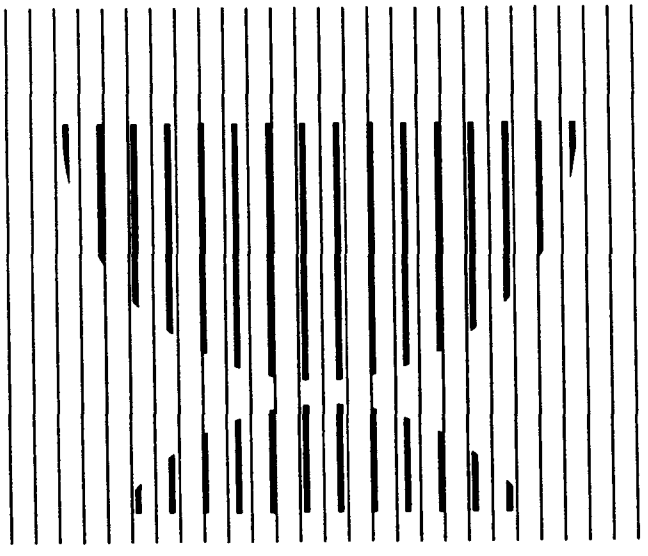
# CBO STAFF MEMORANDUM

## FACTORS CONTRIBUTING TO THE INFANT MORTALITY RANKING OF THE UNITED STATES

February 1992



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This Congressional Budget Office Staff Memorandum examines factors contributing to the international ranking of the United States on infant mortality, and discusses some of the problems in making infant mortality comparisons across countries. It was prepared in response to a request from Representative Willis D. Gradison, Jr., the ranking Republican member of the House Committee on the Budget.

The memorandum was prepared by Linda Bilheimer of CBO's Human Resources and Community Development Division, under the supervision of Nancy Gordon and Kathryn Langwell. Jacquelyn Vander Brug generated the numbers in the tables. Harriet Komisar gave valuable comments. Sherwood Kohn edited the manuscript. Ronald Moore provided administrative assistance for the project and prepared the final layout of the manuscript.

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## SUMMARY

In the United States--as in other industrialized countries--the infant mortality rate has declined dramatically during this century. Yet, despite the high quality and widespread availability of neonatal intensive care technology in this country, the infant mortality rate remains higher than that of many developed nations.

Problems of definition and measurement, however, hamper cross-national comparisons of health statistics. Alternative measures of infant mortality may provide better information but cannot completely compensate for differences among countries in the overall rates of reporting of adverse pregnancy outcomes. For example, very premature births are more likely to be included in birth and mortality statistics in the United States than in several other industrialized countries that have lower infant mortality rates.

Variations in infant mortality rates among the states and between different racial and ethnic groups in this country are greater than the differences between the United States and many other countries. Black infant mortality rates, in particular, are exceptionally high, and the relative gap between black and white infant mortality rates has been increasing over time.

Low birthweight is the primary risk factor for infant mortality and most of the decline in neonatal mortality (deaths of infants less than 28 days old) in the United States since 1970 can be attributed to increased rates of survival among low-birthweight newborns. Indeed, comparisons with countries for which data are available suggest that low birthweight newborns have better chances of survival in the United States than elsewhere. The U.S. infant mortality problem arises primarily because of its birthweight distribution; relatively more infants are born at low birthweight in the United States than in most other industrialized countries. Unfortunately, little progress has been made in reducing U.S. low birthweight rates, which would further improve infant mortality rates.

Federal and state initiatives to lower infant mortality rates have focused on strategies to reduce financial barriers that limit access to prenatal care and on strategies to expand the supply of prenatal care services available to poor pregnant women. The relative advantages and disadvantages of these and other policies to reduce low birthweight and infant mortality are the focus of considerable debate. Recent expansions of the Medicaid program are enabling more low-income children and pregnant women to obtain the health care that they need. Being eligible for Medicaid does not necessarily guarantee access to care, however, especially in areas where providers are in short supply. Hence, federal programs that provide direct support for

maternal and child health services and primary care for low-income populations are also important. Some policy researchers believe, moreover, that the scope of strategies to reduce infant mortality should be broadened from a relatively narrow focus on pregnancy care to the more general issue of how to improve the health status of poor women and their families.

## INTRODUCTION

Because of the high quality and widespread availability of neonatal intensive care in the United States, a low-birthweight baby born in this country probably has a better chance of surviving than anywhere else in the world. Nonetheless, during the 1986-1988 period, more than 10 of every 1,000 infants born in the United States died before they were a year old. This infant mortality rate was higher than those of many developed nations--including countries with significantly lower gross national products per capita, such as Ireland and Spain. A society's infant mortality rate is considered an important indicator of its health status, because infant mortality is associated with socioeconomic status, access to health care, and the health status of women of childbearing age. In addition, it is one of the few measures of health status for which data are widely available in most developed countries.

Other frequently used indicators of health status include:

- o Life expectation at various ages--typically birth and 65 years;

- o Years of potential life lost before age 65--an indicator that is particularly useful for assessing the impact of specific causes of death; and

- o Public health measures such as childhood immunization rates.

Several of these alternative measures are not independent of the infant mortality rate, however, since infant mortality affects both life expectation at birth and years of potential life lost before age 65. Consequently, countries with high infant mortality rates tend to rank poorly on other health status indicators also.

Although the infant mortality rate is universally accepted as an indicator of health status, international comparisons are problematic. Many underdeveloped countries do not have functional vital registration systems and infant mortality rates have to be estimated indirectly or through samples. In developed countries, comparisons of infant mortality rates are complicated by differences in medical practices and reporting requirements. These problems

have raised questions about the validity of ranking infant mortality rates on an international scale.

This paper explores the extent to which the poor U.S. infant mortality ranking reflects a real difference in health status or is the result of variations in the ways births and infant deaths are defined and reported. The infant mortality rate and its components are defined and infant mortality trends in the United States and other countries are described. Subsequent sections of the paper discuss the measurement of perinatal mortality (mortality that occurs around the time of birth), risk factors for infant mortality, and federal and state initiatives to reduce infant mortality rates.[1]

## THE INFANT MORTALITY RATE AND ITS COMPONENTS

The infant mortality rate is defined as the number of deaths of infants up to one year old per 1,000 live births in a given time period. The rate only includes deaths of infants that were first classified as live births--that is,

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1. This paper makes extensive use of data from the National Center for Health Statistics (NCHS). The primary sources of published data are *Health, United States, 1990* (Hyattsville, Md.: Public Health Service, March 1991); and "Advance Report of Final Natality Statistics, 1989," *Monthly Vital Statistics Report*, vol. 40, no. 8 (Hyattsville, Md.: Public Health Service, December 12, 1991). In addition, unpublished data from the Office of International Statistics at NCHS, collected as part of the International Collaborative Effort on Perinatal and Infant Mortality, have been used.

infants that showed some evidence of life after separation from the mother. Deaths of fetuses that show no sign of life after separation from the mother are classified as fetal deaths and are not included in the rate.

Infant mortality has customarily been divided into two components: neonatal mortality (deaths of infants less than 28 days old) and postneonatal mortality (deaths of infants from 28 days to one year old). In developed countries, the neonatal mortality rate is typically larger than the postneonatal rate. In the United States, for example, approximately two-thirds of all infant deaths occur in the neonatal period. Neonatal deaths are generally associated with endogenous factors such as inadequate fetal growth, congenital anomalies, or birth trauma. Low birthweight, which is the product of inadequate fetal growth, results from prematurity, growth retardation, or both. Postneonatal mortality, which is a severe problem in many underdeveloped countries, tends to decline with economic development and environmental improvements. Postneonatal deaths are typically associated with exogenous factors including infectious, parasitic, and respiratory diseases and traumatic injuries. In addition, although the majority of infant deaths attributable to congenital anomalies occur in the neonatal period, a significant proportion of such deaths also occur after the first month of life.

The continuing development of neonatal technology, which is enabling ever smaller and more premature newborns to survive, is blurring some of these distinctions and making clear definitions of the infant mortality rate and its components increasingly difficult. In the case of extremely premature newborns, distinguishing between live births and fetal deaths is becoming an issue of professional judgment. Furthermore, low-birthweight infants who survive the neonatal period are much more likely to die in the postneonatal period than newborns of normal birthweight.

## INFANT MORTALITY TRENDS IN THE UNITED STATES AND OTHER COUNTRIES

Infant mortality rates have declined dramatically throughout this century in all industrialized countries, including the United States. Although vital statistics for the first part of the century are not very reliable, the available data suggest that before World War I more than one-tenth of the infants born in this country died in their first year of life. Furthermore, over 60 percent of these deaths occurred in the postneonatal period, the result of such factors as infections and poor nutrition.[2] Because of improvements in public health,

2. Henry H. Hibbs, Jr., *Infant Mortality: Its Relation to Social and Industrial Conditions*, (New York, N.Y.: Russell Sage Foundation, 1916). Reprinted as *Women and Children First*, David J. Rothman and Sheila M. Rothman, Editors (New York, N.Y.: Garland Publishing Co., 1987).

however, the infant mortality rate in the United States had dropped to less than 30 per 1,000 live births by 1950, although striking differences existed between different racial and ethnic groups. For example, the black infant mortality rate was significantly higher than the white infant mortality rate, with the black postneonatal mortality rate being more than twice the corresponding white rate.

Following a period of relatively little change in infant mortality rates in the 1950s, a second period of significant decline occurred in the late 1960s and the 1970s. As a result, the infant mortality rate, which averaged 25.5 per 1,000 live births between 1960 and 1962, fell to an average of 12.0 per 1,000 live births between 1980 and 1982. Unlike the decline in the first half of the century, however, three-quarters of this later reduction resulted from improvements in neonatal mortality rates, which reflect the development of technologies for neonatal intensive care.[3] Both black and white infant mortality rates fell dramatically during this period, but the ratio of the black to the white rate was virtually the same in the 1980-1982 period as it had been in the 1960-1962 period (see Table 1).

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3. Ronald Williams and Peter Chen, "Identifying the Sources of the Recent Decline in Perinatal Mortality Rates in California," *New England Journal of Medicine*, vol. 306 (January 28, 1982), pp. 207-214; U.S. Congress, Office of Technology Assessment, *Healthy Children: Investing in the Future* (Washington, D.C., February 1988), pp. 40-41.

TABLE 1. BLACK AND WHITE INFANT MORTALITY RATES, UNITED STATES

| Mortality Rate | 1950-1952 | 1960-1962 | 1970-1972 | 1980-1982 | 1986-1988 |
|---|---|---|---|---|---|
| | **Rate Per Thousand Live Births** | | | | |
| Infant | | | | | |
| Black | 45.1 | 42.9 | 30.9 | 20.3 | 17.8 |
| White | 26.0 | 22.6 | 17.1 | 10.5 | 8.7 |
| Neonatal | | | | | |
| Black | 28.0 | 27.3 | 21.5 | 13.5 | 11.6 |
| White | 18.9 | 17.0 | 13.1 | 7.1 | 5.6 |
| Postneonatal | | | | | |
| Black | 17.1 | 15.6 | 9.4 | 6.8 | 6.2 |
| White | 7.1 | 5.5 | 4.0 | 3.4 | 3.1 |
| | **Ratio of Black-to-White Rate** | | | | |
| Infant | 1.7 | 1.9 | 1.8 | 1.9 | 2.1 |
| Neonatal | 1.5 | 1.6 | 1.6 | 1.9 | 2.1 |
| Postneonatal | 2.4 | 2.8 | 2.3 | 2.0 | 2.0 |

SOURCE: Congressional Budget Office calculations based on data from the National Center for Health Statistics.

The U.S. infant mortality rate continued to decline in the 1980s, but more slowly, and the black rate was more than twice the white rate by the 1986-1988 period. The deterioration in the black-to-white ratio in the 1980s reflected the steadily rising ratio of black-to-white neonatal mortality rates--a trend that began in the 1970s.

Although the U.S. infant mortality rate had dropped to approximately one-third of its 1950 level by the 1986-1988 period, other countries experienced larger and more rapid declines over the same time period. Between 1950 and 1952, the United States had the seventh lowest infant mortality rate among 32 countries reporting infant mortality rates (see Table 2). The U.S. ranking fell steadily between 1950 and 1965, remained relatively stable for the next decade, then continued to fall in the 1980s. By the 1986-1988 period, the United States had dropped to 23rd among this group of countries, and the U.S. black infant mortality rate was higher than rates in all other countries in the group except Yugoslavia. By contrast, Japan experienced a dramatic improvement in its infant mortality ranking after World War II. In the 1950-1952 period, Japan ranked 20th among the 32 countries reporting infant mortality rates, with a rate of 55.9 per 1,000 live births. This rate was almost halved by the 1960-1962 period, and by the 1986-1988 period the rate was five per 1,000 live births--the lowest rate among this group of countries.

TABLE 2. INTERNATIONAL INFANT MORTALITY RATES BY RANKING

| 1950-1952 | | 1960-1962 | | 1970-1972 | | 1980-1982 | | 1986-1988 | |
|---|---|---|---|---|---|---|---|---|---|
| Country | Rate* | Country | Rate* | Country | Rate* | Country | Rate* | Country | Rate* |
| Sweden | 20.9 | Netherlands | 15.7 | Sweden | 11.0 | Sweden | 6.9 | Japan | 5.0 |
| Iceland | 23.2 | Sweden | 15.9 | Netherlands | 12.2 | Finland | 7.0 | Sweden | 6.0 |
| Netherlands | 24.3 | Iceland | 16.5 | Japan | 12.4 | Iceland | 7.0 | Finland[b/] | 6.0 |
| Australia | 24.5 | Norway | 18.1 | Iceland | 12.4 | Japan | 7.1 | Iceland | 6.3 |
| Norway | 25.9 | Australia | 20.0 | Norway | 12.4 | Norway | 7.9 | Switzerland[b/] | 6.8 |
| U.S. (White) | 26.0 | Finland | 20.8 | Finland | 12.7 | Switzerland | 8.1 | Netherlands | 7.4 |
| New Zealand | 27.9 | Switzerland | 21.1 | Denmark | 13.2 | Denmark | 8.2 | Canada | 7.5 |
| United States | 28.7 | Denmark | 21.1 | France | 14.2 | Netherlands | 8.4 | Hong Kong | 7.5 |
| England & Wales | 29.1 | England & Wales | 21.6 | Switzerland | 14.3 | Canada | 9.7 | France[b/] | 7.9 |
| Denmark | 29.5 | New Zealand | 22.0 | New Zealand | 16.3 | France | 9.7 | Denmark | 8.0 |
| Switzerland | 30.1 | France | 22.1 | U.S. (White) | 17.1 | Hong Kong | 10.2 | German F.R. | 8.1 |
| Finland | 37.0 | U.S. (White) | 22.6 | Australia | 17.3 | Australia | 10.3 | Norway | 8.2 |
| Scotland | 37.1 | Czechoslovakia | 23.0 | England & Wales | 17.7 | U.S. (White) | 10.5 | Singapore[b/] | 8.3 |
| Canada | 39.4 | United States | 25.5 | Canada | 17.8 | Ireland | 10.7 | Ireland[b/] | 8.3 |
| Northern Ireland | 40.1 | Scotland | 26.3 | Hong Kong | 18.1 | Singapore | 11.0 | Scotland | 8.5 |
| Israel | 43.5 | Northern Ireland[b/] | 26.9 | Ireland | 18.5 | England & Wales | 11.3 | U.S. (White) | 8.7 |
| Ireland | 44.4 | Canada | 27.4 | United States | 19.2 | Belgium | 11.6 | Australia[b/] | 8.8 |
| France | 44.7 | Japan | 28.6 | Scotland | 19.4 | Scotland | 11.6 | Spain[a/] | 9.2 |
| U.S. (Black) | 45.1 | Belgium | 28.9 | Singapore | 19.9 | German F.R. | 11.7 | England & Wales | 9.3 |
| Belgium | 49.1 | Ireland | 29.6 | Belgium | 20.1 | Spain | 11.9 | Northern Ireland | 9.3 |
| German F.R. | 52.0 | Israel | 31.2 | Israel | 21.5 | United States | 12.0 | Austria | 9.4 |
| Japan | 55.9 | German F.R. | 31.5 | Czechoslovakia | 21.8 | New Zealand | 12.3 | Belgium[b/] | 9.7 |
| Austria | 59.9 | Singapore | 32.8 | Northern Ireland | 22.1 | Austria | 13.2 | Italy | 9.8 |
| Italy | 64.4 | Austria | 34.5 | German F.R. | 23.2 | Northern Ireland | 13.4 | United States | 10.1 |
| Spain | 66.2 | Hong Kong[b/] | 37.9 | Spain | 24.6 | Italy | 13.9 | New Zealand[b/] | 10.7 |
| Puerto Rico | 67.0 | Bulgaria | 40.1 | Austria | 25.6 | Israel | 14.9 | Israel | 10.8 |
| Czechoslovakia | 68.8 | Italy | 42.0 | Bulgaria | 26.1 | Czechoslovakia | 17.2 | Czechoslovakia | 12.7 |

(Continued)

TABLE 2. INTERNATIONAL INFANT MORTALITY RATES BY RANKING

| 1950-1952 | | 1960-1962 | | 1970-1972 | | 1980-1982 | | 1986-1988 | |
|---|---|---|---|---|---|---|---|---|---|
| Country | Rate* | Country | Rate* | Country | Rate* | Country | Rate* | Country | Rate* |
| Singapore | 75.6 | Puerto Rico | 42.2 | Puerto Rico | 27.7 | Puerto Rico | 18.0 | Puerto Rico | 13.5 |
| Hungary[b/] | 77.0 | U.S. (Black) | 42.9 | Italy | 28.3 | Bulgaria | 19.1 | Bulgaria | 14.4 |
| Portugal | 92.5 | Spain | 43.6 | Poland | 30.3 | U.S. (Black) | 20.3 | Portugal | 14.4 |
| Hong Kong[b/] | 95.4 | Hungary | 46.0 | U.S. (Black) | 30.9 | Poland | 20.7 | Hungary | 17.4 |
| Bulgaria | 95.4 | Poland | 55.2 | Hungary | 34.7 | Hungary | 21.4 | Poland[b/] | 17.5 |
| Poland | 106.2 | Portugal | 81.6 | Portugal | 49.7 | Portugal | 21.9 | U.S. (Black) | 17.8 |
| Yugoslavia | 120.5 | Yugoslavia[b/] | 83.1 | Yugoslavia | 49.7 | Yugoslavia | 30.8 | Yugoslavia[b/] | 25.9 |

SOURCE: Congressional Budget Office calculations from data compiled by the Office of International Statistics, National Center for Health Statistics.

NOTE: Data for the United States are for the 50 states and the District of Columbia. Infant mortality rates for Puerto Rico are shown separately.

* = Infant deaths per 1,000 live births.

a. Based on one year's data only.

b. Based on two years' data only.

The decline in the U.S. infant mortality ranking relative to other industrialized countries (and to some much poorer countries) is a major cause of concern. The wide disparities that exist within the United States are also perplexing. In the 1986-1988 period, excluding the District of Columbia, infant mortality rates ranged from 7.9 per 1,000 live births in Massachusetts to 12.8 in Mississippi.[4] Part of this interstate variation can be attributed to demographic differences, but race-specific infant mortality rates also varied greatly across the states. White infant mortality rates ranged from 7.2 in Massachusetts to 10.1 in Idaho, and black infant mortality rates--among states with at least 5,000 black births over the three-year period--ranged from 14.4 in Kentucky to 22.0 in Michigan.

In assessing the causes of both the decline in the U.S. international infant mortality ranking and the large interstate differences in infant mortality rates, a key issue for researchers is how much these disparities reflect real differences in health status and how much they are caused by definitional, reporting, and measurement differences. To explore these issues, the National Center for Health Statistics (NCHS) established the International Collaborative Effort on Perinatal and Infant Mortality (ICE) in 1984. Under the aegis of the ICE project, 11 industrialized countries are conducting

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4. To compare the infant mortality rate in the District of Columbia with state rates is inappropriate, since infant mortality rates tend to be higher in urban areas than in states. Nonetheless, the infant mortality rate in the District of Columbia--21.2 per 1,000 live births in the 1986-1988 period--is high compared with most other large cities.

collaborative research to develop a greater understanding of differential infant mortality rates. Much of the current knowledge about comparative infant mortality rates comes from the ICE initiative.

## MEASUREMENT OF PERINATAL OUTCOMES

In most countries, vital statistics are generated by national civil registration systems, which are typically based on a combination of active and passive registration. Registration is active insofar as it is legally required but passive to the extent that it depends on individual compliance. In addition to systems based on civil registries, some less-developed countries estimate their vital statistics, typically using sample surveys.

The accuracy and completeness of vital statistics vary considerably across countries and little detailed information exists on the impact of alternative registration systems and variations in public compliance with registration laws on the reporting of vital events. The United States, however, is unusual in placing responsibility for reporting births and deaths on hospitals, health care professionals, and funeral homes rather than on individual families. (This type of system is only feasible in countries in which the majority of births take place in hospitals or are attended by health care

professionals.) In most other countries, responsibility for civil registration of vital events lies with the family. The impact of the U.S. system on reporting is unclear. There is no evidence, however, that it leads to more complete reporting than in most other industrialized countries, some of which have mechanisms for reporting vital events through their medical systems to supplement the data from civil registration.

In addition to different registration systems, countries also have different medical practices and reporting requirements, which may affect the comparability of infant mortality rates. These differences have become more important as the gestational age for newborn viability has declined. In countries where physicians are more aggressive about attempting to resuscitate very premature newborns--of which the United States is probably the leading example--extremely small neonates are more likely to be classified as live births than in countries with less aggressive resuscitation policies.[5] Thus, for example, if little attempt is made to resuscitate newborns weighing less than 500 grams (1 pound, 2 ounces), these births may be classified as fetal deaths and not be included in either the live birth or the infant mortality statistics. By contrast, when attempts are made to resuscitate the tiniest newborns, they are more likely to be classified as live births, although most will subsequently die and then be included in the infant mortality statistics.

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5. Robert Hartford, "Comparing the United States and Japan in Infant Mortality," unpublished paper (Hyattsville, Md.: National Center for Health Statistics, 1991).

Some of the problems in comparing infant mortality rates can be addressed by using mortality measures that are based on total births rather than live births only. Given the variation that exists in resuscitation policies, mortality measures that include both infant deaths and fetal deaths allow greater comparability between countries (or between states or regions).

Several alternative indicators have been suggested that encompass mortality in the perinatal period (the period around birth). Two measures, in particular, are used by the National Center for Health Statistics:

- The *Perinatal Mortality Ratio*, which is the number of late fetal deaths (28 weeks or more gestational age) plus infant deaths within seven days of birth per 1,000 live births; and

- The *Feto-infant Mortality Rate*, which is the number of late fetal deaths plus infant deaths within the first year of life per 1,000 live births plus late fetal deaths.[6]

6. In other words, the denominator of the feto-infant mortality rate includes live births and late fetal deaths, whereas the denominator of the perinatal mortality ratio includes live births only.

The international ranking of the United States improves somewhat when these alternative measures are used but it is still relatively low and appears to be deteriorating. Only 31 countries have had the data necessary to produce infant mortality rates, perinatal mortality ratios, and feto-infant mortality rates since 1960. Among these countries, the U.S. ranking on all three measures has declined since the early 1960s (see Table 3). By the 1986-1988 period, the United States ranked 22nd on infant mortality, 20th on perinatal mortality, and 19th on feto-infant mortality.

These measures still do not provide an entirely valid basis for comparison, however, because they only include fetal deaths of 28 weeks or more gestational age, which is the minimum gestational age required for fetal death reporting in many industrial countries. Consequently, if births below 28 weeks gestational age are classified as fetal deaths, they will not be included in either the infant mortality statistics or the alternative mortality measures. Limited data from Japan, Norway, and the United States--the only three ICE countries for which data on fetal deaths below 28 weeks gestational age are available--suggest that births from 20 to 27 weeks gestational age are more likely to be classified as live births in the United States than in the other two countries.[7] Furthermore, if fetal deaths of 20 weeks or more

7. Robert Hartford, "The International Collaborative Effort on Perinatal and Infant Mortality--Overview and Major Results," paper, International Working Congress on Problems of Infant Mortality in Europe, sponsored by the Union of National European Paediatric Societies and Associations, Dusseldorf, Germany, October 18, 1991.

gestational age were included in feto-infant mortality rates, the Norwegian and Japanese rates would probably be comparable to the U.S. rate. Data from these and other ICE participants also indicate that the United States has a higher proportion of infant deaths of less than 28 weeks gestational age than several other industrialized countries with lower infant mortality rates.

Because of data limitations, especially the lack of information in many countries on fetal deaths below 28 weeks gestational age, any conclusions drawn from these findings are speculative. The available data suggest, however, that some of the disparities in infant mortality rates between the United States and other industrialized countries may be attributable to different resuscitation policies for premature newborns, resulting in different classifications of live births and fetal deaths. Classification differences may also be contributing to the wide variations in infant mortality rates among the states.

TABLE 3. UNITED STATES RANKINGS ON INFANT MORTALITY INDICATORS AMONG THIRTY-ONE COUNTRIES

| Mortality Rate or Ratio | 1960-1962 | 1970-1972 | 1980-1982 | 1986-1988 |
|---|---|---|---|---|
| Infant[a/] | 13 | 16 | 19 | 22 |
| Perinatal[b/] | 16 | 19 | 18 | 20 |
| Feto-infant[c/] | 11 | 15 | 17 | 19 |

SOURCE: Congressional Budget Office calculations based on data compiled by the Office of International Statistics, National Center for Health Statistics.

NOTE: The country that is ranked first has the lowest rate. Countries were included in the rankings if they could provide at least one full year of data for each statistic in all four time periods. The resulting groups of countries is the same as that in Table 2, except for the exclusion of Ireland and Spain, and the inclusion of the German Democratic Republic. Four of the 31 countries had less than three years' data in the 1960-1962 period, one country had less than three years' data in the 1970-72 period, and 17 countries had less than three years' data in the 1986-1988 period.

a. The infant mortality rate is the number of infant deaths per 1,000 live births.

b. The perinatal mortality ratio is the number of late fetal deaths (28 weeks or more gestational age) plus infant deaths within 7 days of birth per 1,000 live births.

c. The feto-infant mortality rate is the number of late fetal deaths plus infant deaths within the first year of life per 1,000 live births plus late fetal deaths.

## RISK FACTORS FOR INFANT MORTALITY

Epidemiologic studies indicate that several factors are associated with increased risk of infant death. Some of these are primarily related to deaths in the perinatal period, while others are more strongly associated with deaths in the postneonatal period. As noted previously, however, these distinctions are becoming less clear as neonatal technology enables tinier newborns to survive, causing the postponement of some infant deaths to the postneonatal period.

### Risk Factors for Perinatal Mortality

Low birthweight is the primary risk factor for perinatal (fetal and neonatal) mortality. Most fetal deaths and very-low-birthweight (less than 1,500 grams) births are associated with prematurity (less than 37 weeks gestation), as are approximately half of moderately-low-birthweight (1,500 to 2,499 grams) births.[8] Other low-birthweight newborns are full-term infants suffering from growth retardation.

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8. These metric weights convert to pounds and ounces as follows: 1,500 grams corresponds to 3 pounds, 5 ounces and 2,499 grams corresponds to 5 pounds, 8 ounces.

During the 1970s, the United States made some progress in reducing the percentage of moderately-low-weight births, but only a small reduction was achieved in the percentage of very-low-weight births. As a result of this modest improvement, the overall low-birthweight rate (less than 2,500 grams) fell from 7.93 percent of live births in 1970 to 6.84 percent in 1980, with the very-low-birthweight rate declining from 1.17 percent to 1.15 percent during the same period. No further improvements occurred in the 1980s and the very-low-birthweight rate increased slightly, reaching 1.24 percent of live births by 1988.[9] The decline in the neonatal mortality rate over the last two decades--from 15.1 per 1,000 live births in 1970 to 6.3 per 1,000 live births in 1988--can be largely attributed to the improved survival of low-birthweight infants, resulting from the widespread utilization of neonatal intensive care technology. Further reductions in neonatal mortality could be achieved by reducing the incidence of low birthweight--especially low birthweight associated with prematurity.

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9. Because approximately 4 million births occur each year in the United States, apparently small increases in the very-low-birthweight rate translate into important differences in the actual number of very tiny liveborn infants. If, for example, the very-low-birthweight rate had remained at 1.15 percent--the rate in 1980--for the years 1981 through 1988, approximately 16,000 fewer very-low-birthweight infants would have been born during this period, with 3,500 fewer in 1988 alone.

The factors that increase a mother's risk of having a low birthweight infant, which are complex and interactive, have been classified into six categories by the Institute of Medicine:[10]

- o Demographic risks, including low socioeconomic status, low level of education, race (higher risk for black women), childbearing at extremes of the reproductive age span, and being unmarried;

- o Medical risks predating pregnancy, including number of children previously borne by the mother (none or more than four), poor obstetric history, certain diseases and conditions such as chronic hypertension and diabetes, and low weight relative to height;

- o Medical risks in the current pregnancy, including poor weight gain, short interpregnancy interval, multiple pregnancy, and various medical complications;

- o Health care risks, including absent or inadequate prenatal care, and premature delivery resulting from medical intervention;

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10. Institute of Medicine, *Preventing Low Birthweight* (Washington, D.C.: National Academy Press, 1985).

- Behavioral and environmental risks, including smoking, alcohol and other drug use, poor nutritional status, living at high altitudes, and exposure to toxic substances; and

- Other potential risk factors that may increase the risk of preterm labor, such as stress, uterine irritability, cervical changes, infections, inadequate expansion of plasma volume, and progesterone deficiency.

Researchers know more about the prevalence of some of these risks than others. Maternal risk information is generally limited to the data available from birth and fetal death certificates, which have typically included age, education, race, ethnic origin, marital status, parity (number of children previously borne), number of previous infant deaths and terminations (spontaneous and induced), and use of prenatal care--including the month prenatal care began and the number of prenatal care visits. States do not necessarily include all of these variables on their certificates, and the reliability of specific data items varies. The amount of risk information available should increase in the future as a result of the 1989 revisions to the U.S. Standard Certificate of Live Birth and the U.S. Standard Report of Fetal Death, which include checklists of medical and other risk factors for the pregnancy.

The higher mortality risks of black infants compared with white infants reflect their corresponding birthweight differences; black infants are more than twice as likely as white infants to be born at low birthweight. Sixteen percent of single-delivery births in 1980 were black, but black infants accounted for 40 percent of those weighing less than 500 grams, 35 percent of those weighing between 500 grams and 1,499 grams, and 30 percent of those weighing between 1,500 grams and 2,499 grams.[11] Furthermore, the proportion of black newborns weighing less than 1,500 grams rose steadily during the 1980s, reaching 2.78 percent by 1988--three times the corresponding white rate. Relatively more black mothers than white mothers appear to be at high risk for adverse pregnancy outcomes, and the available data suggest that, in recent years, little progress has been made in reducing the prevalence of several known risk factors.

Although the proportion of births to teenagers fell from 15.6 percent in 1980 to 12.5 percent in 1988, the overall teenage birth rate actually increased slightly during this period, with all of the increase being attributable to higher birth rates among younger (under 18 years of age) teenagers.[12]

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11. Carol J.R. Hogue and others, "Overview of the National Infant Mortality Surveillance (NIMS) Project--Design, Methods, Results," *Public Health Reports*, vol. 102 (March-April 1987), pp. 126-138.

12. The proportion of births to teenagers is the proportion of all births that occur to women under 20 years old. By contrast, the teenage birth rate is the proportion of all women under 20 years old who give birth in any year. Between 1980 and 1988, the birth rate for women aged 10 to 14 rose from 1.1 to 1.3 per 1,000. During the same period, birth rates for women aged 15 to 17 rose from 32.5 to 33.8 per 1,000, while

Throughout the decade, the proportion of black infants who were born to younger teenage mothers was at least twice the national rate; in 1988, 5 percent of all births and 10 percent of black births were to women under the age of 18.

Birth rates for unmarried women rose steadily during the 1980s. By 1988, the rate had reached 38.6 per 1,000 unmarried women aged 15 to 44, with the most rapid increases occurring in the white population. The proportion of black newborns whose mothers were unmarried was still more than three times the corresponding white rate, however. In 1988, 64 percent of black infants and 18 percent of white infants were born to unmarried women.

Throughout the 1980s, approximately one-quarter of all mothers received no prenatal care in the first trimester. Furthermore, the proportion of births to women who commenced prenatal care in the third trimester or received no prenatal care at all increased slightly from 5.1 percent of births in 1980 to 6.1 percent in 1988. Black women were more likely to receive inadequate prenatal care than white women. In 1988, 61 percent of black mothers, compared with 79 percent of white mothers, began prenatal care in

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rates for women aged 18 to 19 declined from 82.1 to 81.7 per 1,000. Recently released data indicate, however, that birth rates increased significantly in 1989 among all these teenage groups.

the first trimester, and 11 percent of black mothers, compared with 5 percent of white mothers, received late or no prenatal care. An overwhelming body of research literature suggests that pregnant women who receive early and appropriate prenatal care have better pregnancy outcomes--especially lower rates of low birthweight and prematurity--than those who receive inadequate care. The lack of progress in this area has been of concern to the Congress, and was a factor in the decision to expand Medicaid coverage for pregnant women in the second half of the 1980s.

Although data on the prevalence of drug abuse during pregnancy are limited, one study has suggested that rising low-birthweight rates in New York City may be associated with increases in the proportion of births to women who abuse drugs during their pregnancies.[13] Low-birthweight rates in New York City, which were declining prior to 1984, rose between 1984 and 1988. Paralleling this increase, the estimated proportion of births to women who abused drugs during their pregnancies rose from 6.7 per 1,000 live births in 1981 to 20.3 per 1,000 live births in 1987. Although drug abuse is likely to be underreported on birth certificates, the author of the study argues that this does not affect the fundamental conclusion that the proportion of drug-exposed infants has increased dramatically.

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13. Theodore Joyce, "The Dramatic Increase in the Rate of Low Birthweight in New York City: An Aggregate Time-Series Analysis," *American Journal of Public Health*, vol. 80 (June 1990), pp. 682-684.

Other researchers argue, however, that isolating the effects of drug use on pregnancy outcomes is extremely difficult. Mothers who use cocaine during their pregnancies, for example, are also likely to use alcohol and tobacco (as well as other drugs), have poor nutrition, receive inadequate prenatal care, and be at increased risk for sexually transmitted diseases. In addition, they and their children frequently live in hazardous environments, facing multiple problems such as poverty, violence, and homelessness.[14] Prenatal drug use may, therefore, serve as an indicator for multiple risk factors but the causal relationships are uncertain.

## Risk Factors for Postneonatal Mortality

More than 60 percent of U.S. postneonatal deaths in 1988 were attributable to sudden infant death syndrome (SIDS), congenital anomalies, external causes of death (including injuries, poisoning, and homicide), and pneumonia and influenza. SIDS alone accounted for more than one-third of postneonatal deaths (see Table 4).

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14. Linda C. Mayes and others, "The Problem of Prenatal Cocaine Exposure," *Journal of the American Medical Association*, vol. 267 (January 15, 1992), pp. 406-408.

TABLE 4. POSTNEONATAL MORTALITY, UNITED STATES, 1988[a]

| Cause of Death | Number | Percent |
|---|---|---|
| Sudden Infant Death Syndrome (SIDS) | 5,108 | 35.9 |
| Congenital Abnormalities | 2,254 | 15.9 |
| Accidents, Adverse Effects, and Homicide[b] | 1,117 | 7.9 |
| Pneumonia and Influenza | 517 | 3.6 |
| Other | 5,224 | 36.7 |
| All Causes | 14,220 | 100.0 |

SOURCE: National Center for Health Statistics, *Vital Statistics of the United States, 1988*, Vol II, Mortality, Part A (Washington, D.C.: Public Health Service), 1991.

a. Deaths of infants from 28 days to one year old.

b. This category includes external causes of injury and poisoning.

With the exception of congenital anomalies, the predominant causes of death in the perinatal and postneonatal periods differ, but several of the underlying risk factors appear to be the same. Low birthweight infants, in particular, are at much greater risk for postneonatal mortality than normal birthweight infants. In addition, black infants are twice as likely to die in the postneonatal period as white infants, and the risk is also high for Native Americans.

Although SIDS is the leading cause of postneonatal mortality in the United States, the syndrome is still poorly understood. SIDS deaths occur more frequently among infants whose mothers are socioeconomically disadvantaged. Low-birthweight infants appear to experience higher rates of SIDS than normal birthweight infants, with some research suggesting that growth retardation rather than prematurity is the important risk factor.[15]

Significantly, however, low birthweight newborns appear to be at higher risk for most causes of postneonatal death, including those that have no direct association with birthweight, such as external causes of injury and poisoning. Low birthweight may, therefore, be serving as a proxy indicator for a range

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15. Donald R. Petersen, "Sudden Infant Death Syndrome," in *Perinatal Epidemiology*, Michael B. Bracken, Editor (New York, N.Y.: Oxford University Press, 1984), pp. 339-353.

of social conditions, which may be the underlying risk factors for much postneonatal mortality.

## Racial and Ethnic Differences in Infant Mortality and Risk Factor Rates

Infant mortality and low-birthweight rates vary widely among different racial and ethnic groups in the United States. Too little is known about the causes of these variations, which are the focus of intensive research efforts. Findings from recent studies indicate the range and complexity of the underlying issues and demonstrate the inadequacy of simple explanations for differences among birth outcomes.

Racial differences in birthweight-specific mortality have been the focus of several recent studies. In 1980, overall neonatal mortality risks were lowest for infants with birthweights between 3,500 and 3,999 grams.[16] Optimum birthweight--that is the birthweight at which mortality is minimized--appears to vary, however, by population group. Furthermore, at birthweights less than 3,000 grams and at low gestational ages, black infants have lower neonatal mortality rates than white infants in the same birthweight and gestational age

16. These metric weights convert to pounds and ounces as follows: 3,000 grams corresponds to 6 pounds 10 ounces; 3,500 grams corresponds to 7 pounds 11 ounces; and 3,999 grams corresponds to 8 pounds 13 ounces.

categories. This counterintuitive finding--that low-birthweight black infants have better survival probabilities than low-birthweight white infants--is not inconsistent with black infants having higher mortality rates than white infants, because a much larger proportion of black infants are born at low birthweight. In addition, white infants have lower mortality rates than black infants in the higher weight ranges in which most births occur.[17]

The disparity between black and white birth outcomes remains one of the most perplexing public health policy problems. Not only are black mothers more likely to be in high risk categories, but they also appear to have worse birth outcomes than white mothers, even when the effects of such risk factors as age, marital status, parity, and education are taken into account.[18] The likelihood that adverse black pregnancy outcomes are genetically related is small, however, since black infants are at greater risk for all causes of infant death other than congenital anomalies. Furthermore, after controlling for selected risk factors, infants of foreign-born black women appear to have

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17. Hogue and others, "Overview of the National Infant Mortality Surveillance (NIMS) Project--Design, Methods, Results;" Alexander and Cornely, "Racial Disparities in Pregnancy Outcomes: the Role of Prenatal Care Utilization and Maternal Risk Status;" Allen J. Wilcox and Ian T. Russell, "Birthweight and Perinatal Mortality: I. On the Frequency Distribution of Birthweight," *International Journal of Epidemiology*, vol. 12, no. 3 (1983), pp. 314-318.

18. Joel C. Kleinman and Samuel S. Kessel, "Racial Differences in Low Birthweight," *New England Journal of Medicine*, vol. 317 (Sept. 17, 1987), pp. 749-753; Greg R. Alexander and Donald A. Cornely, "Racial Disparities in Pregnancy Outcomes: The Role of Prenatal Care Utilization and Maternal Risk Status," *American Journal of Preventive Medicine*, vol. 3 (1987), pp. 254-261.

lower neonatal mortality rates and to experience greater intrauterine growth than infants of native-born black women.[19]

Maternal health status is an important determinant of neonatal mortality risk, and part of the difference in birth outcomes may be attributable to differences in the health status of black and white women of child-bearing age. A recent study of deaths from chronic diseases and conditions among young women found that mortality differentials between black and white women increased significantly during the key child-bearing years. Compared with white women in the same age group, black women between 25 and 29 years old were at considerably greater risk of dying from hypertension, anemias, urinary problems, cirrhosis, hepatitis, pneumonia, heart disease, and pulmonary disease.[20] Higher prevalence of these diseases and conditions may reflect less access to health care among poor and minority women and may contribute to differences in birth outcomes.

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19. Howard Cabral and others, "Foreign-born and US-born Black Women: Differences in Health Behaviors and Birth Outcomes," *American Journal of Public Health*, vol. 80 (January 1990), pp. 70-71; Joel C. Kleinman, Lois A. Fingerhut, and Kate Prager, "Differences in Infant Mortality by Race, Nativity Status, and Other Maternal Characteristics," *American Journal of Diseases of Children*, vol. 145 (February 1991), pp. 194-199.

20. Arline T. Geronimus and John Bound, "Black/White Differences in Women's Reproductive Health Status: Evidence from Vital Statistics," *Demography*, vol. 27 (August 1990), pp. 457-466.

Other researchers have suggested that living in very poor urban neighborhoods is so strongly associated with adverse pregnancy outcomes that isolated changes in some of the traditional risk factors--such as maternal age, education, and marital status--may not have a major impact on low birthweight.[21] Excess low-birthweight rates among the black population may reflect the effects of generations of poverty and inadequate health care, and therefore may not decline without long-term improvements in these conditions.

Most research on variation in perinatal outcomes has focused on the differences between black and white outcomes and much less attention has been paid to other racial and ethnic groups. Studies of other population groups in the United States raise further puzzling questions, however, which are complicated by misclassifications of race and ethnicity that sometimes occur in vital records.[22] Misclassification may be particularly problematic among Hispanics, Native Americans, and Asians and Pacific Islanders. Consequently, findings reported in these studies should be treated cautiously.

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21. James W. Collins and Richard J. David, "The Differential Effect of Traditional Risk Factors on Infant Birthweight Among Blacks and Whites in Chicago," *American Journal of Public Health*, vol. 80 (June 1990), pp. 679-681.

22. Robert A. Hahn, Joseph Mulinare, and Steven M. Teutsch, "Inconsistencies in Coding of Race and Ethnicity Between Birth and Death in U.S. Infants," *Journal of the American Medical Association,* vol. 267 (January 8, 1992), pp. 259-263.

Like black mothers, many Hispanic mothers appear to be at high risk for adverse pregnancy outcomes. They have low rates of first-trimester prenatal care enrollment, and many are young, unmarried and have low levels of education. Nonetheless, their rates of adverse outcomes are relatively low. Variations in the registration of vital events (in addition to the misclassification of ethnicity on birth and death certificates) may contribute to this apparently anomalous finding.[23] Simple generalizations about Hispanic birth outcomes and prenatal care use should be avoided, however, since considerable variation arises among subgroups of the Hispanic population--possibly reflecting socioeconomic differences. Infants born to Puerto Rican mothers, in particular, have higher mortality risks and higher rates of low birthweight than other Hispanics, while Cuban mothers have higher rates of early enrollment in prenatal care.

Asians and Pacific Islanders in the United States have low rates of infant mortality and low birthweight, with Japanese infants having particularly low mortality rates. Good birth outcomes among Asians and Pacific Islanders probably result from their relatively low risks. In particular, the proportion of unmarried mothers in this population group is low, maternal education levels are relatively high, and the proportion of mothers receiving prenatal

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23. Jose E. Becerra, Carol J.R. Hogue, Hani K. Atrash, and Nilsa Perez, "Infant Mortality Among Hispanics: A Portrait of Heterogeneity," *Journal of the American Medical Association* (January 9, 1991), vol. 265, pp. 217-221.

care in the first trimester is about the same as the national average. Significantly, birth outcomes among recent Southeast Asian refugees to this country--a population group that might, initially, have been at high risk for adverse outcomes--appear to be improving over time. Researchers report that average birthweight among Southeast Asian immigrants in Washington State increased during the 1980s, with a corresponding decline in low-birthweight rates.[24]

Native American mothers have low rates of first trimester prenatal care enrollment and their infants have high mortality rates. The underlying causes of infant death among Native Americans, however, appear to differ from those of other population groups. In particular, low-birthweight rates for Native Americans are relatively low and neonatal mortality rates are close to the national average, but postneonatal mortality rates are high. In comparison with white infants, Native American infants appear to be at greatly increased risk of dying from SIDS and infections. The Indian Health Service has suggested that efforts to reduce infant mortality among Native Americans

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24. De-Kun Li, Hanyu Ni, Stephen M. Schwartz, and Janet R. Daling, "Secular Change in Birthweight Among Southeast Asian Immigrants to the United States," *American Journal of Public Health*, vol. 80 (June 1990), pp. 685-688.

should focus on the problems of poor living conditions and lack of access to medical care--factors which contribute to the risk of postneonatal death.[25]

International Comparisons of Infant Mortality Risk Factors

Lack of data precludes making broad international comparisons of infant mortality risk factors, although countries participating in the ICE project are trying to develop this capability.[26] Limited information does exist for two risk factors, however: birthweight and teenage pregnancy rates.

Birthweight Comparisons. Researchers have suggested that differences in international perinatal mortality rates can be partly attributed to differences in rates of prematurity.[27] Low-birthweight rates provide only partial information on prematurity, but have been more consistently collected and reported over time than direct measures of gestational age. Unfortunately--as with infant mortality--variations in the definition and measurement of low

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25. Mark J. Vanlandingham, James W. Buehler, Carol J.R. Hogue, and Lilo T. Strauss, "Birthweight-specific Infant Mortality for Native Americans Compared With Whites, Six States, 1980," *American Journal of Public Health*, vol. 78 (May 1988), pp. 499-503.

26. Robert Hartford, National Center for Health Statistics, personal communication.

27. Bea J. van den Berg and Frank W. Oechsli, "Prematurity," in *Perinatal Epidemiology*, Michael B. Bracken, Editor (New York, N.Y.: Oxford University Press, 1984), pp. 69-85.

birthweight make accurate comparisons among countries difficult. In addition to differences in the classification and reporting of live births and fetal deaths discussed earlier in this paper, measurement variations occur due to:

- Differences in local policies and medical practices affecting when an infant is first weighed and the amount of placental blood infused; and

- Errors introduced by inaccurate weighing and rounding weights up or down. (The latter is a particular problem when weights are in pounds and ounces rather than grams.)[28]

Given these difficulties, great care should be taken in making international birthweight comparisons. Nonetheless, the limited data available suggest that a greater proportion of infants are born at low weights in the United States than in other industrialized countries (see Table 5). The widespread diffusion of neonatal technology in the United States may have tempered some of the negative effects of the poor birthweight distribution, however, since perinatal mortality rates for low-weight births appear to be lower in the United States than in other countries for which comparable data are available. Between 1980 and 1982, for example, both Japan and Norway had considerably higher

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28. Eva Alberman, "Low Birthweight," in *Perinatal Epidemiology*, Michael B. Bracken, Editor (New York, N.Y.: Oxford University Press, 1984), pp. 86-98.

TABLE 5. LOW-BIRTHWEIGHT RATES IN DEVELOPED COUNTRIES, AS A PROPORTION OF LIVE BIRTHS, 1980

| Country | Percentage of Births | |
|---|---|---|
| | 1,500 Grams or Less | 2,500 Grams or Less |
| Japan | 0.39 | 5.18 |
| Sweden [a] | 0.49 | 4.03 |
| Switzerland | 0.49 | 5.14 |
| German Democratic Republic | 0.55 [b] | 6.19 |
| Norway | 0.59 | 3.25 |
| New Zealand | 0.65 | 5.27 |
| Federal Republic of Germany | 0.71 | 5.51 |
| Denmark | 0.72 | 6.00 |
| England and Wales [c] | 0.77 | 6.79 |
| Austria | 0.80 | 5.68 |
| Italy | 0.83 | 6.71 |
| Canada [d] | 0.84 | 6.10 |
| Scotland [e] | 0.96 | 6.73 |
| Israel | 0.99 | 7.16 |
| United States | 1.15 | 6.84 |

SOURCE: United Nations: Demographic Yearbook 1981, New York, 1983. Cited in *Preventing Low Birthweight*, Institute of Medicine, 1985, p. viii.

a. Data for 1978.

b. Probably an underestimate because of a nonstandard definition of live births and late fetal deaths.

c. Macfarlane, A. and Mugford, M.; *Birth Counts, Statistics of Pregnancy and Childbirth*, (London: Her Majesty's Stationery Office, 1984).

d. Data for 1979.

e. McIlwaine, GM, Dunn, F., Howat, RCL, Smalls, M., Wylie, MM, and MacNaughton, MC; *Perinatal Mortality Survey, Scotland 1977-1981* (Glasgow: University of Glasgow, 1983).

birthweight-specific perinatal mortality rates for births under 2,500 grams than selected U.S. states, although their overall perinatal mortality rates were lower (see Table 6).[29]

All the evidence to date indicates that improvements in the U.S. birthweight distribution could lower infant mortality rates. International studies suggest, however, that achieving significant reductions in low-birthweight rates will be difficult to achieve in the short term. Although birthweight distributions vary considerably across countries, within countries they are remarkably stable over time, probably reflecting the long-term influences of maternal height and socioeconomic status. Experts believe that Japan provides an exception to this pattern.[30] Following World War II, the Japanese standard of living changed fundamentally within a short period of time. This change was accompanied by a rapid rise in average adult height in the decade after the war. Furthermore, the Japanese established a program for legal abortion, which may have influenced the distributions of maternal age, parity, and socioeconomic status for live births. As a result of these changes, the birthweight distribution appeared to shift, with an increase

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29. Note that the data in Table 6, which are *perinatal* mortality rates (that is, they include early neonatal and late fetal deaths), indicate that a higher proportion of low-weight births were live-born infants that survived the first week of life in selected U.S. states than in Japan and Norway. For longer term survival comparisons, feto-infant mortality rates by birthweight are needed. Unfortunately, these data are not available.

30. Alberman, "Low Birthweight."

in average weight for live births of all gestational ages. (The observed increase in birthweight among recent Southeast Asian immigrants in this country may result from a similar sharp rise in living standards.)

Teenage Pregnancy Rates. Teenage pregnancy and birth rates in the United States are significantly higher than in many other industrialized countries (see Table 7). The extent to which higher rates of teenage child-bearing affect the U.S. infant mortality ranking is unclear and must await more detailed risk factor studies by the ICE participants. Nonetheless, U.S. data suggest that this could, indeed, be an important factor. A strong association exists between young maternal age and the risks of neonatal and postneonatal mortality. Elevated neonatal mortality risks for infants born to teenage mothers appear to result--at least in part--from higher low-birthweight rates among teenagers. By contrast, higher postneonatal mortality risks for infants of teenage mothers appear to be independent of birthweight.[31]

31. Andrew Friede and others, "Young Maternal Age and Infant Mortality: the Role of Low Birth Weight," *Public Health Reports*, vol. 102 (March-April 1987), pp. 192-199.

TABLE 6. BIRTHWEIGHT-SPECIFIC PERINATAL MORTALITY RATES, 1980-1982 (PER 1,000 SINGLE-DELIVERY BIRTHS)

| Birthweight (in grams) | Japan | Norway | United States (Black) | United States (White) |
|---|---|---|---|---|
| All Birthweights | 10.8 | 10.5 | 19.8 | 11.1 |
| Less Than 500 | 990.3 | 1,000.0 | 886.7 | 916.7 |
| 500-999 | 735.2 | 680.3 | 525.6 | 601.0 |
| 1,000-1,499 | 485.4 | 352.9 | 160.4 | 237.9 |
| 1,500-1,999 | 215.6 | 158.9 | 60.6 | 106.6 |
| 2,000-2,499 | 40.2 | 54.9 | 20.7 | 30.4 |
| 2,500-2,999 | 6.3 | 13.9 | 5.3 | 7.7 |
| 3,000-3,499 | 3.0 | 4.1 | 3.1 | 2.9 |
| 3,500-3,999 | 2.8 | 2.0 | 3.2 | 2.2 |
| 4,000-4,499 | 6.5[a] | 2.9 | 5.1 | 2.3 |
| 4,500 or More | --- | 3.1 | 14.4 | 5.8 |

SOURCE: Howard J. Hoffman, Per Bergsjo, and Daniel W. Denman, "Trends in Birth Weight-Specific Perinatal Mortality Rates: 1970-1983," in *Proceedings of the International Collaborative Effort on Perinatal and Infant Mortality, Vol. II* (Hyattsville, Md.: National Center for Health Statistics, March 1990), p. III-61.

NOTES: The U.S. rates are based on births occurring in California, Michigan, Missouri, upstate New York, and North Carolina.

Perinatal deaths include late fetal deaths (28 weeks gestational age or more) and early neonatal deaths (under one week of age).

a. Perinatal mortality rate for all births of 4,000 or more grams.

TABLE 7. TEENAGE PREGNANCY AND BIRTH RATES, PER 1,000 WOMEN BETWEEN 15 AND 19 YEARS OLD

| Country | Pregnancies[a] | Births |
|---|---|---|
| Netherlands | 15.0 | 7.7 |
| Sweden | 33.2 | 11.7 |
| Denmark | 34.0 | 12.0 |
| Finland | 37.4 | 15.7 |
| Canada | 45.4 | 24.8 |
| Norway | 45.8 | 19.6 |
| New Zealand | 52.8 | 32.4 |
| England and Wales | 53.4 | 27.5 |
| Czechoslovakia | 79.3 | 53.7 |
| Hungary | 93.3 | 54.2 |
| United States | 109.9 | 51.7 |

SOURCE: Data from the Alan Guttmacher Institute, cited in *Adolescent Health, Volume II: Background and the Effectiveness of Selected Prevention and Treatment Services*, U.S. Office of Technology Assessment (Washington, D.C.: November 1991), p. 329.

a. Pregnancy rates--which include births, fetal deaths, spontaneous abortions, and induced abortions--can only be rough estimates and should be treated very cautiously.

## FEDERAL AND STATE INITIATIVES TO REDUCE INFANT MORTALITY

Maternal and child health experts believe that further reductions in U.S. infant mortality rates could be achieved through effective preventive measures to reduce the rate of low birthweight. This philosophy underlies recent federal and state initiatives to improve access to prenatal care for poor pregnant women.

Reducing low birthweight is a major goal of the Medicaid expansions for pregnant women and associated efforts by the states to streamline the Medicaid eligibility process and to enhance the quality and accessibility of prenatal care. The intent of these initiatives is to reduce the financial barriers to prenatal care, thereby encouraging earlier and more frequent use of prenatal care by poor women. Improved patterns of prenatal care use may then lead to reductions in low-birthweight rates, with subsequent improvements in infant mortality.

Another recent federal initiative to reduce infant mortality is the Healthy Start program--administered by the Health Resources and Services Administration--which is funding projects in 15 urban and rural areas with exceptionally high infant mortality rates. The intent of these projects is to develop innovative, community-based programs for improving birth outcomes,

with the goal of lowering infant mortality rates in the selected areas by more than 50 percent over five years.

The Healthy Start program builds on the existing structure of federal support for maternal and child health services. The federal government plays a critical role in financing the planning and direct provision of maternal and child health services on a nationwide basis through the Maternal and Child Health Block Grant, which supports the maternal and child health services of state and local health departments, and through Community and Migrant Health Centers, which provide primary health care services to populations that are medically underserved. (The appropriations for Community and Migrant Health Centers now include specific funding for programs to reduce infant mortality and to coordinate care for pregnant women and infants.)

These federal and state initiatives incorporate two alternative approaches to reducing infant mortality:

- Policies that attempt to increase the demand for prenatal care by poor pregnant women to ensure that they use existing prenatal care resources; and

- Policies that expand the supply of prenatal care resources in order to ensure that women are able to obtain appropriate care.

The Medicaid expansions represent major investments of federal, state, and local dollars in the health of poor women and children, but the evaluation of their effects on birth outcomes may not be possible for several years. Further expansions are, however, being considered. At issue is whether this is the preferred federal option for reducing infant mortality, or whether other strategies--or combinations of strategies--would be preferable. Recent research has raised several concerns for consideration.

Medicaid eligibility alone does not guarantee access to care, as evidenced by the fact that obtaining prenatal care is a major problem for some pregnant women who already have Medicaid coverage. This problem may be particularly severe in areas where poverty populations are concentrated and prenatal care providers are in short supply, such as some inner-city neighborhoods and rural communities. Increasing the Medicaid income eligibility ceiling for pregnant women may enhance access to care for a new group of women, who have slightly higher incomes and live outside these high poverty areas, but may not address the access problems of those who are already eligible. (Although increasing Medicaid reimbursement rates may encourage more physicians to accept Medicaid clients, very high rate

increases would probably be necessary to induce physicians to relocate their practices to extremely poor areas.) To improve health care access for concentrated poverty populations may, therefore, require more public and federally subsidized clinics to be established. Furthermore, some evidence suggests that low-income pregnant women who receive care from public providers may have better birth outcomes than those who receive care from private providers.[32] This may be attributable to differences in the content of the prenatal care provided in public clinics compared with the care provided by private physicians, since some public clinics provide a wide range of care coordination, referral, and support services in addition to the medical components of prenatal care.

Regardless of the approach adopted, the primary goal of most current strategies aimed at improving birth outcomes in the United States is to ensure that all pregnant women receive early and appropriate prenatal care. Although supportive of such efforts, a growing number of maternal and child health policy researchers are emphasizing the role of the overall health status of women of child-bearing age in determining birth outcomes, the overwhelming effects of poverty on women's health status and their birth outcomes, and the importance of ensuring access to health care for women

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32. See, for example, Paul A. Buescher and others, "Source of Prenatal Care and Infant Birth Weight: The Case of a North Carolina County," *American Journal of Obstetrics and Gynecology,* vol. 156 (January 1987), pp. 204-210.

both before pregnancy and after the postpartum period. According to these researchers, the scope of the debate on how to reduce U.S. infant mortality rates should be broadened from a relatively narrow focus on pregnancy care to the more general issue of how to improve the health status of poor women and their families. Policies aimed at addressing this issue might require strategies that extend well beyond the traditional boundaries of health care, including housing, education, and job training initiatives, with concomitant increases in federal, state, and local funding.

# REFERENCES


Alberman, Eva, "Low Birthweight," in *Perinatal Epidemiology*, Michael B. Bracken, Editor (New York, N.Y.: Oxford University Press, 1984), pp. 86-98.

Alberman, Eva, and Stephen Evans, "Trends in Birthweight Distribution 1970-83," *Proceedings of the International Collaborative Effort on Perinatal Mortality, vol. II* (Hyattsville, Md.: National Center for Health Statistics, March 1990), pp. III.37-III.49.

Alexander, Greg R. and Donald A. Cornely, "Racial Disparities in Pregnancy Outcomes: the Role of Prenatal Care Utilization and Maternal Risk Status," *American Journal of Preventive Medicine,* vol. 3 (1987), pp. 254-261.

Allen, David M., and others, "Mortality in Infants Discharged from Neonatal Intensive Care Units in Georgia," *Journal of the American Medical Association*, vol. 261 (March 24/31 1989), pp. 1763-1766.

Bakketeig, Leiv S., Howard J. Hoffman, and Ann R. Titmuss Oakley, "Perinatal Mortality," in *Perinatal Epidemiology* (Michael B. Bracken, Editor), 1984, pp. 99-151.

Becerra, Jose E., Carol J.R. Hogue, Hani K. Atrash, and Nilsa Perez, "Infant Mortality Among Hispanics: A Portrait of Heterogeneity," *Journal of the American Medical Association, vol. 265* (January 9, 1991), pp. 217-221.

Benson Gold, Rachel, Asta-Maria Kenney, and Susheela Singh, *Blessed Events and the Bottom Line: Financing Maternity Care in the United States* (New York, N.Y.: Alan Guttmacher Institute, 1987).

Berentzen, William H., "German Infant Mortality 1960-1980," *Geographical Review*, vol. 77 (April 1987), pp. 157-170.

Buescher, Paul A., and others, "Source of Prenatal Care and Infant Birth Weight: The Case of a North Carolina County," *American Journal of Obstetrics and Gynecology*, vol. 156 (January 1987), pp. 204-210.

Cabral, Howard and others, "Foreign-Born and U.S.-Born Black Women: Differences in Health Behaviors and Birth Outcomes," *American Journal of Public Health*, vol. 80 (January 1990), pp. 70-72.

Centers for Disease Control, "Trends in Fertility and Infant and Maternal Health--United States, 1980-1988," *Journal of the American Medical Association*, vol. 266 (July 3, 1991), pp. 24-25.

Centers for Disease Control, "Trends in Years of Potential Life Lost Due to Infant Mortality and Perinatal Conditions, 1980-1983 and 1984-1985," *Journal of the American Medical Association*, vol. 259 (May 27, 1988), pp. 2970-2971.

Children's Defense Fund, *Special Report Three: Maternal and Child Health in America's Cities* (Washington, D.C.: January 1991).

Cole, Susan, Robert B. Hartford, Per Bergsjo, and Brian McCarthy, "International Collaborative Effort (ICE) on Birth Weight, Plurality, Perinatal, and Infant Mortality. III: A Method of Grouping Underlying Causes of Infant Death to Aid International Comparisons," *Acta Obstet. Gynecol. Scand.*, vol. 68 (1989), pp. 113-117.

Collins, James W., and Richard J. David, "The Differential Effect of Traditional Risk Factors on Infant Birthweight Among Blacks and Whites in Chicago," *American Journal of Public Health*, vol. 80 (June 1990), pp. 679-681.

D'Souza, Stan, A. Bhuiya, Susan Zimicki, and K. Sheikh, *Mortality and Morbidity: The Matlab Experience* (Ottawa, Canada: International Development Research Centre, 1988).

Ford, Melvina, "Maternal and Child Health Initiatives", *CRS Issue Brief* (Washington, D.C.: Congressional Research Service, June 6, 1991).

Fossett, James W., and others, "Medicaid in the Inner City: The Case of Maternity Care in Chicago," *Milbank Quarterly*, vol. 68, no. 1 (1990), pp. 111-141.

Freedman, Mary Anne, and others, "The 1989 Revisions of the U.S. Standard Certificates of Live Birth and Death and the U.S. Standard Report of Fetal Death," *American Journal of Public Health*, vol. 78 (February 1988), pp.168-172.

Friede, Andrew, and others, "Young Maternal Age and Infant Mortality: the Role of Low Birth Weight," *Public Health Reports*, vol. 102 (March-April 1987), pp.192-199.

Geronimus, Arline T., and John Bound, "Black/White Differences in Women's Reproductive Health Status: Evidence from Vital Statistics," *Demography*, vol. 27 (August 1990), pp.457-466.

Greb, Anne E., Richard M. Pauli, and Russell S. Kirby, "Accuracy of Fetal Death Reports: Comparison with Data from an Independent Stillbirth Assessment Program," *American Journal of Public Health*, vol. 77 (September 1987) pp. 1202-1205.

Hack, Maureen, and Avroy A. Fanaroff, "Outcomes of Extremely-Low-Birth-Weight Infants Between 1982 and 1988," *New England Journal of Medicine*, vol. 321 (December 14, 1989), pp. 1642-1646.

Hahn, Robert A., Joseph Mulinare, and Steven M. Teutsch, "Inconsistencies in Coding of Race and Ethnicity Between Birth and Death in U.S. Infants," *Journal of the American Medical Association*, vol. 267 (January 8, 1992), pp. 259-263.

Hale, Christiane B., *Infant Mortality: An American Tragedy*, Population Trends and Public Policy, 18 (Washington D.C.: Population Reference Bureau, April 1990).

Hartford, Robert B., "Comparing the United States and Japan in Infant Mortality," unpublished paper, Hyattsville, Md.: National Center for Health Statistics, 1991.

Hartford, Robert B., "The International Collaborative Effort on Perinatal and Infant Mortality--Overview and Major Results," paper presented at the International Working Congress on Problems of Infant Mortality in Europe, sponsored by the Union of National European Paediatric Societies and Associations, Dusseldorf, Germany, October 10, 1991.

Hibbs, Henry H., Jr., *Infant Mortality: Its Relation to Social and Industrial Conditions* (New York, N.Y.: Russell Sage Foundation, 1916). Reprinted as *Women and Children First*, David J. Rothman and Sheila M. Rothman, Editors (New York, N.Y.: Garland Publishing, 1987).

Hogue, Carol J.R., and others, "Overview of the National Infant Mortality Surveillance (NIMS) Project--Design, Methods, Results," *Public Health Reports*, vol. 102 (March-April 1987), pp. 126-138.

Institute of Medicine, *Prenatal Care: Reaching Mothers, Reaching Infants*, (Washington, D.C.: National Academy Press, 1988).

Institute of Medicine, *Preventing Low Birthweight*, (Washington D.C.: National Academy Press, 1985).

Joyce, Theodore, "The Dramatic Increase in the Rate of Low Birthweight in New York City: An Aggregate Time Series Analysis," *American Journal of Public Health*, vol. 80 (June 1990), pp. 682-684.

Kleinman, Joel C., Lois A. Fingerhut, and Kate Prager, "Differences in Infant Mortality by Race, Nativity Status, and Other Maternal Characteristics," *American Journal of Diseases of Children*, vol. 145 (February 1991), pp. 194-199.

Kleinman, Joel C., and Samuel S. Kessel, "Racial Differences in Low Birthweight," *New England Journal of Medicine*, vol. 317 (Sept. 17, 1987), pp. 749-753.

Li, De-Kun, Hanyu Ni, Stephen M. Schwartz, and Janet R. Daling, "Secular Change in Birthweight Among Southeast Asian Immigrants to the United States," *American Journal of Public Health*, vol. 80 (June 1990), pp. 685-688.

Mayes, Linda C., and others, "The Problem of Prenatal Cocaine Exposure," *Journal of the American Medical Association*, vol. 267 (January 15, 1992), pp. 406-408.

National Center for Health Statistics, "Advance Report of Final Natality Statistics, 1989," *Monthly Vital Statistics Report*, vol. 40, no. 8, supplement (Hyattsville, Md.: Public Health Service, 1991).

National Center for Health Statistics, *Health, United States, 1990*, (Hyattsville, Md.: Public Health Service, 1991).

National Center for Health Statistics, *Proceedings of the International Collaborative Effort on Perinatal and Infant Mortality, Volumes I and II* (Hyattsville, Md.: March 1990).

National Commission to Prevent Infant Mortality, *Death Before Life: The Tragedy of Infant Mortality* (Washington, D.C.: August 1988).

Office of Technology Assessment, United States Congress, *Healthy Children: Investing in the Future* (Washington D.C.: U.S. Government Printing Office, February 1988).

Office of Technology Assessment, United States Congress, Neonatal Intensive Care for Low Birthweight Infants: Costs and Effectiveness (Washington, D.C.: December 1987).

Pampel, Fred C., and Vijayan Pillai, "Patterns and Determinants of Infant Mortality in Developed Nations, 1950-1975," *Demography*, vol. 23 (November 1986), pp. 525-542.

Petersen, Donald R., "Sudden Infant Death Syndrome," in *Perinatal Epidemiology* (Michael B. Bracken, Editor), New York, N.Y.: Oxford University Press, 1984, pp. 339-354.

Piper, Joyce, "Preventing and Postponing Death: Trends in Tennessee Infant Mortality," *American Journal of Public Health*, vol. 81 (August 1991), pp.1046-1048.

Schlesinger, Mark, and Karl Kronebusch, "The Failure of Prenatal Care Policy for the Poor," *Health Affairs* (Winter 1990), pp. 91-111.

Singh, Harmeet K.D., "Stork Reality: Why America's Infants are Dying," *Policy Review* (Spring 1990), pp. 56-63.

Smith, Wrynn, *Obstetrics, Gynecology, and Infant Mortality* (New York, N.Y.: Facts on File Publications, 1987).

United Nations, *Demographic Yearbook, 1989* (New York, N.Y.: 1991).

United States General Accounting Office, *Prenatal Care: Early Success in Enrolling Women Made Eligible by Medicaid Expansions* (Washington, D.C.: February 1991).

United States General Accounting Office, *Prenatal Care: Medicaid Recipients and Uninsured Women Obtain Insufficient Care* (Washington, D.C.: September 1987).

United States Public Health Service, Expert Panel on the Content of Prenatal Care, *Caring for Our Future: The Content of Prenatal Care* (Washington, D.C.: 1989).

van den Berg, Bea J., and Frank Oechsli, "Prematurity, " in *Perinatal Epidemiology* (Michael J. Bracken, Editor), New York., N.Y.: Oxford University Press, 1984, pp. 69-85.

Vanlandingham, Mark J., and others, "Birthweight-Specific Infant Mortality for Native Americans Compared With Whites, Six States, 1980," *American Journal of Public Health*, vol. 78 (May 1988), pp. 499-503.

Wilcox, Allen J., and Ian T. Russell, " Birthweight and Perinatal Mortality: I. On the Frequency Distribution of Birthweight," *International Journal of Epidemiology*, vol. 12, no. 3 (1983), pp. 314-318.

Williams, Ronald, and Peter Chen, "Identifying the Sources of the Recent Decline in Perinatal Mortality Rates in California," *New England Journal of Medicine*, vol. 306 (January 28, 1982), pp. 207-214.

Yankauer, Alfred, "What Infant Mortality Tells Us," *American Journal of Public Health*, vol. 80 (June 1990), pp. 653-654.