# Infant Mortality 4

Infant mortality is sometimes used as a yardstick for comparing the outcomes of health systems in countries at similar levels of socioeconomic development although it does not represent the overall health status of a nation (226,256). In comparisons of developed and developing countries, infant mortality may be a social or economic indicator, but in developed countries infant mortality is not highly correlated with established socioeconomic measures (e.g., per-capita gross domestic product and the percentage spent on health) (45).

Infant mortality rates are useful for identifying problems with the health status of infants and mothers and the delivery of health care and related services to these groups (226). Thus, learning why infant mortality rates are up to twice as high in the United States as in other developed countries could lead to improvements in U.S. health programs for mothers and infants. The reasons for international differences in infant mortality are complicated, however, and to understand these differences requires consideration of differences in population characteristics, individual risk behaviors, and features of vital statistics systems. Ongoing examinations of the range of individual and societal factors that influence infant mortality has already provided valuable insight into why U.S. infant mortality is relatively high.

## INTERNATIONAL COMPARISONS OF INFANT MORTALITY RATES AND TRENDS

### Infant Mortality Rates

Infant mortality is measured as the annual number of deaths of infants below age 1 per annual number of live births and is expressed as deaths per 1,000 live births per year. Among 39

**Table 4-1-infant Mortality Rates and Ranks, United States and Selected Countries, 1990**

| Country | Infant mortality Rate[a] | Rank | Country | Infant mortality Rate[a] | Rank |
|---|---|---|---|---|---|
| Japan | 4.60 | 1 | Ireland | 8.20 | 21 |
| Sweden | 5.96 | 2 | New Zealand | 8.31 | 22 |
| Finland[b] | 6.03 | 3 | Italy | 8.53 | 23 |
| Hong Kong | 6.14 | 4 | United States | 9.22 | 24 |
| Singapore | 6.67 | 5 | Greece | 9.66 | 25 |
| Canada | 6.82 | 6 | Israel | 9.84 | 26 |
| Switzerland | 6.83 | 7 | Cuba | 10.74 | 27 |
| Germany, Federal Republic of | 6.98 | 8 | Portugal | 10.99 | 28 |
| Norway | 7.02 | 9 | Czechoslovakia | 11.25 | 29 |
| Netherlands | 7.06 | 10 | Puerto Rico | 14.77 | 30 |
| France | 7.33 | 11 | Bulgaria | 14.77 | 31 |
| German Democratic Republic | 7.33 | 12 | Hungary | 14.82 | 32 |
| Denmark | 7.39 | 13 | Costa Rica | 15.26 | 33 |
| Northern Ireland | 7.49 | 14 | Poland | 16.00 | 34 |
| Scotland | 7,73 | 15 | Chile | 16.82 | 35 |
| Austria | 7.84 | 16 | Kuwait[d] | 17.33 | 36 |
| England and Wales | 7.88 | 17 | Yugoslavia | 20.20 | 37 |
| Belgium | 7.94 | 18 | Union of Soviet Socalist Republics | 21.96 | 38 |
| Spain[c] | 8.07 | 19 | Romania | 30.09 | 39 |
| Australia | 8.17 | 20 | | | |

aNumber of deaths of infants under 1 year per 1,000 live births.
[b]Data are for 1989.
[c]Data are for 1988.
[d]Data are for 1987.

NOTES: Rankings are from lowest to highest infant mortality rates based on the latest data available for counties or geographic areas with at least 1 million population and with "complete" counts of live birth and Infant deaths as Indicated In the *United* Nations *1990* Demographic *Yearbook.*

SOURCE: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Health Statistics, International infant Mortality Data Set, Hyattaville, MD, 1993.

selected developed countries in the world, 1990 infant mortality rates range from a low of 4.6 in Japan to 30.1 in Romania (table 4-l). With a rate of 9.2, the United States ranks 24th, which puts it in the bottom half.

When comparisons of infant mortality are restricted to the United States and 12 other selected developed countries, the difference between the lowest and highest rates is two-fold (from 4.6 in Japan to 9.2 in the United States) (table 4-2).[1] In 1990, the United States ranked last in overall infant mortality, 1lth of 13 in neonatal deaths (those occurring during the first 27 days of life)[2] and 10th of 13 in postneonatal deaths (those occurring between 28 days and 1 year of age)[3] (table 4-2). The United States continues to rank poorly (8th of 13) when the infant mortality rate of only the country's white population is compared with the infant mortality rates of other nations. International variation in infant mortality

1 All subsequent comparisons with the United States are based on the following 12 countries: Australia, Canada, France, Germany (the former Federal Republic of Germany), *Italy,* Japan, *the* Netherlands, New *Zealand,* Norway, Spain, Sweden, and the United Kingdom.

2 Mortality within the first 27 days of life (neonatal death) is described by the neonatal mortality rate, which is the annual number of neonatal deaths per annual number of live births, and is expressed per 1,000 live births per year.

3 Mortality between 28 days and 1 year of age (postneonatal death) is described by the postneonatal mortality rate, which is the annual number of postneonatal deaths per annual number of live births, and is expressed per 1,000 live births per year.

**Table 4-2-Rates and Ranks of Infant, Neonatal, Postneonatal, and Feto-infant Mortality in the United States and Selected Countries, 1990**

| country | Infant mortality | | Neonatal mortality | | Postneonatal mortality | | Fete-infant mortality | |
|---|---|---|---|---|---|---|---|---|
| | Rate[a] | Rank | Rate[b] | Rank | Rate[c] | Rank | Rate[d] | Rank |
| United States | 9.22 | 13 | 5.85 | 11 | 3.38 | 10 | 13.21 | 10 |
| Australia | 8.17 | 10 | 4.85 | 10 | 3.31 | 8 | 12.06 | 6 |
| Canada | 6.82 | 3 | 4.61 | 8 | 2.21 | 3 | 10.72 | 4 |
| England and Wales | 7.88 | 8 | 4.58 | 7 | 3.32 | 9 | 12.44 | 8 |
| [e] | 7.33 | 7 | 3.55 | 4 | 3.79 | 12 | 13.66 | 11 |
| Germany[f] | 6.98 | 4 | 3.54 | 3 | 3.44 | 11 | 10.37 | 3 |
| Italy[g] | 8.53 | 12 | 7.25 | 13 | 2.08 | 2 | 13.96 | 12 |
| Japan | 4.60 | 1 | 2.60 | 1 | 1.99 | 1 | 8.38 | 1 |
| Netherlands | 7.06 | 6 | 4.81 | 9 | 2.24 | 4 | 12.74 | 9 |
| New Zealand | 8.31 | 11 | 4.07 | 6 | 4.24 | 13 | 12.37 | 7 |
| Norway | 7.02 | 5 | 3.92 | 5 | 3.10 | 7 | 11.55 | 5 |
| Spain[h] | 8.07 | 9 | 6.05 | 12 | 2.95 | 6 | 14.69 | 13 |
| Sweden | 5.96 | 2 | 3.50 | 2 | 2.46 | 5 | 9.50 | 2 |

[a]Number of deaths of infants under 1 year per 1,000 live births.
[b]Number of neonatal deaths per 1,000 live births.
[c]Number of postneonatal deaths per 1,000 live births.
[d]Number of late fetal deaths plus infant deaths under 1 year per 1,000 live births plus late fetal deaths.
[e]Data are for 1990, except for feto-infant mortality rate which is for 1989.
[f]Based on data from the former Federal Republic of Germany.
[g]Data are for 1990, except for the neonatal and postneonatal mortality rates, which are for 1988.
[h]Data are for 1987, except infant mortality, which is for 1988.

NOTES: Rankings are from lowest to highest infant mortality rates based on the latest data available for countries or geographic areas with at least 1 million population and with 'complete" counts of live births and infant deaths as indicated in the *United Nations 7988 Demographic Yeabook Some of the* international variation in infant mortality rates is due to variation among counties in distinctions between fetal and infant deaths, The fete-infant mortality rate attempts to reduce internationaJ variation due to clinical distinctions between fetal and infant deaths.

SOURCE: U.S. Department of Health and Human Services, Public Health Service, C-enters for Disease Control and Prevention, National Center for Health statistics, International Infant Mortality Data Set, Hyattsville, MD, 1993.

**Table 4-3--infant Mortality Rates, by Race, Geographic Division, and State: United States, Average Annual 1987-89**

| Geographic division and State | All 1987-89 | White[a] 1987-89 | Black[a] 1987-89 |
|---|---|---|---|
| United States | 9.9 | 8.3 | 18.6 |
| New England | 8.1 | 7.3 | 17.7 |
| Connecticut | 8.8 | 7.4 | 19.5 |
| Maine | 7.8 | 7.8 | -b- |
| Massachusetts | 7.6 | 6.8 | 16.7 |
| New Hampshire | 8.0 | 8.0 | -b- |
| Rhode Island | 8.9 | 8.4 | 15.9[c] |
| Vermont | 7.4 | 7.4 | -b- |
| Middle Atlantic | 10.3 | 8.2 | 19.7 |
| New Jersey | 9.5 | 7.3 | 19.2 |
| New York | 10.7 | 8.7 | 18.7 |
| Pennsylvania | 10.1 | 8.0 | 22.8 |
| East North Central | 10.5 | 8.5 | 20.4 |
| Illinois | 11.6 | 8.9 | 21.5 |
| Indiana | 10.4 | 9.3 | 20.5 |
| Michigan | 11.0 | 8.3 | 22.4 |
| Ohio | 9.6 | 8.3 | 17.3 |
| Wisconsin | 8.7 | 7.8 | 17.0 |
| West North Central | 8.9 | 8.0 | 18.6 |
| Iowa | 8.7 | 8.2 | 22.6[c] |
| Kansas | 8.7 | 7.8 | 18.9 |
| Minnesota | 7.8 | 7.1 | 22.8 |
| Missouri | 10.1 | 8.7 | 17.5 |
| North Dakota | 9.1 | 8.4 | -b- |
| Nebraska | 8.5 | 7.7 | 20.6[c] |
| South Dakota | 9.9 | 8.1 | -b- |
| South Atlantic | 11.3 | 8.6 | 18.5 |
| Delaware | 11.8 | 9.2 | 20.5 |
| District of Columbia | 21.9 | 14.4 | 25.3 |
| Florida | 10.3 | 8.1 | 17.8 |
| Georgia | 12.5 | 9.4 | 18.5 |
| Maryland | 11.0 | 8.3 | 17.7 |
| North Carolina | 11.9 | 9.1 | 18.8 |
| South Carolina | 12.6 | 9.4 | 17.9 |
| Virginia | 10.2 | 7.8 | 18.2 |
| West Virginia | 9.4 | 9.1 | 18.7[c] |
| East South Central | 11.3 | 8.9 | 17.7 |
| Alabama | 12.1 | 9.1 | 17.9 |
| Kentucky | 9.9 | 9.2 | 16.7 |
| Mississippi | 12.5 | 9.0 | 16,4 |
| Tennessee | 11.1 | 8.5 | 19.2 |
| West South Central | 9.6 | 8.2 | 15.9 |
| Arkansas | 10.4 | 8.6 | 16.6 |
| Louisiana | 11.4 | 8.4 | 16.1 |
| Oklahoma | 9.1 | 8.5 | 14.1 |
| Texas | 9.1 | 8.1 | 15.8 |

**Table 4-3--infant Mortality Rates, by Race, Geographic Division, and State: United States, Average Annual 1987-89 (Continued)**

| Geographic division and State | All 1987-89 | White[a] 1987-89 | Black[a] 1987-89 |
|---|---|---|---|
| Mountain | 9.2 | 8.7 | 19.3 |
| Arizona | 9.5 | 8.9 | 21.4 |
| Colorado | 9.4 | 9.1 | 16.5 |
| Idaho | 9.6 | 9.3 | -b- |
| Montana | 10.0 | 9.1 | -b- |
| Nevada | 8.7 | 7.7 | 20.0 |
| New Mexico | 8.9 | 8.3 | 22.6[c] |
| Utah | 8.3 | 8.0 | -b- |
| Wyoming | 9.2 | 9.1 | -b- |
| Pacific | 8.8 | 8.1 | 18.9 |
| Alaska | 10,4 | 8.0 | 15.7C |
| California | 8.7 | 8.0 | 18,8 |
| Hawaii | 8.1 | 5.5 | 14.4[c] |
| Oregon | 9.3 | 9.1 | 21.4[c] |
| Washington | 9.3 | 8.7 | 20.6 |

aDeaths are tabulated by race of decedent; live births are tabulated by race of 'other"
bData for States with fewer then 1,000 live births for the 3-year period are considered highly unreliable and are not shown.
[c]Data for States with fewer than 5,000 live births for the 3-year period are considered unreliable.

SOURCE: US. Department of Health and Human Servicea, Public Health Service, Centers for Disease Control and Prevention, National Center for Health Statistics, *Health United States and prevention Profile: 1991,* DHHS Pub. No. (PHS)92-1232 (Hyattsville, MD: U.S. Department of Heath and Human services, May 1992).

rates exceeds the rather large variation observed among U.S. regions and States (tables 4-2 and 4-3)$_0$

### TIME OF DEATH

**The timing** of infant deaths varies greatly among the 13 comparison countries. The United States, which recorded the highest infant mortality rate in 1990, had the greatest proportion of its infant deaths (38 percent) during the first day of life (figure 4-l). In New Zealand, which had the second highest infant mortality rate, most deaths (51 percent) occurred in the postneonatal period (from 28 to 1 year of age).

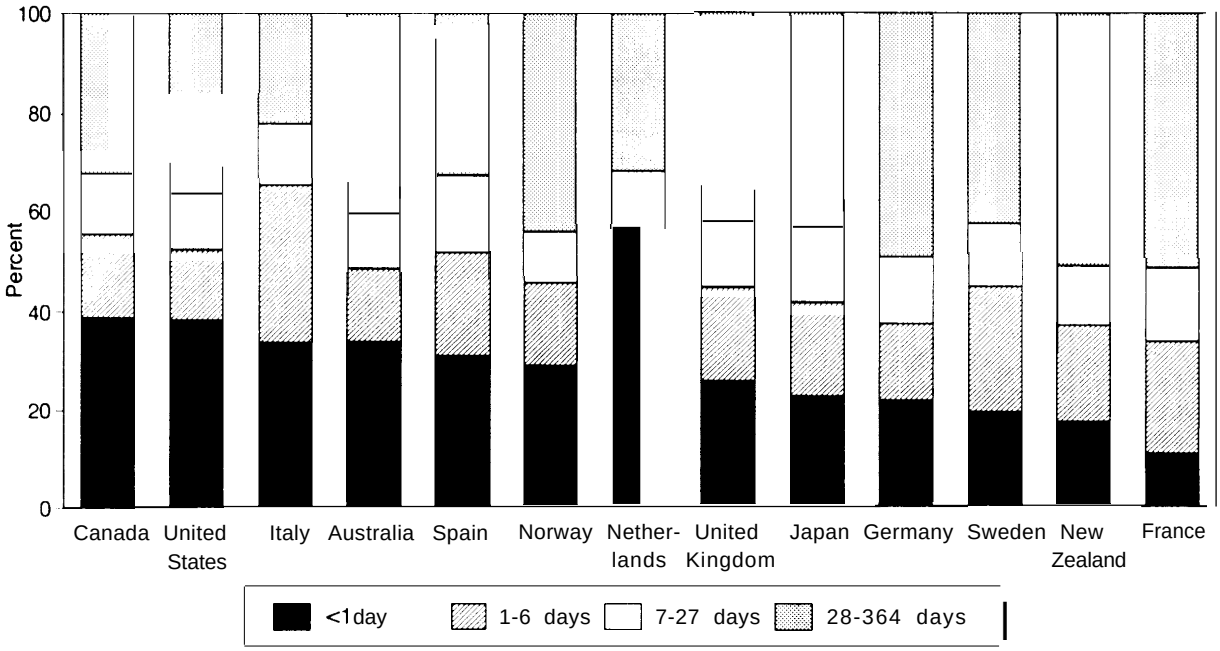
### CAUSE OF DEATH

Perinatal conditions (e.g., birth trauma, respiratory distress syndrome), congenital anomalies, and sudden infant death syndrome (SIDS) are the leading causes of infants' deaths, and account for 60 to 85 percent of all deaths in each of the 13 comparison countries (figure 4-2). In 1988, a relatively high proportion of deaths in the United States were attributable to perinatal causes (46 percent), which is consistent with the large proportion of deaths occurring here during the first day of life. Japan, with the lowest recorded infant mortality rate, has the highest proportion of deaths attributable to congenital anomalies (35 percent). There appear to be differences in how countries diagnose and report deaths from SIDS. As many as 33 percent of infants' deaths in New Zealand are attributed to SIDS, whereas only 4 percent of such deaths in Japan are attributed to SIDS.

## Infant Mortality Trends

**The** United States has not always ranked poorly in infant mortality when compared with other developed countries. In 1950, the infant mortality rates of Spain, Italy, Japan, Germany, France, Canada, and the United Kingdom were higher than the U.S. rate (figure 4-3). By 1970, however,

**Figure 4-1-infant Mortality, Distribution of Time of Death, United States and Selected Countries, 1990°**




**a Data for Italy are for 1988 and data for Spain are** for 1987.

**SOURCE: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Health Statistics, International Infant Mortality Data Set, Hyattsville, MD, 1993.**

most other countries[4] had experienced sharper declines in infant mortality than the United States. Rates of decline since 1950 were greatest for Japan and Spain. Since 1970, rates in Italy, Spain, and Germany have dropped the most.

## TECHNICAL DIFFICULTIES IN MAKING INTERNATIONAL COMPARISONS OF INFANT MORTALITY

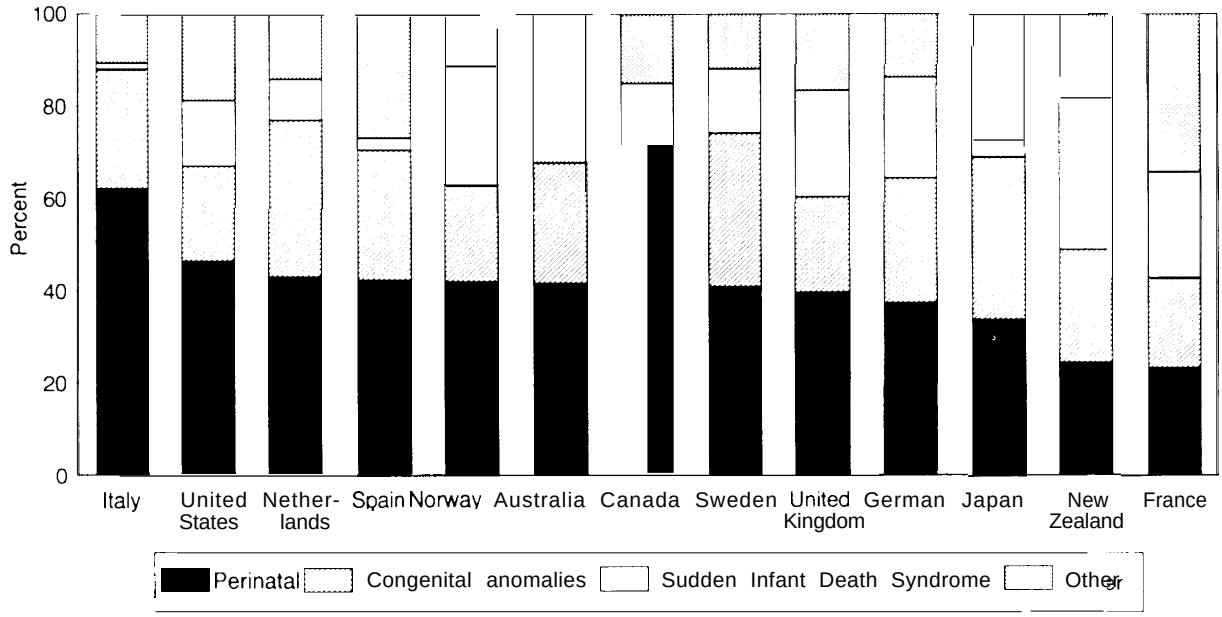
Recent evidence suggests that international differences in resuscitation practices and the classification of infant deaths may elevate the U.S. infant mortality rate somewhat (190). Physicians in the United States appear to be more likely to resuscitate extremely premature and low birthweight infants who later die.[5] These births are classified as live births and are included in the U.S. infant mortality statistics. Other countries appear to be more likely to class@ such births as fetal deaths. Because most countries do not require registration of fetal deaths of fewer than 28 weeks of gestation, these extremely premature infants are not counted within the registration system.[6] That the United States also has a much higher proportion of deaths occurring within 24 hours of birth and with extremely low birthweights (under 500 grams) suggests that different

[4] Of the countries with higher infant mortality rates than the United States in 1950, the rates in Germany, Spain, and Italy continued to exceed the U.S. rate in 1970 (figure 4-3).

[5] Extremely premature infants are those born at less than 28 weeks of gestation. Extremely low birthweight infants are those born weighing less than 500 grams (70).

[6] Distinguishing a live birth from a stillbirth can be difficult. The World Health Organization recommends that a birth be considered live if the newborn shows any sign of life, such as heartbeat, breathing, umbilical cord pulsation, or voluntary muscle movement (253).

**Figure 4-2-infant Mortality, Distribution of Cause of Death, United States and Selected Countries, 1988"**




**a Data for Canada, Spain, and New Zealand are for 1987.**

**SOURCE: World Health Organization, *World Health Statistics* Annual (Geneva, Switzerland: World Health Organization, 1989, 1991, 1992).**

resuscitation (and possibly reporting) practices affect the reported statistics (71).

Some countries have birth registration practices that might contribute to reporting differences. In France, for example, infants may be classified as stillbirths if they die before their births are registered, which may be as much as 2 days after birth (73,108). In some countries, a particular outcome might be preferred for cultural or other reasons, which may cause health care providers' or parents' reports of outcomes to be unreliable (68, 121). For example, some observers speculate that Japan's low infant mortality rate and very high fetal mortality rate may be explained in part by social and cultural customs that favor the recording of infant deaths as stillbirths because the latter are not recorded in Koseki, the Japanese family registration system (73).[7]

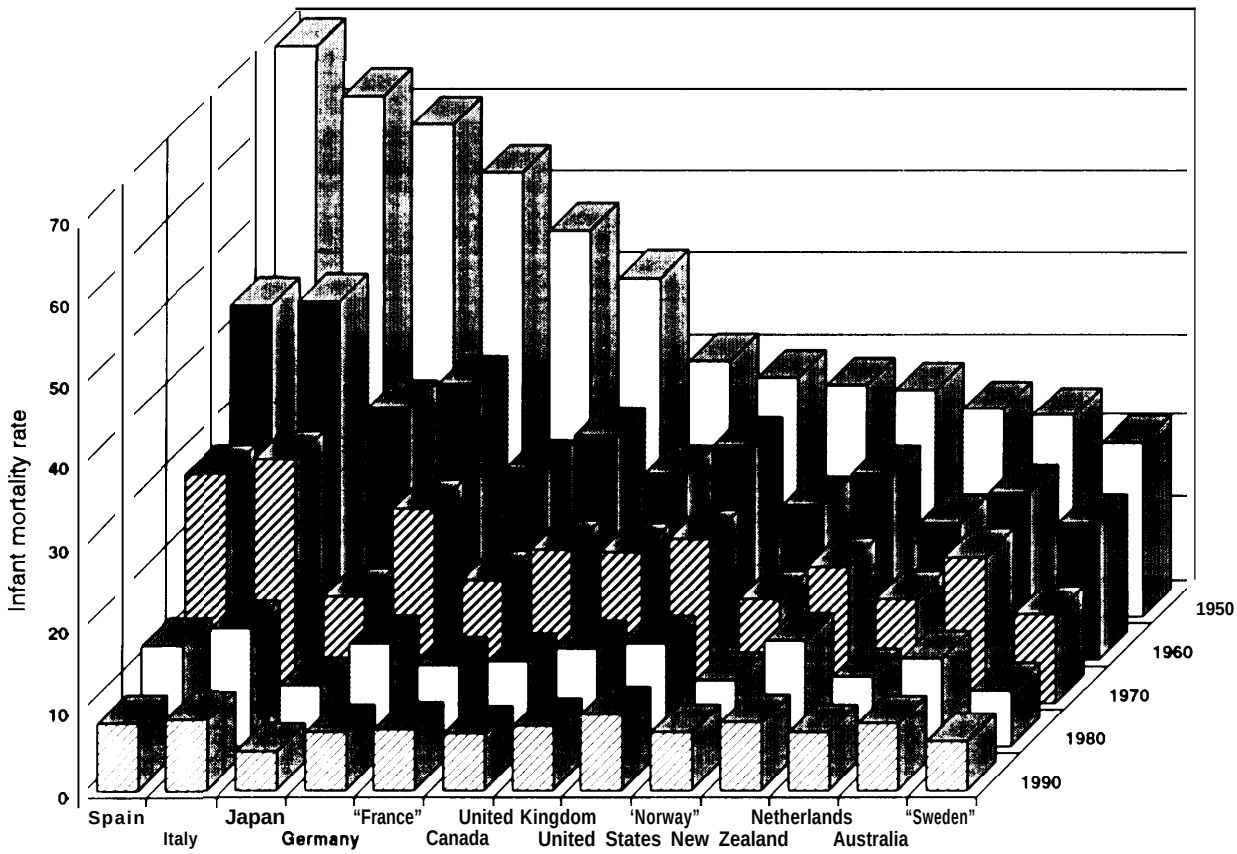
The fete-infant mortality rate (FIMR), a measure combining late fetal and infant deaths,[8] overcomes some of the problems in comparing countries with different ways of classifying live births and fetal deaths. Using the FIMR instead of the infant mortality rate (IMR) for international ranking of the 13 comparison countries, the United States moves from 13th to 10th, not a marked improvement (table 4-2).

The FIMR avoids some problems that arise because of international differences in clinical practice and classification, but the FIMR includes

[7] Some speculate that the preference for registering stillbirths stems from the fact that an infant death is considered a significant health problem in a family medical history, whereas a stillbirth is not. Such family histories have historically been reviewed while arranging marriages (70).

[8] The fete-infant mortality rate is the number of late fetal deaths (after at least 28 weeks of gestation) plus the number of infant deaths within the first year of life per 1,000 live births plus late fetal deaths (231).

**Figure 4-3-infant Mortality Trends, United States and Selected Countries, 1950 to 1990[a]**




a The latest data for Spain are for 1988.

SOURCE: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Health Statistics, International Infant Mortality Data Set, Hyattsville, MD, 1993.

only late fetal deaths, although some evidence suggests that the U.S. infant mortality rate includes births that other countries would likely categorize as early fetal deaths (those occurring at 20 to 27 weeks of gestation). Only a few countries, including Norway, Japan, and the United States, compile statistics on early fetal deaths. When early and late fetal deaths are combined with infant deaths, the United States FIMR is lower than that of Norway and only 16 percent higher than that of Japan (17.35 versus 14.90) (70). This comparison may be unreliable, however, because reporting early fetal death is more complete in areas that require reporting at earlier gestational ages.[9] Fetal death registration begins at 12 weeks of gestation in Japan, at 16

[9] Within the United States, for example, States that require reporting fetal death from conception report higher fetal mortality rates than States that require reporting fetal deaths starting at 20 weeks of gestation (226). When the U.S. FIMR calculation (including fetal deaths from 20 weeks of gestation) is limited to the eight States that report fetal deaths from conception, the rate is about one-third higher than the Japanese rate (19.9 versus 14.9). In this comparison however, U.S. reporting (starting from conception) might be more complete than Japanese reporting, which starts at 12 weeks of gestation.

weeks in Norway (l), and at 20 weeks in most of the United States.[10] Perhaps, therefore, Norway and Japan have more complete reporting of fetal deaths than does the United States.

The gap between the 1990 U.S. and Japanese infant mortality rates closes somewhat when infants of 20 to 27 weeks of gestation are excluded from the calculation. Under that condition, the U.S. infant mortality rate declines relative to the Japanese rate, but the U.S. rate remains approximately 25 to 30 percent higher than the Japanese rate (70). Alternatively, one can compare the rates of infant mortality occurring at least 24 hours after birth or at least 7 days after birth. Both measures avoid most of the problems that arise from disparities in how live births and fetal deaths are classified. Even these measures for ranking, however, leave the United States in the bottom half, at 20th, of the 39 countries shown in table 4-1 (70).

## INTERNATIONAL DIFFERENCES IN RISK FACTORS ASSOCIATED WITH INFANT MORTALITY

Although reporting differences make international comparisons of infant mortality difficult, an attempt has been made to assemble perinatal and infant mortality data from developed countries into a standardized database to further international comparisons. The International Collaborative Effort (ICE) on Perinata1 and Infant Mortality, established in 1984 by the U.S. National Center for Health Statistics (NCHS), is a collaboration of researchers from the public and private sectors of the United States and 10 other industrialized nations: Denmark, England and Wales, Germany, Hungary, Israel, Japan, Norway, Scotland, and Sweden. A major accomplishment is the ICE database of standardized information from each country,[11] which can be analyzed to aid our understanding of how and why countries differ in particular outcomes of pregnancy.

Factors associated with whether an infant will live or die in its first year include its race, sex, birth order, place of residence, birthweight, gestational age, and whether it is born alone or as part of a set of twins, triplets, or other multiple. Additional factors include the mother's age, prior pregnancy outcomes, health status, personal habits (e.g., prenatal care, smoking, alcohol consumption), and socioeconomic status (101). How these biologic and social factors interact to influence infant mortality is unclear, but the availability of richer data sets[12] and improved research tools should help unravel the causal mechanisms. Internationally comparable data are available for some, but not all, of these correlates of infant mortality.

### Low Birthweight

Low birthweight results from prematurity, poor growth, or a combination of the two, and is associated with a high risk of death. Using the ICE database, analysts have explored the contributions of the birthweight distribution-that is, the frequency with which various birthweights occur in a particular population-and birthweight-specific mortality rates to overall infant mortality (100). Analyses have shown that birthweight distributions always follow a bell-shaped curve with a residual group of high-risk, low birthweight infants at the left tail, but that different

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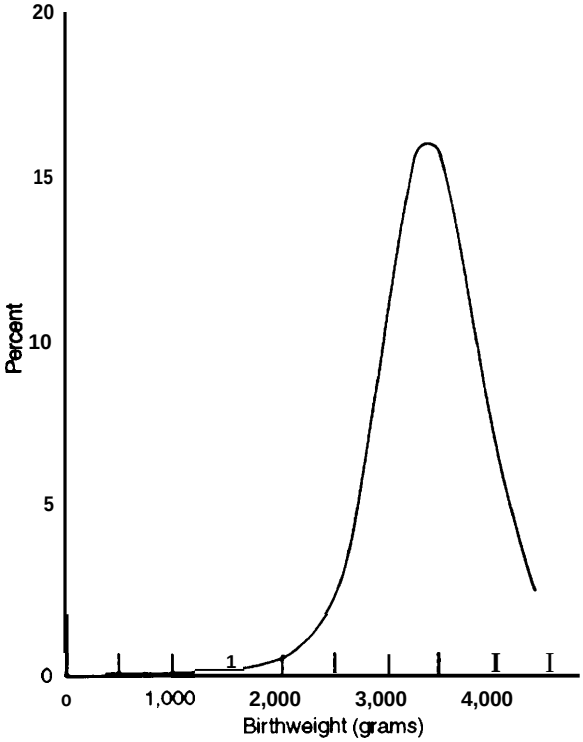
10 States vary in their fetal death registration requirements. Most States require reporting fetal deaths occurring at gestations of 20 weeks or more, and some States (e.g., Massachusetts) also require the registration of the deaths of fetuses weighing 350, 400, or 500 grams or more at birth. Other States (e.g., New York) require the registration of all pregnancy outcomes (226).

11 The most recent data set includes information on infant and fetal death by plurality, birthweight, length of gestation, and cause of death (71). The database includes information from linked files on births and infants' deaths.

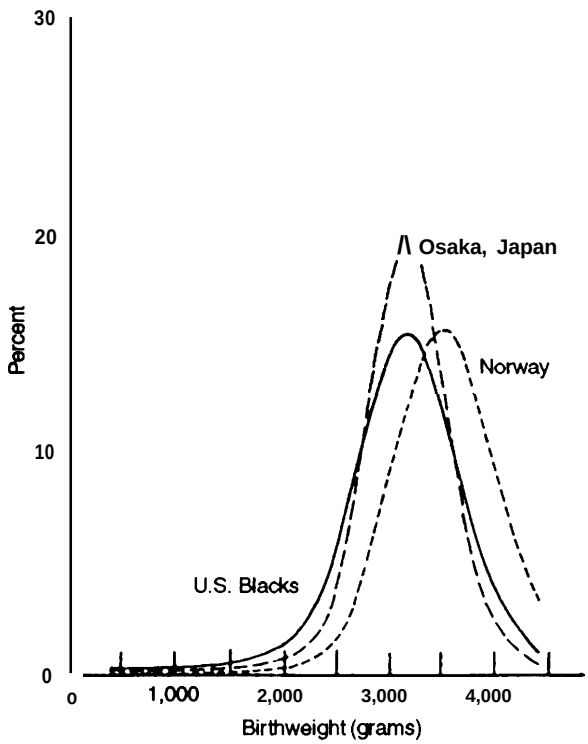
12 The standard U.S. birth certificate, fo, example, was modified in 1989 to include information on maternal medical and lifestyle risk factors (e.g., weight gain, educational attainment, smoking status) and health care (210). Data sets are created to include infant death certificates matched or linked to birth certificates enabling researchers to assess the relative contributions of risk factors to infant mortality.

**Figure 4-4-Birthweight Distribution, Singleton Total Births for U.S. Whites**




SOURCE: U.S. Department of Health and Human services, Public Health Service, Centers for Disease Control and Prevention, National Center for Health Statistics, Proceedings of the *International Collaborative Effort on Perinatal Infant Mortality, Volume III,* DHHS Pub. No. (PHS) 92-1252 (Hyattsville, MD: U.S. Department of Health and Human Services, October 1992).

**Figure 4-5 Birthweight Distributions, Singleton Total Births for ICE Countries**




KEY: ICE = International Collaborative Effort

SOURCE: U.S. Department of Health and Human services, Public Health Service, Centers for Disease Control and Prevention, National Center for Health Statistics, Proceedings *of the International Collaborative Effort on Perinatal and Infant Mortality, Volume III,* DHHS Pub. No. (PHS) 92-1252 (Hyattsville, MD: U.S. Department of Health and Human Services, October 1992).

countries vary greatly in the distribution of birthweights that occur (figure 4-4).[13]

Comparisons of population-specific birthweight distributions show that, on average, babies born in Norway, for example, are heavier than Black babies born in the United States or babies born in Osaka, Japan (i.e., the birthweights of Norwegian babies are to the right of those of Japanese and U.S. Black babies on the distribution curve) (figure 4-5).[14] Japanese and U.S. Black babies have on average similar birthweights but the distributions of births differ. The birthweights of most Japanese babies are near the median birthweight whereas a disproportionate number of U.S. Black babies have low birthweights, which occupy the left tail of the distribution curve.

**A** population's average birthweight is not a good predictor of overall infant mortality. Sweden and Japan, which have the lowest infant mortality rates, have the highest and lowest average birthweights, respectively (table 4-4). And Japan and U.S. Blacks, which have the

[13] U.S. data are for nine selected States.

[14] U.S. data are for nine selected States.

**Table 4-4-Characteristics of Birthweight Distributions and Mortality Rates, United States and Selected Populations 1983-86**

| Population | Predominant distribution mean | Standard deviation | Percent in residual distribution | Percent <1,500 gm | Percent <2,500 gm | Mortality 1,000 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Neonatal | Post-neonatal | Infant | Fetal | Feto-infant |
| United States | | | | | | | | | | |
| Whltes[a] | 3,469 | 504 | 2.0 | 0.86 | 4.7 | 4.4 | 2.9 | 7.3 | 4.3 | 11.5 |
| Blacks[a] | 3,217 | 508 | 4.3 | 2.56 | 11.6 | 8.0 | 5.9 | 13.8 | 6.5 | 20.3 |
| Denmark | 3,478 | 509 | 2.2 | 0.81 | 4.9 | 3.6 | 2.5 | 6.1 | 4.4 | 10.4 |
| England and Wales | 3,354 | 491 | 2.2 | 0.89 | 6.1 | 4.9 | 3.9 | 8.8 | 5.3 | 14.1 |
| Israel | | | | | | | | | | |
| Jews | 3,294 | 472 | 2.7 | 1.13 | 7.0 | 6.6 | 2.9 | 9.6 | 4.4 | 13.9 |
| Non-Jews | 3,301 | 486 | 2.3 | 1.02 | 6.8 | 10.7 | 8.6 | 19.2 | 10.3 | 29.3 |
| Japan (Osaka) | 3,192 | 410 | 1.3 | 0.59 | 5.3 | 3.3 | 2.0 | 5.3 | 5.5 | 10.8 |
| Sweden | 3,537 | 508 | 1.8 | 0.65 | 3.8 | 3.8 | 2.4 | 6.2 | 3.7 | 9.9 |

*U.S. data are for nine selected States: California, Georgia, Michigan, Minnesota, Missouri, North Carolina, upstate New York Utah, end Wisconsin.

SOURCE: J.C. Kleinman, "Implications of Differences in Birthweight Distribution for Comparisons of Birthweight-Specific Mortality," *Proceedings of the International Collaborative Effort on Perinatal and Infant Mortality, Volume III,* U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Health Statistics, DHHS Pub. No. (PHS) 92-1252 (Hyattsville, MD: U.S. Department of Health and Human Services, October 1992).

lowest average birthweights, have the lowest and highest infant mortality rates in the ICE countries.

Because birthweight distributions are unique across populations, some observers have suggested that mortality risks be evaluated in terms of percentiles of the birthweight distribution. Instead of defining low birthweight by means of a uniform, arbitrary birthweight cutoff point (usually less than 2,500 grams), low birthweight could be defined for each country as a percent of the birthweight distribution (129). If, for example, the birthweight representing the 10th percentile were used to define low birthweight, 2,788 grams would be considered low for U.S. Whites, as would 2,440 grams for U.S. Blacks, and 2,677 grams for infants born in England and Wales (129). If each population's birthweight distribution were considered unique and normal for that population, differences in birthweight-specific mortality rates would become more important factors in determining infant mortality (231).[15]

Among the ICE populations studied, two subpopulations with exceptionally high mortality rates stand out: non-Jewish residents of Israel and Blacks in the United States (table 4-4). Both of these subpopulations have infant and fete-infant mortality rates twice as high as those of the respective majority populations. The explanations for the subpopulations' exceptionally high infant mortality rates differ. Non-Jewish residents of Israel have the highest reported IMR and FIMR of all comparison countries, and yet the mean birthweight is higher, and the proportion of low birthweight infants (defined here as those weighing less than 2,500 grams) is lower than that in the majority Jewish population. This subpopulation's excess infant mortality rate appears to reflect high mortality rates at every birthweight. The high infant mortality rate of U.S. Blacks reflects both a relatively large proportion of low birthweight infants and high mortality rates at higher birthweights.

Rates of infant and fete-infant mortality are higher for U.S. Whites than for residents of Sweden and Denmark, but lower than for those of England and Wales. Both birthweight distribution and birthweight-specific rates contribute to these differences, but their relative importance is uncertain (100). If the prevalence of low birthweights were the major contributor to infant mortality, targeted interventions designed to increase birthweight could lead to decreases in infant mortality. If, however, mortality rates were high at all birthweights (as is the case for Israel's non-Jewish population), a broader set of interventions would be needed.

## Multiple Births

**The risk** of death is greater for infants born as twins, triplets, or other multiples than for infants born alone, chiefly because infants of multiple births weigh much less than those born singly. The occurrence of multiple births varies by country and population group, although most of them report rates of about 20 multiple births per 1,000 births and stillbirths. Multiple births occur most often among U.S. Blacks and least often among the Japanese, whose rates are 25 and 13, respectively (76). In view of the disparity between these extremes, international comparisons of infant mortality should be made separately for single and multiple births.

## Teenage Pregnancy

Babies born to teenage mothers are more likely to die than are babies born to older mothers, probably because of differences in the mother's social and environmental characteristics. Mothers giving birth in their teens, for example, are more likely to have low incomes, poor educations, and inadequate prenatal care. Although birth rates for teenagers are much higher in the United States than in comparison countries (table 4-5), and there is a correlation between a country's infant

15 Birthweight distributions within countries tend to be stable over time (43).

## Table 4-5-Live Birth Rates by Maternal Age, United States and Selected Countries, Circa 1990

| Country | Year | Maternal age | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | All ages | <20[a] | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45+[b] |
| United States | 1989 | 61.8 | 59.4 | 115.4 | 116.6 | 76.2 | 29.7 | 5.2 | 0.2 |
| Australia | 1990 | 58.3 | 22.0 | 79.6 | 139.0 | 101.6 | 34.6 | 5.5 | 0.2 |
| Canada | 1989 | 54.5 | 24.8 | 82.5 | 126.1 | 81.9 | 26.4 | 3.8 | 0.1 |
| France | 1990 | 54.5 | 9.1 | 75.8 | 140.0 | 92.3 | 35.8 | 7.7 | 0.5 |
| Germany[c] | 1988 | 43.7 | 10.3 | 56.2 | 111.4 | 78.1 | 26.0 | 4.5 | 0.2 |
| Italy | 1988 | 39.4 | 9.6 | 58.6 | 97.2 | 68.6 | 26.5 | 5.4 | 0.3 |
| Japan | 1990 | 38.9 | 3.6 | 44.3 | 138.0 | 92.2 | 20.6 | 2.4 | 0.0 |
| Netherlands | 1990 | 49.9 | 8.3 | 48.2 | 126.4 | 106.5 | 31.0 | 3.7 | 0.5 |
| New Zealand | 1990 | 67.2 | 34.4 | 101.2 | 147.5 | 105.7 | 36.8 | 5.4 | 0.3 |
| Norway | 1990 | 58.0 | 16.9 | 93.3 | 145.0 | 95.2 | 32.4 | 4.7 | 0.3 |
| Spain | 1986 | 47.1 | 16.7 | 65.8 | 112.0 | 73.5 | 31.2 | 8.9 | 0.8 |
| Sweden | 1989 | 57.1 | 12.7 | 92.8 | 149.0 | 103.4 | 38.7 | 6.4 | 0.3 |
| United Kingdom | 1990 | 56.5 | 33.0 | 91.1 | 122.7 | 87.0 | 31.0 | 5.0 | 0.3 |

aRates computed on female population ages 15 to 19.
bRates computed on female population ages 45 to 49.
cBased on data from the former Federal Republic of Germany.

SOURCE: United Nations, 1991 Demographic Yearbook table 11 (New York, NY: United Nations, 1992).

mortality rate and the prevalence of teenagers giving birth, the elimination of such births from the computation would have little effect on infant mortality rates. Disregarding births to teenagers in the United States, for example, would lower the infant mortality rate by only 4 percent for Whites and 7 percent for Blacks, and would have essentially no effect on our international infant mortality ranking (102).

Relatively low use of contraceptives among sexually active teenagers in the United States, in part, explains higher teenage pregnancy rates in the United States than in Europe (185). Pregnant U.S. teenagers are, however, more likely to use elective abortion than their European counterparts (185).

The high proportion of births by women under the age of 20 or over 39 correlates with the high rate of infant mortality in the United States. If women in the United States gave birth at the same ages as women in Japan, where there are relatively few births to very young and older women (table 4-5), the U.S. infant mortality rate would be about 10 percent lower than it is (108). However, the socioeconomic, lifestyle, and health status characteristics of U.S. mothers at the extremes of the maternal age distribution, rather than age itself, probably account for the differences (70).

Births to unmarried women increased markedly between 1%0 and 1989 in the United States and many other developed countries, reflecting the rise in births to teens and older well-educated women[16] (table 4-6). An exception is Japan, where the proportion of births to unmarried women has remained constant at 1 percent. In the United States, the proportion of all births to unmarried women increased from 5 percent in 1960 to 27 percent in 1989. The proportions are even greater in other countries. In 1989, roughly one-half of the births in Denmark and Sweden were to unmarried women.

## Use of Prenatal Care

Early, comprehensive, prenatal care improves birth outcomes (191a). The proportion of pregnant women lacking prenatal care or seeking prenatal care late (after 15 weeks of pregnancy) is greater in the United States than in selected Western European countries (21 percent in the United States compared with 4 percent in France, 8 percent in Denmark, and 14 percent in Belgium). These differences in prenatal care persist even when comparisons are restricted to college-educated women. Despite the fact that U.S. women seek care later than European women, the median number of prenatal care visits is higher in the United States (11 visits) than in Denmark (10 visits) or in France (7 visits) (22).[17] Differences in the number of prenatal visits might reflect differences in the recommendations of local professionals. In the United States, for example, the American College of Obstetricians and Gynecologists and the American Academy of Pediatrics recommend from 13 to 15 prenatal care visits. By contrast, the Royal College of Obstetricians and Gynecologists in Great Britain recommends only 7 to 9 visits (191a).

## Elective Abortion

High rates of elective abortion seem to be correlated with low infant mortality rates in some countries (e.g., Japan, Sweden) (45). Infant mortality might be reduced if high-risk pregnancies were selectively terminated (30). This relationship does not exist in the United States, where the infant mortality rate is relatively high despite a very high elective abortion rate (45).

## Sociodemographic Differences

Significant racial, ethnic, and socioeconomic differentials in infant mortality and other health outcomes exist not only in the United States, but

16 In the United States, for example, the proportion of all mothers that were never-married women 18 to 44 years old with 1 or more years of college doubled from 1982 to 1992 from 5.5 to 11.3 percent (5).

17 The number of prenatal care visits is unavailable for Belgium from this source.

## Table 4-6-Births to Unmarried Women, Selected Countries, Selected Years[a]

| Country | 1960 Total live births (1,000) | 1960 Percent born to unmarried women | 1970 Total live births (1,000) | 1970 Percent born to unmarried women | 1980 Total live births (1,000) | 1980 Percent born to unmarried women | 1989 Total live births (1,000) | 1989 Percent born to unmarried women |
|---|---|---|---|---|---|---|---|---|
| United States | 4,258 | 5 | 3,731 | 11 | 3,612 | 18 | 4,041 | 27 |
| Canada | 479 | 4 | 372 | 10 | 360 | 13 | 384 | 23 |
| Denmark | 76 | 8 | 71 | 11 | 57 | 33 | 62 | 46 |
| France | 820 | 6 | 850 | 7 | 800 | 11 | 766 | 28 |
| Germany[b] | 969 | 6 | 811 | 6 | 621 | 8 | 662 | 11 |
| Italy | 910 | 2 | 902 | 2 | 640 | 4 | 567 | 6 |
| Japan | 1,624 | 1 | 1,932 | 1 | 1,616 | 1 | 1,269 | 1 |
| Netherlands | 239 | 1 | 239 | 2 | 181 | 4 | 189 | 11 |
| Sweden | 102 | 11 | 110 | 18 | 97 | 40 | 116 | 52 |
| United Kingdom | 918 | 5 | 904 | 8 | 754 | 12 | 777 | 27 |

[a]For U.S. figures, beginning 1980, marital status is inferred from a comparison of the childs' and parents' surnames on the birth certificate for those States that do not report on marital status. No estimates are included for misstatements on birth records or failures to register births.
bBased on data from the former Federal Republic of Germany.

SOURCE: U.S. Department of Commerce, Bureau of the Census, *Statistics Ah&mtoftie Unitid States, 7992*(1) 12th Ed.) (Washington, DC: U.S. Government Printing Office, 1992).

also in several other developed countries where access to high quality medical care is universal. In the former Federal Republic of Germany, for example, 1988 infant mortality rates were 25 percent higher for births by migrant workers than for those by nonmigrants.[18] In Sweden, neonatal mortality rates were 50 percent higher and late fetal mortality rates were 80 percent higher for manual workers than for nonmanual workers (box 4-A).

## EFFECTS OF RACE IN THE UNITED STATES

Black infants are twice as likely as White infants to die (234).[19] Blacks have higher rates of low birthweight, the leading risk factor for infant mortality, and mortality rates are higher among Blacks than Whites for infants with normal birthweights. The racial disparity in reproductive outcomes in the United States cannot be explained fully by known sociodemographic differences. Even in low-risk populations, Black infants have higher death rates than White infants (102). For example, mortality rates for infants born to college-educated parents are nearly twice as high for Blacks as for Whites.[20] A higher incidence of low birthweight explains the higher infant mortality rates for this selected population (163).[21]

About 40 percent of the racial disparity in postneonatal mortality in the United States can be attributed to differences in how maternal risk characteristics (i.e., marital status, age, parity, educational attainment, prenatal care) are distributed. The remaining 60 percent possibly derives from income and behavioral factors (101).

The medical risk factors of mothers may account for some of the racial differences in infant mortality rates. According to studies of U.S. birth certificate data, anemia was reported more than twice as often in Black mothers as in White mothers (34.7 per 1,000 compared with 14.6 per 1,000), and the rate of chronic hypertension was nearly twice as high in Black mothers as in White mothers (10.8 compared with 5.7) in 1990.[22] Differences in how much weight mothers gain may also account for infant mortality disparities. According to available guidelines, gaining at least 22, but not more than 35 pounds, is optimal. Black women are more likely than white women to gain fewer than 21 pounds during pregnancy (234).[23]

Some studies suggest that maternal smoking is responsible for approximately 20 to 40 percent of all instances in which infants have low birthweights. Higher rates of low birthweight among Blacks, however, cannot be explained by smoking practices: Black mothers are less likely to smoke during pregnancy than White mothers; and among those who do smoke during pregnancy, Black mothers smoke less than White mothers (234). Alcohol use can cause fetal alcohol syndrome[24] and affect birthweight (234).[25] The proportions of women reporting alcohol consumption during pregnancy are similar for Blacks and Whites, but a greater proportion of Black than

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[18] In 1988, births by migrant workers represented 9 percent of German births (161).

[19] In 1990, the infant mortality rates for Whites and Blacks were 7.6 and 18.0 per 1,000 live births in the United States (234).

[20] Among this highly educated population, the infant mortality rates for Black and White infants were 10.2 and 5.4 per 1,000 live births, respectively (163).

[21] For infants born to highly educated parents, mortality rates are the same for Blacks and Whites when the birthweight is normal (i.e., at or above 2,500 grams) (163).

[22] Findings that death rates for U.S. women of reproductive age are at least 25 percent greater for Blacks than for Whites indicate that discrepancies in women's health status may play a role in the racial difference in infant mortality (58).

[23] Black mothers with pregnancies of 40 weeks gestation or more were more likely than comparable White mothers to gain fewer than 21 pounds (26 percent compared with 16 percent) (234).

[24] Fetal alcohol syndrome is characterized by retarded growth, facial malformations, and dysfunctions of the central nervous system, including mental retardation (234).

[25] The effect of alcohol on birthweight is independent of the effect of tobacco use and other maternal and infant characteristics (234).

## Box 4-A—Socioeconomic Differences in Pregnancy Outcomes in Selected Countries

- **Australia**—In 1990, the infant mortality rate was three times greater for Aborigines than for the total Australian population.
- **Denmark**—Stillbirth and infant mortality rates for the lowest social group were 60 percent higher than for the highest social group during the period 1983-87. Social group was defined by the father's occupation recorded on the birth register. The lowest social group included the unemployed and unskilled manual workers, whereas the highest social group included university graduates, managers, teachers, and technicians. Comparisons were made controlling for social group differences in age, parity, and county of residence.
- **England and Wales**—Infant mortality rates for the lowest social class were nearly twice as high as those for the highest social class in 1987. Social class was defined in terms of the father's occupation.
- **Germany**[1]—Infant mortality rates of German migrant workers in 1988 were 25 percent higher than those of nonmigrant Germans. Births to migrant workers represent 9 percent of German births.
- **Israel**—Infant mortality was about twice as high for Moslems and Druze as for Jews in 1987. Births to Moslems and Druze represent 22 percent of births in Israel.
- **Norway**—Perinatal and postneonatal death rates among less educated parents (i.e., mothers and fathers with fewer than 9 years of formal education) were 50 to 80 percent higher than those of more educated parents during the period 1979-82.
- **Sweden**—Neonatal and late fetal death rates were 50 and 80 percent higher, respectively, among unskilled manual workers than among intermediate nonmanual workers during 1985-86 (after adjusting for differences in age, parity, and smoking). Postneonatal death rates did not vary significantly by socioeconomic status.

[1] Based on data from the former Federal Republic of Germany.

SOURCES: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Center for Health Statistics, *Proceedings of the International Collaborative Effort on Perinatal and Infant Mortality, Volume III*, DHHS Pub. No. (PHS) 92-1252 (Hyattsville, MD: U.S. Department of Health and Human Services, October 1992); M. Whitehead, K. Judge, D.J. Hunter, et al., "Tackling Inequalities in Health: The Australian Experience," *British Medical Journal* 306:783-787, March 20, 1993.

White women who drink report high alcohol consumption .26

## SUMMARY

Of 39 developed countries, the United States ranked 24th in infant mortality in 1990. The U.S. infant mortality rate (9.2) was 35 percent higher than Canada's rate (6.8) and twice as high as Japan's rate (4.6). The U.S. international standing was much better in 1950 and 1960, but other countries have since experienced more rapid declines in infant mortality.

Interpreting international differences in infant mortality rates is difficult, because countries vary in how they report vital events. Available evidence suggests that infant mortality rates are inflated in the United States because many events that would be considered fetal deaths in other countries are counted as live births in the United States. Although U.S. rates would be comparable to those of Japan if infant deaths were combined with fetal deaths that occurred after at least 20 weeks of gestation, such a comparison might be invalid because of evidence suggesting that the United States undercounts early fetal deaths.

26 Among the mothers who consumed alcohol during pregnancy, Black mothers were twice as likely as the White mothers to hsve consumed three or more drinks per week (37 percent compared with 18 percent) (234).

Moreover, despite the fact that the current international rank of the United States is overly pessimistic, its true rank is probably no better than 20th of 39, a rank that has deteriorated considerably over time.

Among the factors that influence whether an infant will live or die in its frost year are the infant's race, sex, birth order, place of residence, birthweight, gestational age, and whether it is born alone or a part of a set of twins, triplets, or other multiples; additional factors include the mother's age, prior pregnancy outcomes, health status, personal habits (e.g., prenatal care, smoking, alcohol consumption), and socioeconomic status. How these biologic and social factors interact to influence infant mortality is unclear, but available international data should aid in the assessment of how these factors vary in relation to infant mortality rates in the United States and abroad.

By applying new analytic methods to an international perinatal and infant mortality database, researchers have assessed the relative roles of birthweight distribution and birthweight-specific mortality on infant mortality in the United States. The ICE research suggests that when definitions of low birthwe ight take population-specific birthweight distributions into account (rather than use an arbitrarily defined value for all populations), the relatively high infant mortality rate in the United States may reflect birthweight-specific mortality more than birthweight distribution. This implies that efforts to improve the U.S. infant mortality rate must target interventions both to lower the prevalence o f infants born in the high-risk, low birthweight end of the distribution curve and to lessen the chances of death for infants of all birthweights.

The age of the mother, her use of prenatal care, her race and ethnicity, and her socioeconomic status are all factors associated with infant mortality. There are relatively more births in the United States by women under the age of 20 or over the age of 39, groups who tend to be at greater risk of poor pregnancy outcomes. The difference in age distribution may explain up to 25 percent of the difference between the infant mortality rate of the United States and countries with more favorable rates, such as Canada and Japan. Nonetheless, the socioeconomic, lifestyle, and health status characteristics of U.S. mothers at the extremes of the maternal age distribution, rather than age itself, probably account for the differences.

Patterns of use of prenatal care in the United States differ from those in some **Western** European countries. Pregnant women in the United States tend to seek care later, but average a greater number of prenatal care visits than do women in Denmark and France.

Significant socioeconomic differentials in infant mortality exist in the United States as well as in several other developed countries, even where access to high quality medical care is universal. Improving access to maternal and child health services in the United States would likely decrease the U.S. infant mortality rate, but variation among the Nation's subpopulations might well persist.