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## Annual Summary of Vital Statistics: Trends in the Health of Americans During the 20th Century

Bernard Guyer, MD, MPH\*; Mary Anne Freedman, MA‡; Donna M. Strobino, PhD\*; and Edward J. Sondik, PhD‡

*Note to the Reader: This year's "Annual Summary of Vital Statistics" article represents a major departure from all previous versions. There are 2 reasons for this. First, we wanted to acknowledge the end of the century by taking advantage of the available long-term trend data to reflect on the major improvements that have occurred in the health of Americans over the century. This year's article could be called a "Centennial Summary of Vital Statistics." Second, the introduction of the new 10th revision of the International Classification of Diseases for mortality has delayed the availability of the 1999 mortality data. This article, in its standard annual format, will return in 2001.*

**ABSTRACT.** The overall improvement in the health of Americans over the 20th century is best exemplified by dramatic changes in 2 trends: 1) the age-adjusted death rate declined by about 74%, while 2) life expectancy increased 56%. Leading causes of death shifted from infectious to chronic diseases. In 1900, infectious respiratory diseases accounted for nearly a quarter of all deaths. In 1998, the 10 leading causes of death in the United States were, respectively, heart disease and cancer followed by stroke, chronic obstructive pulmonary disease, accidents (unintentional injuries), pneumonia and influenza, diabetes, suicide, kidney diseases, and chronic liver disease and cirrhosis. Together these leading causes accounted for 84% of all deaths.

The size and composition of the American population is fundamentally affected by the fertility rate and the number of births. From the beginning of the century

there was a steady decline in the fertility rate to a low point in 1936. The postwar baby boom peaked in 1957, when 123 of every 1000 women aged 15 to 44 years gave birth. Thereafter, fertility rates began a steady decline. Trends in the number of births parallel the trends in the fertility rate.

Beginning in 1936 and continuing to 1956, there was precipitous decline in maternal mortality from 582 deaths per 100 000 live births in 1935 to 40 in 1956. Since 1950 the maternal mortality ratio dropped by 90% to 7.1 in 1998.

The infant mortality rate has shown an exponential decline during the 20th century. In 1915, approximately 100 white infants per 1000 live births died in the first year of life; the rate for black infants was almost twice as high. In 1998, the infant mortality rate was 7.2 overall, 6.0 for white infants, and 14.3 for black infants.

For children older than 1 year of age, the overall decline in mortality during the 20th century has been spectacular. In 1900, >3 in 100 children died between their first and 20th birthday; today, <2 in 1000 die. At the beginning of the 20th century, the leading causes of child mortality were infectious diseases, including diarrheal diseases, diphtheria, measles, pneumonia and influenza, scarlet fever, tuberculosis, typhoid and paratyphoid fevers, and whooping cough. Between 1900 and 1998, the percentage of child deaths attributable to infectious diseases declined from 61.6% to 2%. Accidents accounted for 6.3% of child deaths in 1900, but 43.9% in 1998. Between 1900 and 1998, the death rate from accidents, now usually called unintentional injuries, declined two-thirds, from 47.5 to 15.9 deaths per 100 000.

The child dependency ratio far exceeded the elderly dependency ratio during most of the 20th century, particularly during the first 70 years. The elderly ratio has gained incrementally since then and the large increase expected beginning in 2010 indicates that the difference in the 2 ratios will become considerably less by 2030. The challenge for the 21st century is how to balance the needs of children with the growing demands for a large aging population of elderly persons. *Pediatrics* 2000;106:1307-1317; birth, child mortality, death, dependency ratio, fertility, infant mortality, life expectancy, low birth weight, maternal mortality, natality, vital statistics.

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ABBREVIATIONS. AIDS, acquired immunodeficiency syndrome; ICD, International Classification of Diseases; IMR, infant mortality rate; NMR, neonatal mortality rate; PNMR, postneonatal mortality rate; VLBW, very low birth weight; RDS, respiratory distress syndrome; SIDS, sudden infant death syndrome; LBW, low birth weight; HIV, human immunodeficiency virus.

The 20th century has been the century of vital statistics. These statistics chronicle the dramatic overall improvements in the living standards, environmental quality, and health status of Americans over this century. This is not to say that there were not bumps along the road—world wars, economic depressions, influenza and acquired immunodeficiency syndrome (AIDS) pandemics, racial segregation, and the explosive growth and partial decline in tobacco use, among others. All of these events are captured in the health statistics. For this article, we have selected a number of major indicators that have been available for most of the century. In particular, we focus our attention on measures of the health of children and women of reproductive age. The findings point to the challenges that lie ahead in the 21st century.

#### HISTORY OF THE VITAL STATISTICS PROGRAM

The history of vital statistics in the United States dates back to at least 1632, when the General Assembly of Virginia passed a law requiring the registration of christenings, marriages, and burials. The Commonwealth Colony of Massachusetts followed with a similar law in 1639.<sup>1</sup> Later, the US Constitution included provision for a decennial census but not for a national vital registration system, leaving the registration function to the states. In the latter half of the 19th century, the decennial censuses included questions about vital events, but the methodology and results were flawed.<sup>1</sup>

In 1902, when the US Bureau of the Census became a permanent agency of the federal government, the Director of the Bureau was authorized to obtain, annually, copies of death records filed in the vital statistics offices of those states and cities having adequate death registration systems and to publish data from these records. Ten states, the District of Columbia, and several cities met the criteria for inclusion in this national “death-registration area.” The national birth registration area was established in 1915. The Children’s Bureau further promoted the expansion of state participation in birth and death registration under the Sheppard-Towner Act.<sup>2</sup> By 1933 all states were registering live births and deaths with acceptable event coverage and providing the required data to the Census Bureau for the production of national birth and death statistics.

In 1946, responsibility for collecting and publishing vital statistics at the federal level was transferred to the US Public Health Service’s National Office of Vital Statistics. In 1960, the National Office of Vital Statistics was merged with the National Health Survey to establish the National Center for Health Statistics. In 1987, the National Center for Health Statistics became part of the Centers for Disease Control

and Prevention, US Department of Health and Human Services.

#### METHODS

Except as noted, data presented in this article are based on 100% of birth and death certificates registered in all States and the District of Columbia. Death data for 1972 are based on a 50% sample of records,<sup>3</sup> as are birth data for 1951 to 1954 and 1956 to 1972 and births in selected states during the period 1973 to 1984.<sup>4</sup> Data for years before 1933 are based on estimates developed from birth and death statistics for registration states. More than 99% of births and deaths are currently registered.<sup>3,4</sup> Population data for computing rates were provided by the US Bureau of the Census.<sup>5,6</sup> Detailed information on the computation of rates, denominators, sampling procedures, and statistical significance is published elsewhere.<sup>3,4,7,8</sup>

Tabulations of births beginning in 1980 are by race and Hispanic origin of the mother as reported on the birth certificate. Rates by race before 1980 are by race of child, which was determined by an algorithm that took into account the races of the mother and the father.<sup>4</sup> Data on births to unmarried women are based on mother’s reported marital status in most States.<sup>4,7,9</sup>

Causes of death are classified according to the edition of the *International Classification of Diseases (ICD)* in effect at the time of the event.<sup>10</sup> The ICD is revised approximately every 10 years. During the period 1900–1998, 9 revisions of the ICD were used in the United States. The introduction of a new revision of the ICD can create major discontinuities in statistical trend data. Procedures for dealing with these discontinuities are discussed elsewhere.<sup>3</sup>

#### RESULTS

##### Mortality and Life Expectancy

The overall improvement in the health of Americans over the 20th century is best exemplified by the dramatic changes in 2 measures: 1) the age-adjusted death rate and 2) life expectancy. Figure 1 shows the virtually continuous decline in the death rate throughout the century and the corresponding increase in life expectancy over the same period.<sup>8,11</sup> The age-adjusted death rate declined by about 74%, while life expectancy increased 56%. Decline in the death rate occurred at an almost constant rate of change until approximately mid-century. At that point the rate nearly leveled off and then began another decline from the late 1960s to the end of the century. The sharp spike in mortality in 1918 and the concurrent decline in life expectancy reflect the worldwide influenza pandemic. Many of the subsequent annual fluctuations in mortality reflect the impact of recurrent influenza outbreaks of varying degrees.<sup>12</sup>

Life expectancy in the 20th century has increased over 27 years (from 49.2 to 76.5 years), and by far the greatest contributions have been from mortality reductions among children. Mortality reductions in the years up to age 20 have contributed about 58% of the 27 year gain, followed by mortality reductions in ages 20 to 39, which contributed about 17%.<sup>13</sup> All in all, the gain, adding >50% to our life span, has been a triumph of public health and biomedical research.

##### Causes of Death

Leading causes of death also show great changes over the century, with a shift from infectious to chronic diseases. In the early part of the century, infectious respiratory diseases (pneumonia and influenza, tuberculosis) were the leading causes of

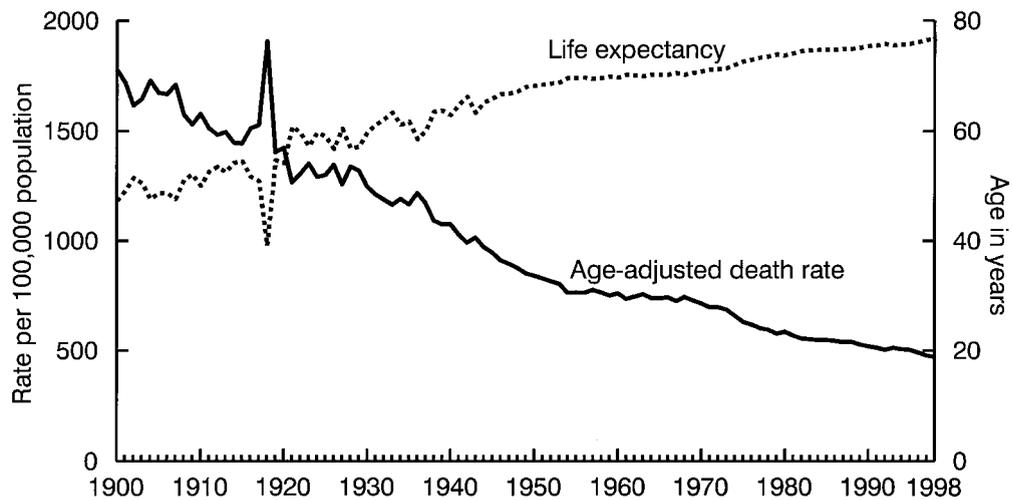


Fig 1. Life expectancy and age-adjusted death rates: United States, 1900–1998.

death, accounting for nearly a quarter of all deaths in 1900. These were followed by diarrhea, heart disease, stroke, liver disease, accidents, cancer, senility, and diphtheria. By 1910, heart disease had become the leading cause, accounting for >10% of deaths.<sup>14</sup> Heart disease has remained the leading cause throughout the century except for the years of the influenza pandemic (1918–1920). While the age-adjusted death rate for heart disease has declined steadily since 1950, this cause is currently responsible for almost a third of all deaths in the United States.<sup>8</sup> Pneumonia and influenza remained the second leading cause until 1933 when cancer replaced it.<sup>15</sup> The age-adjusted death rate from cancer increased by about 55% during the period 1900 to 1998. This increase is partly attributable to the increase in smoking over the century. Smoking is estimated to be responsible for 1 out of 5 deaths in the United States<sup>16</sup> and is estimated to account for as much as 90% of all lung cancer.<sup>17</sup>

The 10 leading causes of death in the United States

in 1998, were, respectively, heart disease and cancer followed by stroke, chronic obstructive pulmonary disease, accidents (unintentional injuries), pneumonia and influenza, diabetes, suicide, kidney diseases, and chronic liver disease and cirrhosis. Together these leading causes accounted for 84% of all deaths.<sup>8</sup>

#### Births and Fertility Rates

Another area of dramatic change, one that fundamentally affects the size and composition of the American population, concerns the fertility rate (defined as the number of births per 1000 women of reproductive age 15–44 years) and the number of births. Figure 2 shows several distinct periods in fertility trends. From the beginning of the century there was a steady decline in the fertility rate to a low point in 1936. The rate increased through the early 1940s, declined briefly in the last years of the World War II, and then spiked steeply upward. Between 1945 and 1947, the onset of the baby boom period, the fertility rate increased nearly one-third. The rate in-

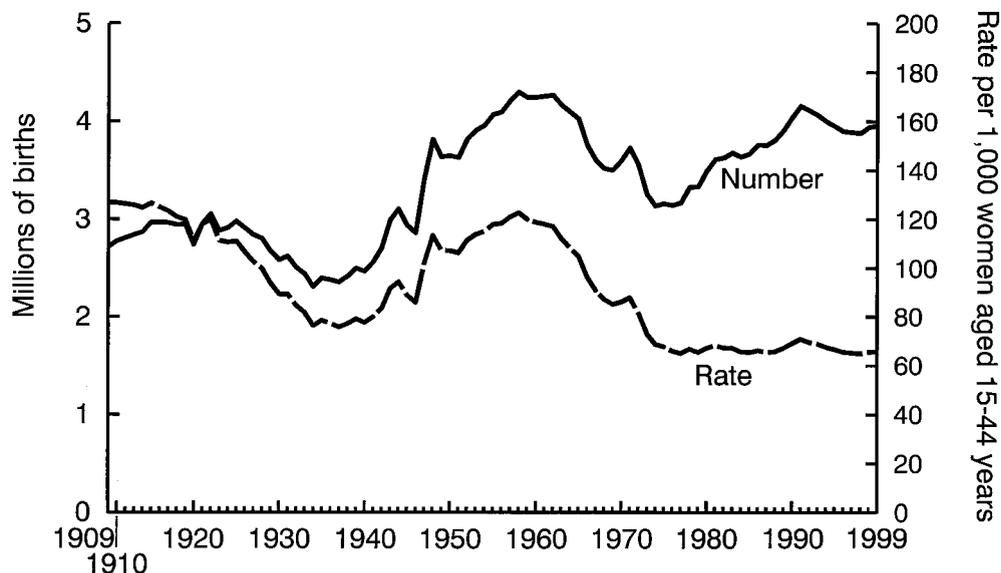
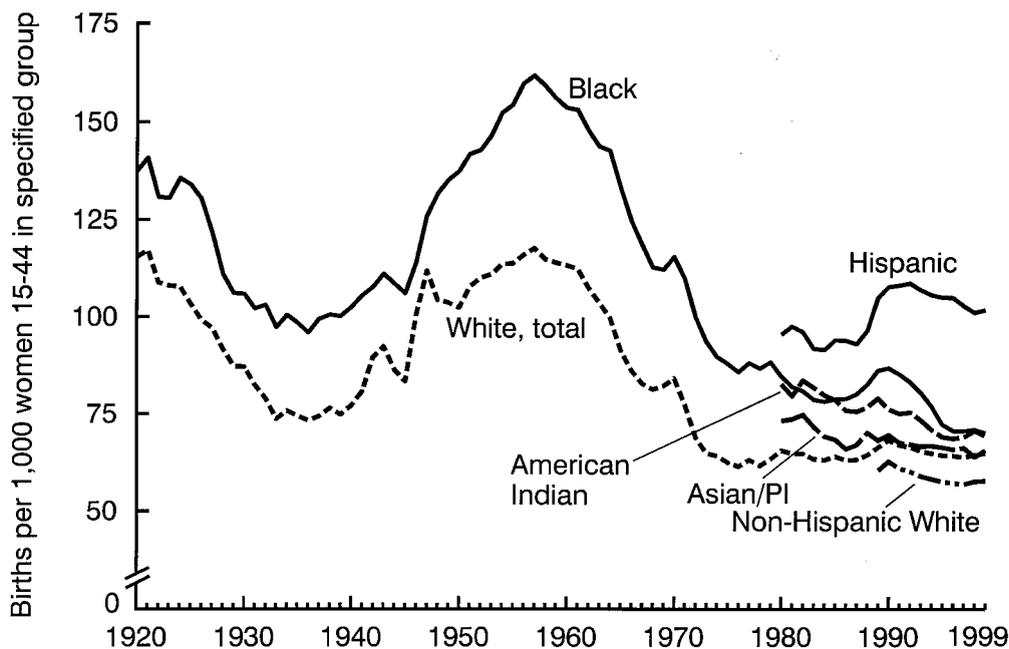


Fig 2. Number of births and fertility rates: United States, 1909–1999.



**Fig 3.** Fertility rates by race and Hispanic origin: United States, 1920–1999. Note: Before 1960, data for black women are for women of all races other than white. Before 1980, data are by race of child; subsequent years are by race of mother.

creased steadily from 1950 to 1957, the peak years of the baby boom. In 1957, 123 of every 1000 women aged 15 to 44 years gave birth.<sup>18</sup>

In the early 1960s, the fertility rate began a steady decline, unbroken except for 1968 to 1970, which continued until 1976, when the rate reached a record low. The rate decreased by nearly half during the 1957 to 1976 period, to 65 births per 1000 women. This decline reflects in part the introduction of the contraceptive pill in the early 1960s and the legalization of abortion in the early 1970s. There has been remarkably little change in the fertility rate during the last quarter century.<sup>7,19,20</sup>

Trends in the number of infants born generally parallel the trends in the fertility rate (Fig 2). The striking one-third increase in the number of births from the mid 1970s through 1990, which occurred while the fertility rate was essentially stable, reflected the growth of the female population of childbearing age, that is, the baby boom generation having babies.<sup>7,19</sup>

Historically, fertility rates have differed considerably by race (Fig 3). For the years 1920 to 1960, rates are available from the vital statistics system only for white women and women of all other races combined. During this period, 95% or more of births to “all other” women were to black women.<sup>18</sup> Until about 1950, trends for white and “all other” women were roughly parallel. The racial disparity widened considerably during the late 1950s and then narrowed again. Rates for black women became available in 1960, with rates for American Indian, Asian or Pacific Islander, and Hispanic women available since 1980. With the exception of rates for Hispanic women, fertility rates now vary little by race, ranging

from 58 to 70 per 1000 in 1999; the rate for Hispanic women was 102.<sup>20</sup>

Unlike the cyclical trends in overall fertility in the 20th century, childbearing by unmarried women increased steadily and substantially from 1940 to 1990 (Fig 4). The birth rate in 1990 for unmarried women was 6 times higher than in 1940, and the number of infants born to unmarried women was 13 times higher. The steep increase in the number of nonmarital births is attributable to the increased numbers of women of childbearing age (especially from the baby boom generation) and the dramatic postponement of marriage beginning in the mid 1960s.<sup>9</sup> Births and birth rates increased sharply for unmarried women in all age groups. During the 1990s, however, all measures of nonmarital childbearing have leveled off. One important factor in this slowdown has been the considerable decline in teen births and birth rates since 1991; the overall teen birth rate decreased 20% during 1991 to 1999, reaching a record low in 1999 (50 births per 1000 teens 15–19).<sup>20,21</sup> As recently as 1980, teens accounted for about half of all nonmarital births; by 1985, this proportion decreased to less than a third, where it remains.

### Maternal Mortality

In the early part of the 20th century, the maternal mortality ratio,<sup>a</sup> defined as the number of maternal deaths (during pregnancy and 42 days postpartum)<sup>10</sup> per 100 000 live births, was a major indicator of the quality of maternal care in terms of both the availability of care and the quality of the available care. The first investigation conducted by the federal Chil-

<sup>a</sup> Use of ‘ratio’ is the preference of the first author; NCHS uses ‘rate’ rather than ‘ratio’.

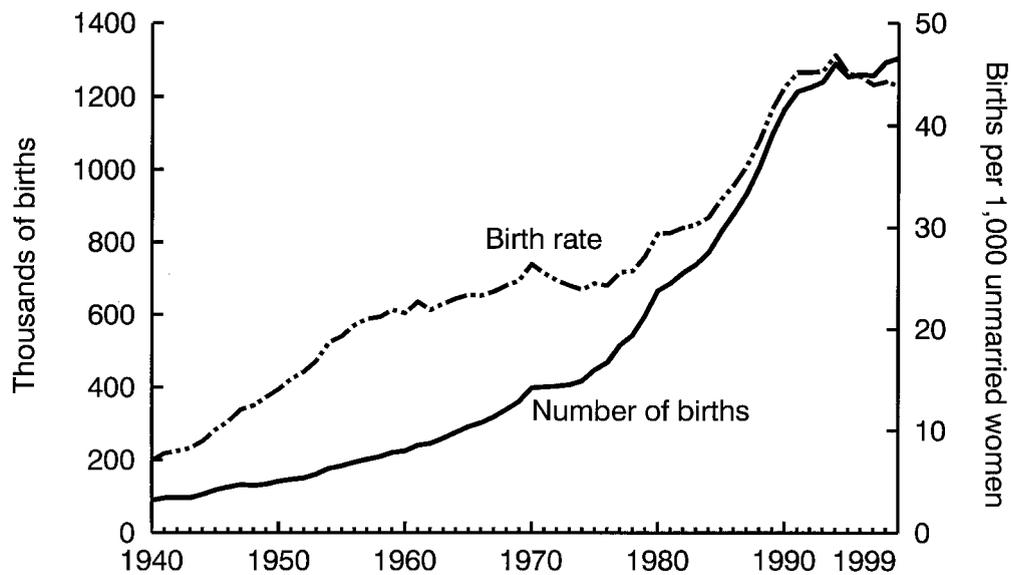


Fig 4. Birth rates and number of births to unmarried women: United States, 1940–1999.

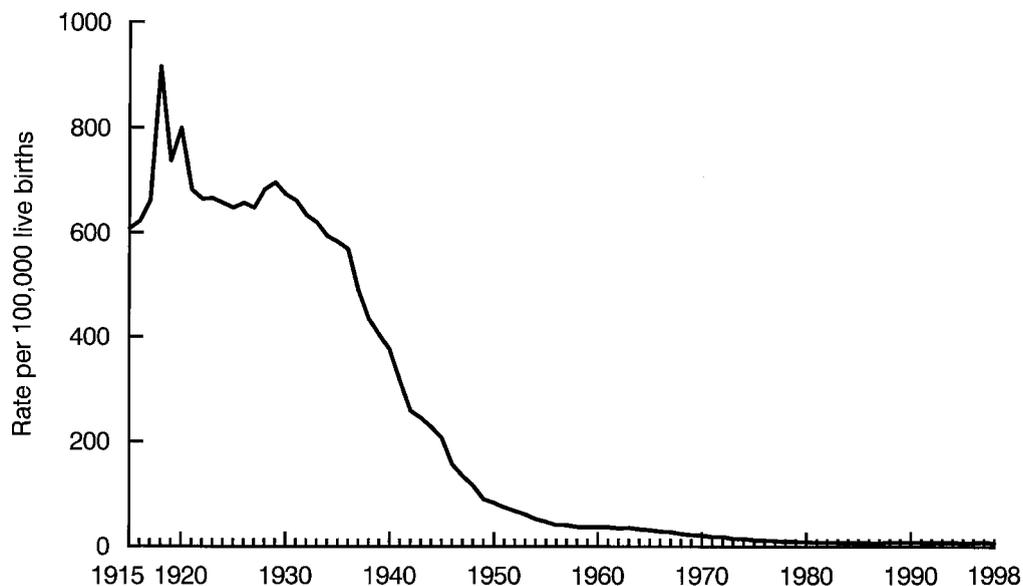


Fig 5. Maternal mortality ratios: United States, 1915–1998.

dren's Bureau, in 1912, indicated that the level of maternal mortality in the United States did not compare favorably with the level reported by other industrial nations.<sup>22</sup>

Figure 5 shows the trend in the maternal mortality ratio from 1915 to 1998. The highest ratios were noted between 1915 and 1920; the peak in 1918 of 916 deaths per 100 000 births was likely influenced by the influenza pandemic. The ratio remained constant throughout most of the 1920s. This plateau was noted despite an increase in hospital deliveries and use of aseptic procedures during labor and delivery and introduction of prenatal care and national policies meant to benefit the deplorable health status of poor women. In fact, there was little evidence before 1930 that hospital delivery resulted in better treatment during labor and delivery than that experienced by women delivered by midwives in their homes.<sup>22</sup>

There were 2 major reasons for the high level of maternal mortality during this period: women either received no care or care in which the attendant failed to recognize the severity of their complications, or they received improperly performed medical intervention. In particular, mortality was close to 50% among women following an unnecessarily or improperly performed procedure or one without careful aseptic procedures. It was estimated that the maternal mortality ratio could be reduced by at least 10% if unnecessary cesarean deliveries were eliminated.<sup>22</sup>

Beginning in 1936 and continuing to 1956, there was precipitous decline in maternal mortality from 582 deaths per 100 000 live births in 1935 to 40 in 1956. Some of this drop has been attributed to the shift in responsibility for maternity care to obstetricians.<sup>22</sup> The percentage of births occurring in hospitals increased from 36.9 in 1935 to 94.4 in 1955.<sup>23</sup>

Hospitals established committees to investigate each maternal death and to assign responsibility for its occurrence. Some of the decline in mortality was also associated with the introduction of new antibiotics; the establishment of hospital blood banks, blood typing, and transfusion procedures; the introduction of safer forms of anesthesia; and the elimination of mid- and high forceps to remove an impacted fetus.<sup>22,24</sup> The role of a rising standard of living, increases in education levels of women, and environmental interventions may have also contributed to the decrease in maternal mortality during 1930 to 1950.

Since 1950, the maternal mortality ratio has dropped by 90% from 83.3 deaths per 100 000 live births to 7.1 in 1998.<sup>8,11</sup> The further reduction was attributed, in part, to a decline in infections related to septic abortion, resulting from liberalization of abortion laws in several states in the late 1960s and early 1970s<sup>24</sup> and the legalization of abortion across the country in 1973 in the *Rowe v Wade* decision by the Supreme Court.<sup>25</sup>

During the 1990s, the maternal mortality ratio plateaued to 7 to 8 deaths per 100 000 live births.<sup>8</sup> The maternal mortality ratio was higher among black women than among white women,<sup>26</sup> a persistent difference throughout the entire 20th century.<sup>22,24</sup>

### Infant Mortality

The infant mortality rate ([IMR], deaths in the first year of life per 1000 live births) has shown an exponential decline during the 20th century; Fig 6 shows the gradual decline in the rate for white and black infants on a logarithmic scale. In 1915, approximately 100 white infants per 1000 live births died in the first year of life; the rate for black infants was almost twice as high. In 1998, the IMR was 7.2 deaths per 1000 live births, 6.0 for white infants, and 14.3 for black infants, a figure more than twice the rate for white infants.<sup>27</sup> Between the years 1915 and 1998, the

overall IMR decreased by 93%, the neonatal mortality rate ([NMR], deaths in the first 28 days of life) by 89% and the postneonatal mortality rate ([PNMR], deaths from 29 days through 11 months) by 96%.<sup>8,11</sup>

During the early part of the century, efforts to improve environmental and living conditions in urban areas were believed to have contributed to the decline in the IMR.<sup>28</sup> Social welfare efforts included the provision of safe milk supplies, parenting education, and improved housing.<sup>29</sup> The provision of comprehensive maternal and infant care that included prenatal and intrapartum care, and postpartum home visits by a health care worker may have also played a role in the decline.<sup>28</sup> Finally, medical advances in the 1930s and 1940s, including the introduction of antibiotics, blood banking, and safe blood transfusion and the development of fluid and electrolyte replacement therapy, undoubtedly accounted for some of the drop in the IMR as well.<sup>28</sup>

The decline in the IMR slowed during the 1950s, despite medical advances, the greater availability of prenatal care, and increases in the percentage of births that occurred in hospitals. In 1950 through 1957, about half of infant deaths occurred in the first day of life,<sup>30</sup> and many of these deaths occurred in the smallest infants.<sup>31</sup> At the time, there was little survival advantage for hospital birth among these small infants who experienced respiratory distress.<sup>32</sup>

The decline in infant mortality received new momentum in the 1960s with the introduction of Medicaid and other federal programs, growing use of family planning services, and changes in abortion laws.<sup>24</sup> There also were further improvements in the living standards and increased education among many segments of the population.<sup>24</sup> More effective management of neonatal problems became available as a result of advances in neonatal medicine. As these advances became implemented in tertiary hospitals, states began an effort to regionalize services for the

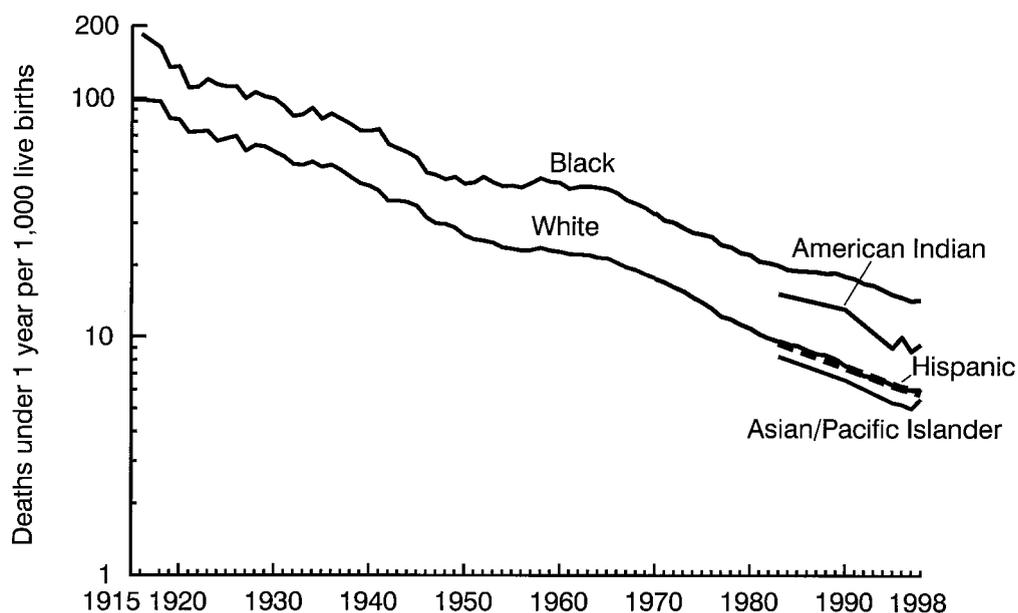


Fig 6. Infant mortality rates by race and Hispanic origin: United States, 1915–1998. Note: Infant deaths are classified by race of decedents. Before 1980, live births are classified by race of parents; for 1980–1998 by race of mother.

high-risk newborn to increase their availability to all infants in need.<sup>32</sup>

After a slowdown in the decline in IMR in the 1980s, 2 important changes were noted in the 1990s related to birth weight specific mortality rates. First, there was a large decrease in mortality for very low birth weight infants ([VLBW], infants weighing <1500 g at birth) between 1989 and 1990. Although direct evidence is not available, this decline is believed to result from the widespread adoption of surfactant use to prevent or reduce the severity of respiratory distress syndrome (RDS) in the VLBW infant.<sup>33</sup> Mortality from RDS dropped by 24% between 1989 and 1990 and has continued to decline thereafter.<sup>8,27,33</sup>

The second change was a drop in the PNMR for normal birth weight infants between 1989 and 1991.<sup>33</sup> This drop was accelerated in 1992 following the recommendation by the American Academy of Pediatrics to prevent sudden infant death syndrome (SIDS) by placing infants on their back or side to sleep.<sup>34–36</sup> Since 1992, SIDS mortality has dropped by >40%.<sup>8,27</sup>

A major challenge facing the nation as we move into the 21st century is the intractable disparity in IMRs for black and white infants that has persisted throughout the century.<sup>29</sup>

### Low Birth Weight

One reason for the racial disparity in IMRs and the poor ranking of the United States is the high rate of low birth weight (LBW). Figure 7 shows trends in LBW rates since 1950 for white and black infants, since 1970 for American Indians and since 1980 for infants born to women of Hispanic and Asian/Pacific Island descent. The LBW rate is much higher for black infants than for any other group for all years for which data are shown. The reasons for this higher

rate remain unknown, but are an important topic for the research agenda in the new century.

Figure 7 also shows a increase between 1990 and 1999 in the LBW rate for infants born to white, American Indian, and Asian/Pacific Islander women. The increase among white women has been shown to be attributable to an increase in multiple births,<sup>37</sup> births that are more likely to be LBW than singleton births. The increase in multiple births has been associated with an increase in the use of ovulation-inducing drugs and assisted reproductive technologies such as in vitro fertilization among white women,<sup>38</sup> and to a lesser extent to a rising age of childbearing.<sup>37</sup> If the increase continues into the new century, then it is unlikely that there will be much improvement in the position of the nation in infant mortality relative to other developed nations.

### Child Mortality

For children older than 1 year of age, the overall decline in mortality experienced during the 20th century has been spectacular (Fig 8). In 1900 >3 in 100 children died between their first and 20th birthday; today, <2 in 1000 die. Nearly 85% of this decline took place before World War II, a period when few antibiotics or modern vaccines and medications were available.<sup>39</sup>

In 1900, the age-specific death rates for children in the United States were 1983 per 100 000 population for 1- to 4-year-olds, 466 for 5- to 9-year-olds, 298 for 10- to 14-year-olds, and 484 for 15- to 19-year-olds. By 1998, the death rates in these age groups had declined by 98%, 96%, 93% and 85%, respectively.<sup>8,11</sup> Compared with the other age groups, the decline in death among adolescents has plateaued since the 1960s.

At the beginning of the 20th century, the leading causes of child mortality in the 1- to 19-year-old age

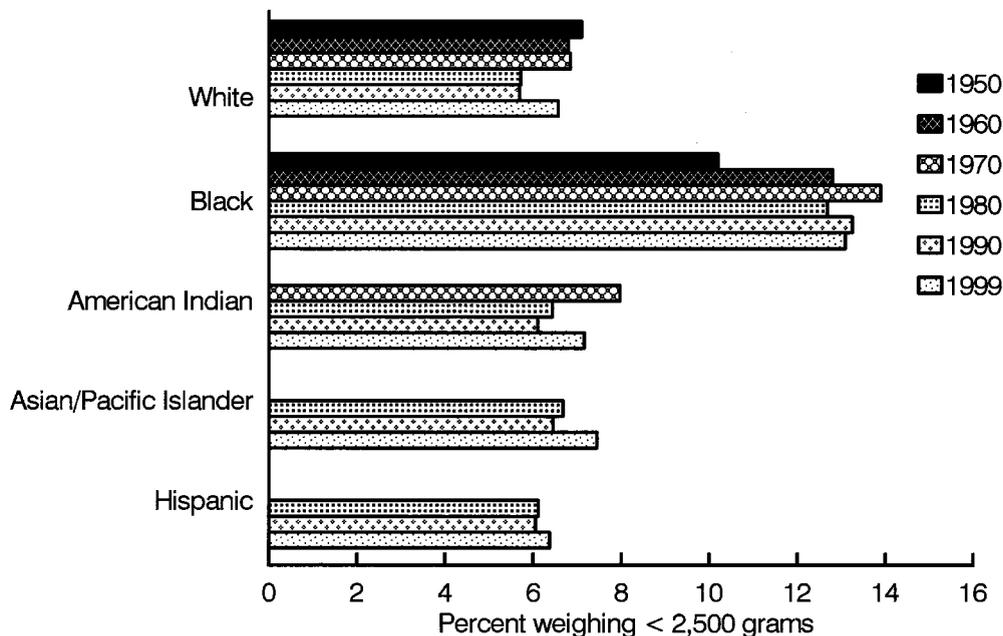


Fig 7. Percent LBW by race and Hispanic origin, selected years: United States, 1950–1999.

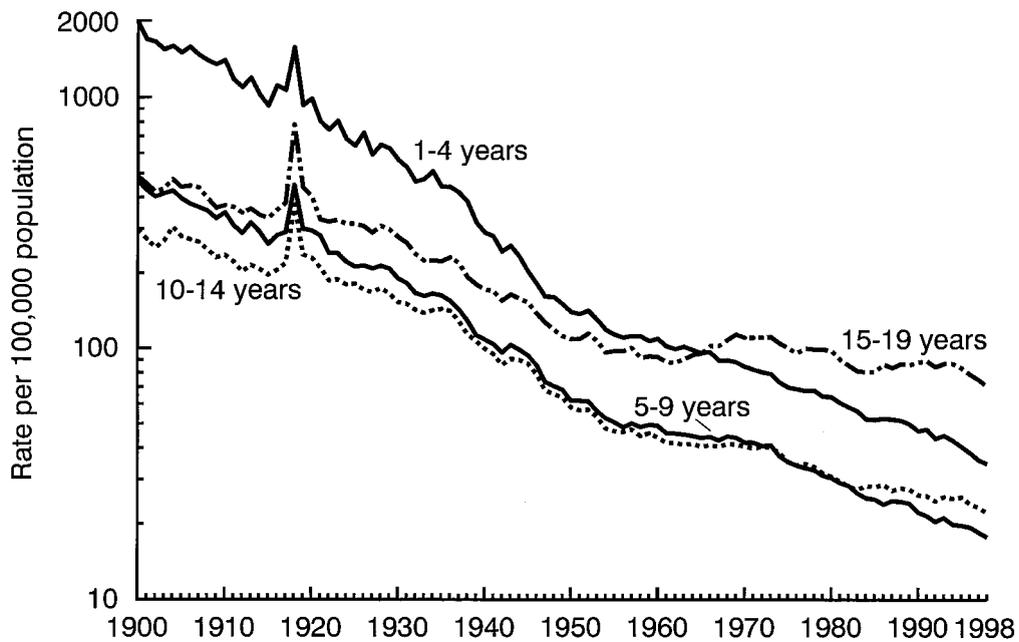


Fig 8. Childhood mortality rates by age at death: United States, 1900–1998.

group were infectious diseases, including diarrheal diseases, diphtheria, measles, pneumonia and influenza, scarlet fever, tuberculosis, typhoid and paratyphoid fevers, and whooping cough.<sup>40</sup> Between 1900 and 1998, the death rate from the major infectious diseases declined 99.7%, from 466 to 0.7 deaths per 100 000 (Fig 9). The percentage of child deaths attributable to infectious diseases declined from 61.6% to 2%. This decline incorporates the emergence of human immunodeficiency virus (HIV)/AIDS which in 1998 accounted for <0.3% of child deaths.<sup>8</sup> Once again, nearly 90% of the decline in infectious disease mortality among US children occurred before 1940, when few antibiotics or vaccines were available.

In contrast to the infectious diseases, accidents

only accounted for 6.3% of child deaths in 1900, but 43.9% in 1998. At the beginning of the century, child deaths from accidental injury were more likely to occur on the family farm, from fires and burns, or in factories and shops where children were workers.<sup>41</sup> Between 1900 and 1998, the death rate from accidents, now usually called unintentional injuries, declined two-thirds, from 47.5 to 15.9 deaths per 100 000 (Fig 9). Although motor vehicle-related deaths were unheard of in 1900, the motor vehicle now accounts for more than half of all injury deaths.<sup>42,43</sup> Deaths from intentional injuries, including homicide and suicide, are not included in the trends noted above, but accounted for 9.5% of deaths in this age group in 1998. Firearms, as the agent of

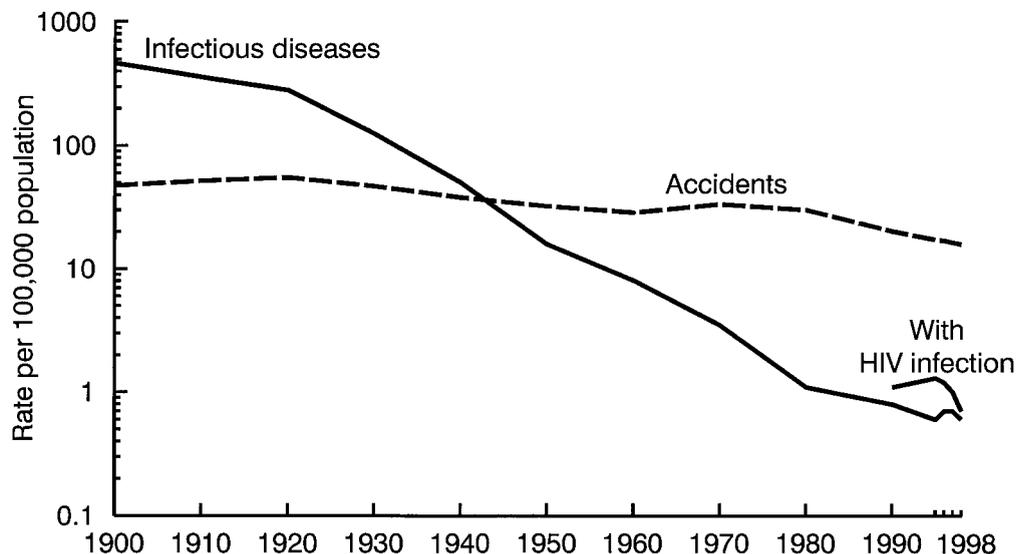


Fig 9. Death rates from infectious diseases and accidents, ages 1–19, selected years: United States, 1900–1998.

both accidental and intentional injury deaths, accounted for about 7% of all injury deaths among children aged 1 to 19 in 1998.<sup>8</sup>

The major declines in child mortality that occurred in the first third of the 20th century have been attributable to a combination of improved socioeconomic conditions in this country and the public health strategies to protect the health of Americans. These public health measures included the establishment of local health departments in nearly all of the states. State and local health departments implemented these public health measures including water treatment, food safety, organized solid waste disposal, and public education about hygienic practices. These improvements in water and food safety and purity are linked to the major decline in diarrheal diseases seen in the early years of the century.<sup>44</sup> Similarly, improvements in housing and decreased crowding in US cities are linked to the reductions in mortality from tuberculosis and other diseases attributable to person-to-person airborne transmission.<sup>43</sup>

Vaccination, while first used in the 18th century, became more widely implemented in the middle part of the century. Vaccines against diphtheria, tetanus, and pertussis became available during the late 1920s but only widely used in routine pediatric practice after World War II. Thus vaccination does not account for the impressive declines in mortality seen in the first half of the century. The reductions in vaccine-preventable diseases, however, are impressive. In the early 1920s, diphtheria accounted for about 175 000 cases annually and pertussis for nearly 150 000 cases; measles accounted for about half a million annual cases before the introduction of vaccine in the 1960s. Deaths from these diseases have been virtually eliminated, as have deaths from *Haemophilus influenzae*, tetanus, and poliomyelitis.<sup>45</sup>

### Population Shifts and Dependency Ratio

The dependency ratio, a measure of the proportion of persons who are considered dependent, children (<18 years) and the elderly (65 years and over), in the population relative to persons eligible to participate in the labor force (18–64 years), is a crude estimate of the extent to which the productive population must provide resources for the dependent population. Figure 10 shows the overall dependency ratio and a youth and an elderly dependency ratio from 1900 to 1990, and their projections through 2050. The data in the figure are taken from decennial census data for 1900 to 1990<sup>46</sup> and are projected for the years 2000 to 2050 using the middle series assumptions for population projections.<sup>47</sup>

The child dependency ratio parallels the birth rates in the country during the 20th century. It was the highest at the turn of the century, declining between 1900 and 1920, but especially during the great depression of the 1930s. The ratio increased in the post-World War II period as a result of the baby boom that started in 1946, but never reached the level seen in 1900, even at the height of the baby boom in 1960. The ratio began to drop after the peak in 1960, declining rapidly between 1970 and 1980. It has remained relatively constant since 1990 and is projected to do so into the first half of the 21st century.

The increase in the dependency ratio for the population aged 65 or older closely parallels the increase in life expectancy during the 20th century. The projections for the 21st century, however, show an accelerated rate of increase in the ratio above the secular trend expected in life expectancy. This increase is a result of the aging of the baby boom population, and is most pronounced starting in 2010 and ending in 2030, when the ratio is expected to plateau.

The child dependency ratio far exceeded the el-

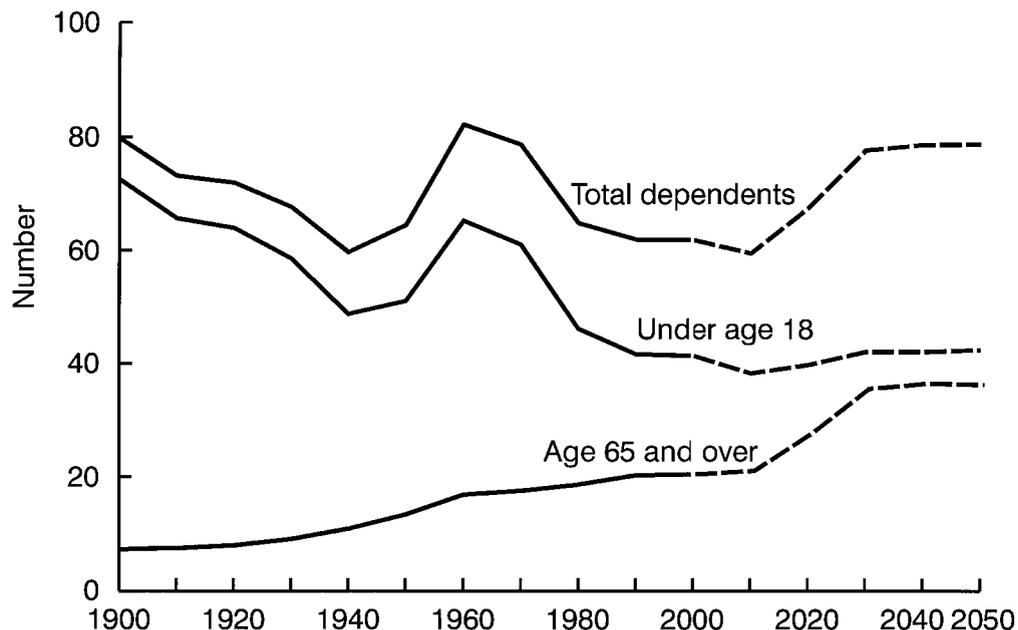


Fig 10. Number of dependents per 100 persons aged 18 to 64, selected years: United States, 1900–2050. Note: Rates are estimated through 1990 and projected for 2000–2050. Source: US Bureau of the Census.

derly dependency ratio during most of the 20th century, particularly during the first 70 years. The elderly ratio has gained incrementally since then and the large increase expected beginning in 2010 indicates that the difference in the 2 ratios will become considerably less by 2030.

The challenge for the 21st century is how to balance the needs of children with the growing demands for a large aging population of elderly persons. Debates about allocation of scarce resources will increasingly need to achieve a delicate balance between the health and resource needs of children with those of the elderly, a debate that is likely to become more favorable to the elderly population based on their numbers alone and their political will. Advocacy for the needs of our most vulnerable population will become increasingly important. The future for our children and subsequent generations depends on our advocacy for children in the ongoing political debate.

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## Annual Summary of Vital Statistics: Trends in the Health of Americans During the 20th Century

Bernard Guyer, Mary Anne Freedman, Donna M. Strobino and Edward J. Sondik

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