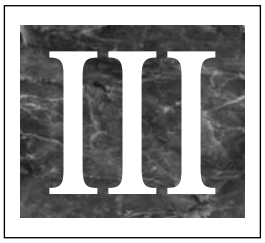


Sex Mortality Differential: A Historical Perspective

''*In equal ages, the mortality of males has been found to be greater than the mortality of females*'' (Price 1772).

Mortality from prehistoric to premodern times has been investigated by studying unearthed bones, mummies, and tombstone epitaphs. Some of the problems with these methods are that the material may not be a random sample, the sample size may be too small, errors may occur in determination of the age and sex of the bones or mummies, soil and archaeological selection may occur, and overstatement or misstatement of age on epitaphs may happen (Angel 1947, Hishinuma 1976). Hopkins (1966) argued that, although it was generally accepted that ancient Roman women died at younger ages than men, mortality rates derived from tombstone commemorations were unreliable because young wives were commemorated disproportionately more often. Also, by comparing mortality rates derived from epitaphs with two United Nations model life tables, Hopkins found that the pattern and level of Roman data are mostly impossible. Therefore the sex mortality differentials found using these methods should be considered only as possible indications of the past. With these points in mind, the results for the stone age and premodern times, as shown in Appendix A, typically show greater male than female mortality — most of the exceptions are from Japan.

The earliest specific mention the author found of differential mortality between the sexes is from classic Jewish texts. The Jerusalem Talmud, completed about 400 C.E., states that women tend to die sooner than men. The Babylonian Talmud, completed about 100 years later, notes that the death of a wife while the husband is alive is a common occurrence [Babylonian Talmud, Ketubot 83(b)]. Tosafot (12th–14th century, France and Germany) suggests that this increased female mortality may be attributable to the rigors of childbirth [*Tosafot of Babylonian Talmud*, Ketubot 83(b)]. Abraham ibn Ezra, poet, grammarian, philosopher, rabbinical scholar, and astronomer (1092–1167, Spain), similarly stated in his biblical commentary to Leviticus 21:2 that males generally live longer than females. A like view was recorded by Moses Maimonides (1135–1204, Spain) in his *Commentary on the Mishna*, in which he wrote ''*the lives of females are shorter than the lives of men, in most cases*.'' Maimonides's well-documented stature as a physician and scientist (in addition to his renowned biblical, talmudic, and philosophic scholarship) lends a high level of credibility to the assertion that male life expectancy exceeded female life expectancy during the medieval period.

Another method of studying historical mortality by sex is to use recorded genealogies. From Hollingsworth's (1957, 1964) analysis of the demography of the British peerage, females had a greater expectation of life at birth than did males for all cohorts born during 1330–1949, except for the 1725–49 cohort. Peller (1965) also found that the expectation of life at birth was greater for females than males for the European ruling families by four, six, one, and two years for the 16th, 17th, 18th, and 19th (1800–85) centuries, respectively. Henry (1956) also found greater life expectancy at birth for females than for males for Genevan families for all cohorts born during each of the seven 50-year periods from 1550 to 1899 of one, four, six, six, three, one, and eight years, respectively (using Henry's Hypothesis 1, which yields the more favorable male mortality). However, because mortality tends to decrease as socioeconomic level increases, it would not be appropriate to extrapolate these results to European populations as a whole.

From his study of the Bills of Mortality in England, John Graunt (1662) observed that more males than females are christened and buried. Yet, at the same

time, physicians asserted that they had two women patients for each man. Graunt continued, "*Now, from this it should follow that more women should die than men, if the number of burials answered in proportion to that of sicknesses; but this must be salved, either by alleging that the physicians cure those sicknesses, so as few more die than if none were sick; or else that men, being more intemperate than women, die as much by reason of their vices as the women do by the infirmity of their sex, and consequently, more males being born than females, more also die.*" Although Gaunt has often been credited with noting the sex mortality differential, in fact, he made no such conclusion. His analysis of mortality by age was not sex-specific, so, in a stable population, noting that more males than females are born and die says nothing about which sex has greater age-specific mortality.

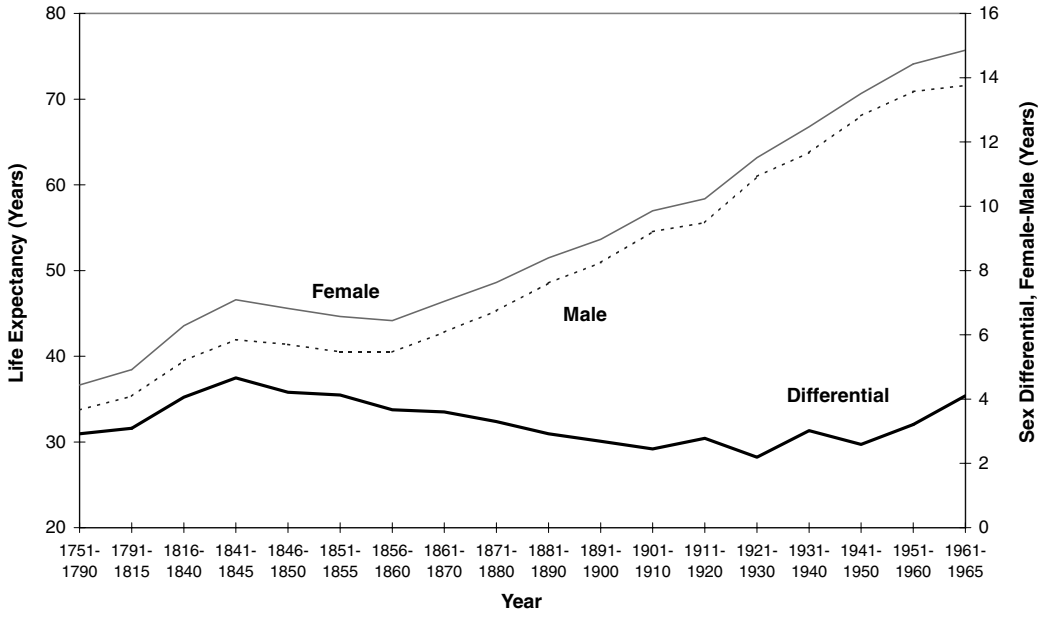
The fact that more males than females were christened and buried in England was also noted by historians in the 18th century (Maitland 1739).

Mortality rates for an entire country, based on the living population and deaths, were first published in 1766 for Sweden. Swedish data are generally acknowledged to be the most reliable for any European country during the 18th century (McKeown and Brown 1955). Rates for 21 age groups, as well as the fetal period, during 1755–57 were calculated. Male mortality rates exceeded female mortality rates in all age groups except for ages 1–3, 30–35, and 80–85 (Wargentin 1766).

National mortality records by sex and individual age are available for Sweden beginning in 1750. As of this date, male mortality rates exceeded female mortality rates for all ages, except at ages 2 and 3 years. Federici (1950) analyzed male/female mortality ratios from the single age, cohort, sex distinct mortality tables (prepared by Delaporte 1941) for 10 European countries from 1750. These ratios uniformly show excess male mortality at almost all ages, except for puberty and the childbearing ages (Herdan 1952). Figure 1 shows the life expectancy at birth in Sweden from 1751 to 1965. Throughout this period, the sex mortality differential has consistently been between three and four years [National Central Bureau of Statistics (Sweden) 1969].

Perhaps not surprisingly, it was an actuary who first examined the mortality differences between the sexes. Richard Price, who has been called the founding father of actuarial science, in 1772 analyzed the calculations underlying reversionary annuity schemes designed by societies in order to provide for the members' widows. He stated that at "*equal ages, the mortality of males has been found to be greater than the mortality of females.*" He came to this conclusion by

FIGURE 1
LIFE EXPECTANCY AT BIRTH IN SWEDEN AND THE SEX DIFFERENTIAL IN LIFE EXPECTANCY AT BIRTH 1751–1965



Source: National Central Bureau of Statistics (Sweden) 1969.

reviewing data from Northampton, Salop, Berlin, Edinburgh, Holland, Vienna, Breslau, Dresden, Leipzig, Ratisbon, Pomerania, and Scotland. He may have been the first actuary to determine "*that in order to calculate the values of life annuities and reversions with exactness, there ought to be distinct tables of the probabilities of life for males and females.*"

Price speculated on the reasons for the excess male mortality by stating, "*It has been observed, that more males should be born than females on account of the particular waste of males, occasioned by wars and other causes. Perhaps it might have been observed with more reason, that this provision had in view, that particular weakness or delicacy in the constitution of males, which makes them more subject to mortality*" (Price 1772). Price later formed the Chester Tables, which were sex distinct, but they never came into general use (Moir 1932).

From careful recordkeeping over 28 years at the Lying-in Hospital in Dublin, Clarke (1786), a physician, observed the greater occurrence of both male stillborns and male mortality in the fortnight after birth, which he ascribed to the larger size of the males. In his introduction to Clarke's results, Price stated that "*the mortality of males exceeds that of females in almost all stages of life, and particularly in the earliest stages*." Clarke later quoted Price as saying, "*human life in males is more brittle than in females*."

Another 18th century writer discussed mortality differences by sex and their causes as follows:

> *When we count the inhabitants of any locality, and note their ages, we will invariably count more old women than old men. Most writers have concluded from that that women were "built stronger" than men. We cannot simply accept that conclusion; it would be contrary to the law of nature that says every living thing's course is regulated by the rate of its development. Although women physically and emotionally develop sooner than men, and gain fertility sooner than men, they also lose it sooner and therefore their (reproductive) career is shorter. We should note that there are several causes, independent of biological strength, why men die younger than women. In fact, men are perpetually exposed to weather conditions in all seasons while women are indoors in their homes. Independently of wars, which fatally affect men much more than women, all dangerous occupations are dominated by men. Men's passions, more violent than those of women, are also more destructive. For every woman who suffers a violent death, we could probably count one hundred men who die similarly. And when the "age of passion" has passed, a portion of the macho gender has disappeared and the majority of those remaining are tired and feeble. Given the preceding, we should not be surprised to find more old women than old men. The proof that men would outlive women, if men and women were to live similar lives, is that among those people whom we deem have attained a prodigious age we rarely find women. However, when we only count the two sexes in aggregate, whether it be in a city or in a countryside, on an island or in a cloister, from the north or from the south, experience shows that men die younger than women. Men are born in greater numbers than women but their superiority in number lasts less than a year. After 50 years, there are 25% more women than men; after 60 years, 33% more; and in older age brackets, women increasingly dominate men in number* (Moheau 1778, translated from French by Robert F. Berendsen and Jérôme Lamontagne).

Black (1789), a physician, stated, "*On contrasting the mortality of males and females, it appears, that, notwithstanding the surplus of male births, the perils of child-bearing, the many vexatious diseases peculiar to the fair sex, and that physicians and apothecaries have many more patients of the latter; yet the total aggregate number of living females exceeds that of males, in most European kingdoms*." He also observed, "*Even in the marriage state, the chance of survivorship seems considerably in favour of the wife*," and that widows outnumbered widowers by three and even four to one, partly because the bridegroom was 6–12 years older than the bride. Black theorized that the presence of more widows than widowers may have been partly due to husbands being "*more exposed to the vicissitudes of the weather and seasons, to excessive labor and noxious trades, and to many other causes of diseases*."

The earliest true mortality table that shows mortality separately by sex found by the author was constructed by Mourgue based on data from Montpellier for 1772–92. Based on this table, the life expectancy at birth was 23.37 years for males and 27.35 years for females, for a sex differential of 3.98 years in favor of the female (Hishinuma 1976). (In Sweden during that time, the life expectancy was 10 years longer for both sexes, but the differential was three years rather than four years.)

The excess mortality of males did not escape Charles Darwin (1871). In *The Descent of Man,* he

quoted Faye that for every 100 stillborn females, there are from 134.6 to 144.9 stillborn males, and that, in England, during the first year of life, for every 100 girls who die, 126 boys die. He also cited Stark that in Scotland males have higher mortality rates at almost every stage of life.

The Carlisle Table, published in 1815 and based on censuses and death lists for 1779–87 in Carlisle, England, was a population table that was based, approximately equally, on men and women. Because the insured population was predominately male, this table understated mortality (particularly at higher ages) when applied to (male) insured lives. When McClintock's Annuitants' Table, which was published in 1899 and based on annuity experience prior to 1892, was constructed, two tables were originally developed based on sex (Tillinghast 1987).

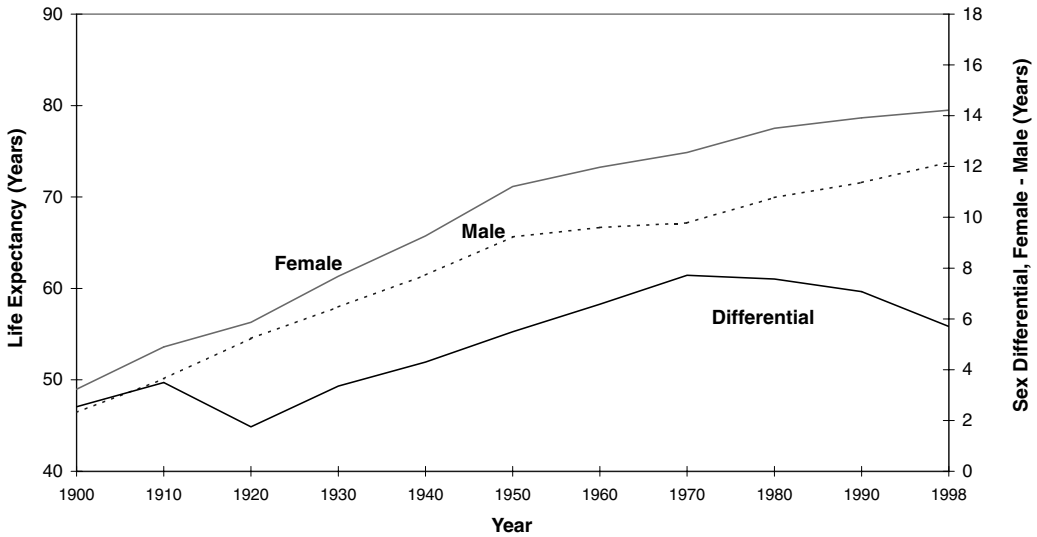
In his study of New England mortality, Richards (1909), using Massachusetts life tables of 1855 and 1893–97, found that the expectation of life at birth was 2.52 years greater for females than for males (46.61 years, compared with 44.09 years).

At the beginning of the 20th century, Young analyzed data in Great Britain to authenticate individuals who have lived at least 100 years. Using experience from all life assurance and annuity societies and annuity experience of the National Debt Office, he found only 30, out of close to 1 million lives, who were centenarians. Of the 30 centenarians, 21 were women and 9 were men.

> *It has proved a constant result of observation that the rate of mortality among female lives was inferior to that of males; during the child-bearing period, it is true that women exhibit a higher mortality than that prevailing among a corresponding body of men of similar ages; but the superior longevity of females, after the term of child-bearing has elapsed, becomes so distinct and pronounced that its excess over that of males is sufficient to compensate the deficiency of vitality during the prior period, and thus to confer on female life, throughout its* ***entire*** *duration, an enhanced probability of prolonged lifetime over that appertaining to males* (Young 1905, emphasis his).

Figures 2 through 6 illustrate the sex mortality differential in the United States during the 20th century and in Canada from 1871. Figure 2 shows the life expectancy at birth in the United States at 10-year intervals from 1900 to 1990. Throughout this period, the sex mortality differential increased from 2.5 years in 1900 to a high of 7.7 years in 1970. The differential has decreased since 1970, to 7.1 years by 1990, and

FIGURE 2
LIFE EXPECTANCY AT BIRTH IN THE U.S. AND THE SEX DIFFERENTIAL IN LIFE EXPECTANCY AT BIRTH 1900–98



Source: 1900–1990 from Social Security Administration in Bell, et al. 1992, as shown in Society of Actuaries Mortality Tables Library [online database]; 1998 from Murphy 2000.

further to 5.7 years by 1998 (Murphy 2000). (The decline in 1920 was likely due to the influenza epidemic of 1918–19, in spite of the fact that mortality rates due to influenza and pneumonia were about 10% higher in men than in women (Britten 1932).)

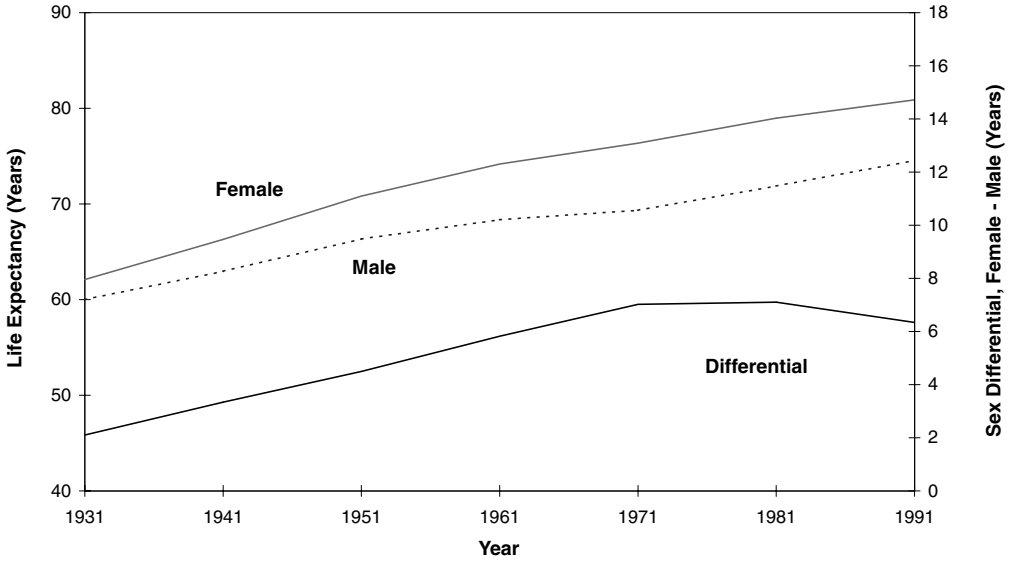
Figure 3 shows the life expectancy at birth in Canada at 10-year intervals from 1931 to 1991. During this time, the sex mortality differential increased from 2.1 years in 1931 to a high of 7.1 years in 1981, followed by a decrease to 6.3 years in 1991. Figure 4 shows the life expectancy at age 7 in Canada in 1871, in 1881, and at 10-year intervals from 1921 to 1991. The life expectancy at age 7 was *greater* for males than for females in 1871 and 1881 by 0.4 and 1.4 years, respectively. During the 20th century, the difference in life expectancy at age 7 for females and males increased from 0.4 years in 1921 to a high of 7.0 years in 1981, and then decreased to 6.3 years in 1991.

Figure 5 shows how the ratio of male-to-female mortality rates varies by age, as well as the trend during the 20th century for the U.S. national death registration area. In 1900, the sex mortality ratio was only slightly greater than 1 for most ages, reached its maximum of 1.22 during the first year, and was less than 1 for ages 9–15 and 26–28. The sex mortality ratio increased slightly from 1900 to 1930, but grew much faster after 1930. Demographers were aware that the sex mortality differential in the original death registration area of the United States was increasing from 1921 to 1927, a period when most mortality rates were rising (Wiehl 1930); by 1938, they were publishing papers devoted to the subject (Wiehl 1938). In 1925, researchers were discussing "*the old-established fact that males have an excess mortality over females*" (Parkes 1925).

Geiser (1923) cited statistics of the ratio of male-to-female stillbirths during the decade 1865–75 in France, Italy, Belgium, Sweden, and Prussia of 1.44, 1.40, 1.35, 1.33, and 1.29, respectively. Regarding adult mortality statistics, he stated that "*the higher death-rate thus implied for adult males has generally been attributed to the 'greater hardships and dangers' of a man's life*." After citing mortality rates by sex for infants under one year of age, he continued: "*Such a differential death-rate in infancy cannot be explained on the basis of "greater hardship and danger" of the males. It would seem, rather, to be due to a general lack of resistance, both to danger and to harmful environmental factors*." The sex mortality ratio, as shown in Figure 5, currently varies considerably by age, with a large spike at age 22.

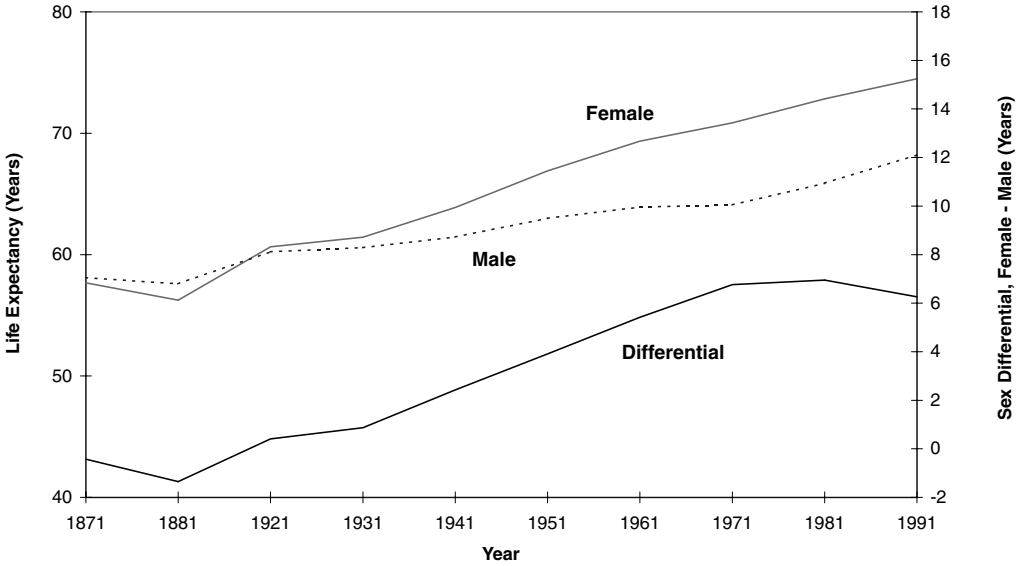
Figure 6 shows how the ratio of male-to-female

FIGURE 3
LIFE EXPECTANCY AT BIRTH IN CANADA AND THE SEX DIFFERENTIAL IN LIFE EXPECTANCY AT BIRTH 1931–91



Source: 1931–71 from Leacy 1993; 1981 from Wadhera 1994; 1991 from Statistics Canada 1994.

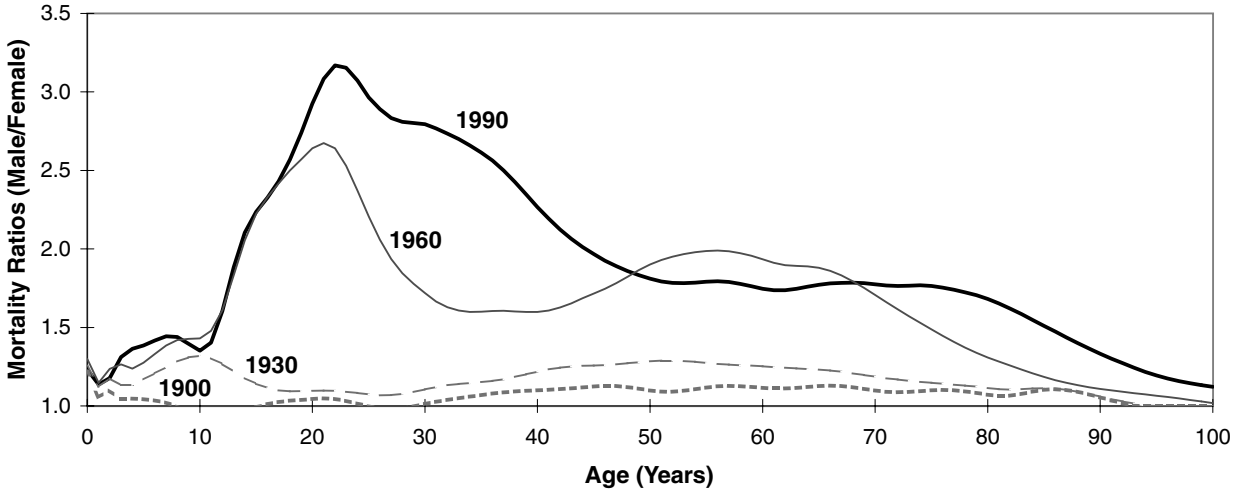
FIGURE 4
Life Expectancy at Age 7 in Canada and the Sex Differential in Life Expectancy at Age 7
1871–1991



Source: Dominion Bureau of Statistics (Canada) 1939, 1947, 1960, 1963; Statistics Canada 1974, 1984, 1994.

mortality rates varies by age, as well as the trend from 1871 for Canada. Because the data for 1871 are based on an abridged mortality table (mortality rates for every fifth year only), only general indications can be deduced. For 1871, mortality rates for males were *less* than for females for ages 12–42 (as low as 80% of the female rate at age 37). At all other ages, other than age 62, the mortality rates for males were greater

FIGURE 5
United States Sex Mortality Ratios at 30-Year Intervals
1900–90



Source: Social Security Administration in Bell, et al. 1992, as shown in Society of Actuaries Mortality Tables Library [online database].

FIGURE 6
CANADA SEX MORTALITY RATIOS
1871, 1931, 1961 AND 1991

Source: Statistics Canada 1994; Dominion Bureau of Statistics (Canada) 1939, 1947, 1963.

than for females, as much as 1.15 times as much at age 57. The general pattern for the other years is similar to that in the United States.

One of the interesting aspects of the declining mortality during the first half of the 20th century is that, while mortality between rural and urban, rich and poor, white and non-white, and upper and lower socioeconomic status individuals have been converging, the mortality gap between the sexes has been increasing (Madigan and Vance 1957).