.8	33.3	38.9
COLORED	11815.0	54.8	25.5	19.7

(a) Cities were: Johnstown, PA; Manchester, NH; Saginaw, MI; Brockton, MA; New Bedford, MA; Waterbury, CT; Akron, OH; and Baltimore, MD. The study was based on samples totaling 22,967 live births and 2,555 infant deaths.

SOURCE: Woodbury (1925, 1926).

Table 6. Fetal, Infant, Neonatal, and Postneonatal Mortality Rates and Ratios.
By Father's Occupation. Single White Births. New York State, 1950-52.

Father's Occupation	Mortality Rates				Mortality Ratios			
	Fetal (b)	Infant	Neo- natal	Post- neonatal	Fetal (b)	Infant	Neo- natal	Post- neonatal
UNADJUSTED								
Professional	12.8	17.8	14.1	3.7	100	100	100	100
Managerial	13.3	18.7	15.2	3.5	104	105	108	95
Sales	14.3	19.6	15.0	4.6	112	110	106	124
Clerical	14.8	18.2	14.3	3.9	116	102	101	105
Craftsmen	15.5	21.0	16.0	5.0	121	118	113	135
Operatives	17.7	23.4	17.4	6.0	138	131	123	162
Services	17.7	23.8	18.2	5.6	138	134	129	151
Non-Farm Labor	17.8	28.4	18.8	9.6	139	160	133	259
All Occupations	15.8	21.6	16.3	5.3	123	121	116	143
ADJUSTED (a)								
Professional	13.6	19.1	15.3	3.8	100	100	100	100
Managerial	12.8	19.6	16.0	3.6	94	103	105	95
Sales	14.2	19.7	15.0	4.7	104	103	98	124
Clerical	15.7	19.1	15.2	3.9	115	100	99	103
Craftsmen	15.7	21.0	16.0	5.0	115	110	105	132
Operatives	17.5	22.6	16.7	5.9	129	118	109	155
Services	16.6	22.8	17.1	5.7	122	119	112	150
Non-Farm Labor	17.8	27.3	18.1	9.1	131	143	118	239
All Occupations	15.8	21.6	16.3	5.3	116	113	107	139

(a) Adjusted for birth weight and mother's age.

(b) Fetal deaths from the 20th week of gestation per 1,000 live births plus fetal deaths.

Source: Chase [1962] adapted by Antonovsky and Bernstein [1977], Table 15A.

Table 7. Estimated Infant Mortality Rates and Ratios. By Education of Father and Age at Death. Legitimate White Live Births. United States. 1964-66.

Education of Father	Infant Mort.	Neo- natal	Less than 1 day	1-6 days	7-27 days	Post- neo- natal	1-5 mos.	6-11 mos.
MORTALITY RATES								
16 years or more	17.0	13.8	8.1	4.8	0.9	3.2	2.4	0.8
13-15 years	19.0	15.9	9.9	4.9	1.1	3.1	2.0	1.1
12 years	17.6	13.7	8.0	4.7	1.0	3.9	3.0	0.9
9-11 years	23.9	17.6	10.2	5.7	1.7	6.3	4.0	2.3
8 years or less	30.3	20.6	11.0	6.8	2.8	9.7	6.9	2.8
All levels	20.8	15.8	9.1	5.3	1.4	5.0	3.5	1.5
MORTALITY RATIOS								
16 years or more	100	100	100	100	100	100	100	100
13-15 years	112	115	122	102	122	97	83	138
12 years	104	99	99	98	111	122	125	113
9-11 years	141	128	126	119	189	197	167	288
8 years or less	178	149	136	142	311	303	288	350
All levels	122	114	112	110	156	156	146	188

Source: MacMahon, Kovar, and Feldman [1972], adapted from Antonovsky and Bernstein [1977], Table 26A.

Table 8. Infant Mortality Rates (per 100,000 Live Births) by Race of Mother & Education of Father. United States. 1991.

Education of Father	Race of Mother					
	All Races	White	All Other	Black	American Indian	Asian & Pacific Islander
INFANT MORTALITY RATE						
Total	863.1	705.4	1451.4	1658.3	1132.7	580.7
No Formal Education	1081.5	1033.0	1235.6	2154.9	*	*
1-7 Years	690.3	678.7	832.7	1049.3	*	720.3
Completed Primary	945.1	914.7	1254.8	1488.0	*	*
9-11 Years	927.3	845.3	1366.1	1499.3	1017.5	744.9
Completed High School	785.1	686.0	1226.0	1365.2	886.5	599.5
1-3 Years College	634.5	563.6	1005.8	1202.3	869.2	454.9
Completed College	497.8	460.0	785.6	1070.3	*	474.8
Graduate Education	483.5	467.7	595.0	815.4	*	483.0
Not Stated	1522.2	1164.4	1967.2	2044.1	1472.0	929.6
MORTALITY RATIOS						
Total	179	151	244	203	130	120
No Formal Education	224	221	208	264	*	*
1-7 Years	143	145	140	129	*	149
Completed Primary	195	196	211	182	*	*
9-11 Years	192	181	230	184	117	154
Completed High School	162	147	206	167	102	124
1-3 Years College	131	120	169	147	100	94
Completed College	103	98	132	131	*	98
Graduate Education	100	100	100	100	*	100
NEONATAL MORTALITY RATE						
Total	544.3	441.7	927.4	1072.5	548.3	358.0
No Formal Education	690.3	691.6	686.4	1144.8	*	*
1-7 Years	435.3	429.4	507.8	734.5	*	448.2
Completed Primary	532.2	520.0	656.4	850.3	*	*
9-11 Years	513.4	467.6	758.2	842.4	384.0	487.5
Completed High School	480.8	416.4	767.2	867.1	409.8	356.9
1-3 Years College	420.8	371.8	677.6	832.8	446.3	269.5
Completed College	352.2	324.1	566.2	816.3	*	294.7
Graduate Education	340.8	332.8	397.4	613.3	*	280.8
Not Stated	969.6	727.1	1271.2	1327.1	774.0	617.7
MORTALITY RATIOS						
Total	160	136	233	175	123	128
No Formal Education	203	213	173	187	*	*
1-7 Years	128	132	128	120	*	160
Completed Primary	156	160	165	139	*	*
9-11 Years	151	144	191	137	86	174
Completed High School	141	128	193	141	92	127
1-3 Years College	123	115	170	136	100	96
Completed College	103	100	142	133	*	105
Graduate Education	100	103	100	100	*	100

Table 8 (cont.)

Education of Father	Race of Mother					
	All Races	White	All Other	Black	American Indian	Asian & Pacific Islander
POSTNEONATAL MORTALITY RATE						
Total	318.7	263.7	524.0	585.8	584.4	222.7
No Formal Education	391.2	341.5	549.1	1010.1	*	*
1-7 Years	255.1	249.4	325.0	314.8	*	272.1
Completed Primary	412.9	394.7	598.5	637.7	*	*
9-11 Years	413.9	377.7	607.9	656.8	633.5	257.3
Completed High School	304.3	269.6	458.9	498.2	476.7	242.7
1-3 Years College	213.7	191.8	328.2	369.5	422.8	185.3
Completed College	145.6	135.9	219.4	254.0	*	180.1
Graduate Education	142.7	134.9	197.5	202.1	*	202.2
Not Stated	552.6	437.3	696.0	717.0	698.0	311.9
MORTALITY RATIOS						
Total	223	195	265	290	138	110
No Formal Education	274	253	278	500	*	*
1-7 Years	179	185	165	156	*	135
Completed Primary	289	293	303	316	*	*
9-11 Years	290	280	308	325	150	127
Completed High School	213	200	232	246	113	120
1-3 Years College	150	142	166	183	100	92
Completed College	102	101	111	126	*	89
Graduate Education	100	100	100	100	*	100

* Based on fewer than 25 infant deaths.

Source: 1991 Birth Cohort Linked Birth/Infant Death Data Set [NCHS, 1996].

Table 9. Mortality Ratios. Highest to Lowest Social Classes. United States, 1895-1966.

Source/Period/Measure	Social Class Mortality	Neonatal Mortality	Post-Neonatal Mortality	Infant Mortality (Index)	Est. q(5)
U.S. CENSUS ca. 1895 IPUMS, 1900 White	Father's Occupation				150
Native White					140
Foreign White					139
Black					150
					196
U.S. CENSUS ca. 1904 IPUMS, 1910 White	Father's Occupation				155
Native White					145
Foreign White					137
Black					163
					141
7 American Cities 1912-15	Income	161	714	357	
Native white				326	
Foreign-born white				140	
Colored				158	
U.S. Birth Registration Area, 1924 ca. 1916-17	Father's Occupation				184
U.S. Birth Registration Area, 1929 ca. 1921-22	Father's Occupation				214
Cleveland, OH 1934-37 Whites	Census Tracts	110	323	150	
Buffalo, NY 1939-41 Whites	Census Tracts				
Males		119	252	144	
Females		105	217	129	
Providence, RI 1949-51	Census Tracts	73	140	82	
Chicago, IL 1950 Whites	Census Tracts	108	147	117	
Nonwhites		201	464	239	
New York State 1950-52 Unadjusted	Father's Occupation	133	259	160	
Adjusted		119	239	143	
California 1956	Father's Occupation	141			

Table 9 (cont.)

Source/Perio/ Measure	Social Class Mortality	Post-Neonatal Mortality	Neonatal Mortality	Infant Mortality (Index)	Est. q(5)
United States 1964-66	Father's Education	149	303	178	
United States(a) 1991 Total	Father's Education	203	274	224	
White		213	253	221	
All Other		173	278	208	
Black		187	500	264	
Amerindian		86	150	117	
Asian & Pacific Islander		160	135	159	

United States(b) 1991	Father's			
Total	Education	156	289	195
White		160	293	196
All Other		165	303	211
Black		139	316	182
Amerindian		86	150	117
Asian & Pacific Islander		160	135	149

- (a) Ratio using husbands with no formal education
(b) Ratio using husbands with completed primary education.

Source: Tables 1-8. Antonovsky and Bernstein [1977].