CHAPTER 2

Who Shall Live?

> Who shall live and who shall die, who shall fulfill his days and who shall die before his time. . . .
>
> Yom Kippur (Day of Atonement) prayer book

Good health and long life have traditionally been among the most prized goals of mankind. In every age and in every land there have been significant efforts to postpone death, whether through sacred dance and song, the imbibing of magic potions, or the application of the most modern medical techniques.

Despite these efforts, for most of man's history life was short and uncertain. It depended primarily upon such basic economic conditions as adequate supplies of food, water, and shelter. Medicine men and healers of all kinds were abundant, but apart from the sympathy and psychological support that they may have provided, it is doubtful that they did more good than harm. Historians of medicine now mostly agree that it was not until well into the twentieth century that the average patient had better than a fifty-fifty chance of being helped by the average physician.

Today, at least in developed countries, the situation is markedly different. First, there is a core of medical knowledge that contributes greatly to life expectancy. This knowledge is widely diffused throughout the United States, Europe, Japan, and Oceania and is even reducing mortality in less developed countries, including some with very low standards of living. That portion of medicine which is most dramatically effective, such as vaccines and antiinfectious drugs, is relatively simple and inexpensive to administer. But once basic levels of medical sophistication, personnel, and facilities become available, additional inputs of medical care do not have much effect. In other words, the total contribution of

modern medical care to life expectancy is large, but over the considerable range of variation in the quantity of care observed in developed countries, the marginal contribution is small.

A second profound change is the disappearance of the traditional relationship between life expectancy and per capita income. As with medical care, a certain minimum level of income is important, but beyond that there is little correlation between mortality and income across and within industrialized countries.

These themes comprise the focus of this chapter, which also highlights the importance of "life-style" and personal behavior as major determinants of "who shall live."

The First Year of Life

The human infant is an exceptionally vulnerable creature. It comes into the world with a precarious hold on life; unassisted, it cannot live for more than a week. This extreme dependency on others persists much longer in humans than in any other species and is the major reason why human beings require an elaborate social structure.

Consideration of the complex support mechanisms required for human survival reveals the fallacies in the arguments of extreme libertarians and romantics. The former assume that man is autonomous, beholden to no one, answerable to no one, capable of rationally determining his own fate on the basis of contractual relationships with other autonomous souls. In fact, each of us owes our very life to others. Without the care given by family or friends, or provided by the church or state, we would not be alive to propound theories of human independence.

Rousseau and other romantics have viewed man as being born into a free and golden future only to be shackled by family and society. The truth is that throughout history most men have been born into a promise of early death. The more "simple" the environment, the more certain was it that the promise would be fulfilled. Even when the infant's mother survived childbirth (until this century the risk of maternal mortality was not small) and was willing to care for her child as best she could, prospects for its survival were not good.

Under primitive conditions it is not unusual for one out of every two newborns to die before the age of one; for many families the survival rate is much worse. Enrico Caruso, the great Italian tenor, was the eighteenth

child born to his poor Neapolitan parents but the first to survive beyond infancy. According to one estimate, the infant mortality rate (the number of deaths in the first year of life per 1,000 live births) for Europe's *ruling families* was over 200 in the sixteenth and seventeenth centuries.[1] The rate for families of lesser means must have been appreciably higher, for, as indicated below, chances for survival improved markedly with increases in living standards.

By the nineteenth century, infant mortality for Europe's ruling families was down to 70. But in New York City the rate for the general population was still as high as 140 per 1,000 live births in 1900. With rising living standards the chances of infant survival began to improve markedly. Between 1900 and 1930 the infant mortality in the United States fell at an annual rate of 2.5 percent to 65 per 1,000, and similar declines were experienced by all other countries undergoing rapid economic development. Most of this decline was the result of a sharp reduction in deaths from what physicians call the "pneumonia-diarrhea" complex.* In New York City infant mortality from this cause fell from 75 in 1900 to about 17 in 1930.

It is important to realize that medical care played almost no role in this decline. While we do not know the precise causes, it is believed that rising living standards, the spread of literacy and education, and a substantial fall in the birth rate all played a part. Some writers also give credit to chlorination of the water supply and the pasteurization of milk, but there is considerable debate about the quantitative importance of these measures. The "pneumonia-diarrhea" complex is still a major killer of infants on some American Indian reservations, and one well-studied attempt to bring all the skills of medicine to bear on this problem was, on the whole, unsuccessful.[2]

The mid-1930s saw the introduction of sulfonamide, the first of the great antimicrobial drugs. During the fifteen years that followed, many other potent antiinfectious drugs were discovered, and the rate of decline in infant mortality improved substantially. Between 1935 and 1950 the infant death rate fell by 4.3 percent annually, an appreciable acceleration over the decline of preceding decades. During this period both medical advances and rising living standards contributed to the reduction in infant deaths.

By 1950, about 70 percent of all infant deaths were occurring in the

* A common cause of death among infants living in poor, unsanitary conditions is internal infection leading to diarrhea which so weakens the infant that it contracts fatal pneumonia.

first month after birth, compared to only 40 percent in 1900. Such "neonatal" deaths, which are usually related to prematurity, congenital malformations, and problems associated with delivery, have proved less responsive to the growth of real income and to medical advances. It is not surprising, therefore, that beginning about 1950 there was a marked deterioration in the rate of decline of infant mortality. Between 1950 and 1965, the average annual decline was only 1.1 percent. During that period there was a great deal of talk about having reached some minimum level below which it would be very difficult to go.

Then, fairly suddenly, infant mortality began to drop again sharply, and since 1965 the rate of decline has been over 4 percent annually. By 1971 the U.S. rate had fallen to 19.2. The reasons for this marked improvement are not known. One possible explanation is that there was a substantial decrease in "unwanted" births after 1965 as a result of improved contraception and more liberal abortion laws. Indeed, the U.S. birth rate fell from 19.4 per 1,000 population in 1965 to 15.1 in 1973. The birth rate for births of fourth order or higher (i.e., those in which the mother has had at least three other children), which present a greater risk, fell by 50 percent. There can be little doubt that a "wanted" child will receive better care, both during pregnancy and after birth, than one that is "unwanted."

Furthermore, beginning in the late 1960s more was done to combat infant deaths by extending maternal and infant care services to families that had not previously been as well served. In some particular settings substantial reductions in infant deaths were achieved through the use of intensive-care units for premature babies, which have greatest risk. How important such additional medical care was in affecting the overall trend, however, is not known.

PREMATURITY

Numerous studies of infant mortality have shown that low-birth-weight babies (defined as under 5½ pounds) face considerably higher risk of death than those of normal weight. One comprehensive report issued by the federal government's National Center for Health Statistics states that "such infants have thirty times the risk of dying in the first four weeks of life compared with infants weighing more than 2500 grams [5½ pounds] at birth."[3] The correlation between low birth weight and post-neonatal deaths is much weaker, but according to one authority, "the premature infant not only has a poorer chance of surviving, . . . but if he does survive he has a higher risk of having a handicapping condition."[4]

We know surprisingly little about the specific reasons for short gestation (premature delivery) or low birth weight. The physical condition of the mother is undoubtedly a major factor, and this in turn is probably related to her diet, to whether she smokes or not, and to other environmental influences. Some of the variables found to be associated with low birth weight and infant mortality in general are income, schooling, race, and prenatal care.

INCOME

Traditionally, as income goes up, infant mortality goes down. In recent years, however, this relationship has become weaker for two primary reasons. First, the relationship was always much stronger for post-neonatal deaths (those occurring in the first year but after the first month) than for neonatal deaths. But today, as noted earlier, infant mortality in developed countries is concentrated in the first month.

A second reason is that once income rises to a level that assures adequate nutrition, housing, water, and waste disposal, further increases in income have much less significance for life expectancy. Most American families have passed that minimum level. A study published in 1972 and based on 1964–66 data showed appreciable declines in white infant death rates as family income rose from under $3,000 to the $5,000–7,000 range. Above that income level, however, there was no further decline with rising income.[5]

A third possible reason for a weakening of this relationship is a wider diffusion of medical care throughout the population. The extent of this diffusion and its effectiveness are, however, open to question. It is relevant to note that large differences in infant mortality among socioeconomic classes in England and Scotland persist despite the existence of free national health services available to all segments of the population.

SCHOOLING

Numerous health studies have shown that length of schooling is one of the most important correlates of health. This is true regardless of the measure of health (mortality, morbidity, or days lost from work) and regardless of whether the data are for individuals or population averages. Infant mortality also conforms to this pattern: in the United States, infants born to white mothers with eight years of schooling or less have almost double the mortality rate of those born to mothers with twelve or more years of schooling. (The correlation with length of father's schooling is also very strong.)

There is, of course, also a very strong correlation between schooling and income, making it difficult to estimate the separate effects of each. There does, however, seem to be some independent contribution to infant health both from schooling and from income. Among *adults* the relationship between schooling and health is much stronger, although, as we shall see in the next section, the effect of income is weak.

RACE

If one wanted a single simple index of the cumulative effects of hundreds of years of prejudice and oppression, the fact that in the United States black infant mortality is almost double the white rate would serve as well as any.

Some investigators believe that this difference can be explained mostly or entirely by a few socioeconomic variables; others report data that refute this view. It does seem clear that the excess of black over white infant death rates is greater than can be explained by *current* differences in income or schooling. As an illustration, *black* infant mortality in New York and California is two-thirds greater than *white* infant mortality in Arkansas and South Carolina, although income and schooling levels are comparable.

Low birth weight is the major factor in black infant mortality (as it is in white). Why so many black infants should be born weighing under 5½ pounds is not known. Diet, rest, and other aspects of care during pregnancy are probably important. It may also be true that the deprived conditions of many black families a generation ago are still taking their toll today. Scientists have shown with animal experiments that nutritional deprivation of females in infancy can affect their subsequent reproductive performance, even when they are provided with adequate diet as adults. Sir Dugald Baird, Regius Professor of Obstetrics and Gynecology at the University of Aberdeen, Scotland, has suggested that this mechanism may also be at work among humans. Finding that infant deaths from malformation of the central nervous system rose sharply in 1946 in first births to women in the semiskilled and unskilled occupational classes, he concluded that "the increase in the death rate could not be traced to any factor operating during the mother's pregnancy, but seemed to be related to the year in which the mother was born. For example, the rates were highest in women born between 1928 and 1936, the years during which the economic depression was at its worst."[6]

Although infant mortality for American blacks has declined over time, just as it has for American whites, the relative differential has not

changed much. This is somewhat surprising because, given the diminishing importance of income on infant mortality as income rises, one might have expected the infant mortality gap to narrow even though relative income differentials have remained about the same. One possibility is that reported black infant death rates for earlier decades were understated because many deaths went unreported. Inequality of access to medical care is also frequently cited as a reason for the black-white differential in infant mortality. But this inequality is probably less now than in earlier decades, and, in any case, the role of medical care in determining the outcome of pregnancy is a subject of considerable controversy.

MEDICAL CARE

Medical care enthusiasts insist that every pregnant woman should consult an obstetrical specialist early in her pregnancy, should continue to visit him frequently, and should be delivered in a hospital with a full range of attending health personnel and elaborate facilities. Skeptics like to point out that in the Netherlands, where a substantial proportion of all births occur at home under the supervision of a midwife, the infant mortality rate is one of the lowest in the world. The Dutch example suggests that *how* medical care is used may be more important than *how much* is used.

The strongest evidence that medical care does have a significant effect on infant mortality appears in a study published by the Institute of Medicine of the National Academy of Sciences. All deliveries in New York City during 1968 were classified according to ethnic group, social and medical risk, and adequacy of medical care during pregnancy and delivery. The study found that within each ethnic-risk category, infant mortality was much lower for the children born to mothers who had adequate care. If the infant mortality rate of children born to mothers with *inadequate* care could have been reduced to the rate of the adequate-care groups, the overall rate for the city would have been 18.4 instead of 21.9 per 1,000 live births.[7] This method of calculation surely overstates the contribution of medical care by assuming that within a given ethnic-risk category *all* of the difference in infant mortality between groups getting different levels of care was in fact due to the care. Furthermore, even a reduction to 18.4 would have left infant mortality in New York City considerably above the rates recorded in Scandinavia and the Netherlands for that same year. Factors other than medical care are clearly of major significance.

Variation in infant mortality rates among various states in this country

does not reflect any significant correlation between rate and the number of physicians per capita after account is taken of differences in income, schooling, and similar variables.[8] Such studies, however, deal only with average results. Medical care programs aimed at groups of particularly high risk—very young girls, women of low socioeconomic status, and the like—have in recent years been able to show substantial reductions in neonatal mortality. Therein may lie an important clue to the role of medical care. For very risky pregnancies, the quantity and quality of care available may be critical; for pregnancies that present little risk (that is, among well-educated, well-fed mothers, neither very young nor very old) the quantity and quality of care may be of minor importance, except insofar as poor care can be worse than none at all.

The possibility that medical care can do harm as well as good is a real and growing one. As the tools of medical intervention—drugs, surgery, radiotherapy, and the like—become more powerful, the risks of iatrogenic disease (ill health arising out of the medical care process itself) increase. For example, two decades ago it was standard procedure in the best hospitals to administer oxygen to low-birth-weight babies. It is now believed that this practice was responsible for considerable retrolental fibroplasia, which leads to blindness.

It is easy to assemble a catalog of horror stories about misdirected medical efforts, but this, too, can be misleading. It is obvious that as knowledge grows in medicine, some of the presently accepted therapies will be found to be useless or even harmful. It is also obvious that mistakes are made in every field and by every profession. What is required is some sense of balance so that the contribution of medical care is not oversold and so that both patient and provider realize the wisdom in the ancient warning to physicians, "Do no harm."

INTERNATIONAL COMPARISONS

What light, if any, do the preceding considerations throw on the large international differences in infant mortality that presently exist? If we compare developed countries with less developed ones, they explain a great deal. But if we confine our attention to differences among developed countries, they don't provide much help. The lowest rates, averaging about 13 per 1,000 in 1970, are found in the Netherlands, Scandinavia, Australia, New Zealand, and Japan, all countries having relatively high levels of income and schooling. Yet in the United States, which has even higher income and education levels, the rate in 1970 was almost 20 per 1,000. The rate for U.S. whites was 17.4; and for whites in

North Dakota, the most favorable state in the country, but certainly not the wealthiest, the rate was 14.

In comparison with *large* European countries, however, the United States does not fare so badly: in 1970 the infant mortality in Italy was 29.2, in West Germany 23.6, in the United Kingdom 18.3, and in France 15.1. Our neighbor, Canada, had almost exactly the same rate as we did, and highly industrialized Belgium and Luxembourg were slightly worse off.

It has been popular to use international comparisons in infant mortality as a stick with which to beat the American medical profession. Some of this criticism has been constructive. It has shattered the smug and incorrect assumption that "Americans have the best health in the world." It has also helped to dramatize gross disparities within this country. Perhaps most important, it has forced some leaders in medicine to begin focusing on health *outcomes* as the criteria of "quality," instead of preoccupying themselves with credentials, expensive equipment, and other ingredients of the *process* of care.

If one examines the data closely, however, the claim that the wide disparities between the U.S. infant mortality rate and rates elsewhere are primarily attributable to deficiencies in American medicine becomes unpersuasive. Many of these differences are of long standing. The U.S. rate was substantially higher than the rate in the Netherlands or New Zealand, for example, long before medical care could have made much difference either way. Even the presence of free national health services does not guarantee low rates, as the United Kingdom data indicate.

In the final analysis, we must recognize the critical importance of the mother—the care she takes of herself during pregnancy and the care she provides for the child after birth. Effective family planning—that is, the bearing of children when and in the number that the parents want—is surely also important in achieving low infant mortality. Just how religion, culture, the political, economic, and social structure, medical care, and other forces combine to affect the outcome of pregnancy remains to be determined.

INFANT HEALTH

Mere survival is not, of course, everything. We want to raise children who will be equipped mentally and physically to contribute to the world's work and to share in the pleasures life has to offer. Their capacity to do this as adults may be dramatically affected by what happens to them during the first year of life. As Dr. Walsh McDermott notes: "We are

beginning to get a solid scientific base for the concept that mental capacity and the capability to be educated can be permanently impaired by early infancy." [9]

There is a widespread belief that reductions in infant and child mortality keep alive persons with "weak constitutions" or other health impairments, thus increasing the health problems and death rates of the population when they become adults. A contrary point of view, however, should be considered. It can be argued that the same forces, socioeconomic and medical, that reduce mortality among infants and children also strengthen the health of those who would have survived anyway, albeit marginally. Mortality can be viewed as one end of a distribution of health conditions, and reductions in mortality can be viewed as part of a more general process which shifts the entire distribution in the direction of better health.

A long-term British study of more than seventeen thousand births has shown that not only do low-birth-weight babies have less chance of surviving, but those that do survive are more likely to have other problems (behavior, learning ability, etc.) by the time they reach school age. Thus, the same measures that offer the most promise for lowering infant mortality (improved nutrition, reduction in cigarette smoking, better timing and spacing of births, and the like) will probably raise rather than lower the quality of life for those who survive.

One thing is clear. The decrease in U.S. infant mortality over the years has *not* resulted in higher death rates among children or adults. Nor does the lower infant mortality in Scandinavia mean that death rates there exceed those of the United States at subsequent ages. The next section provides a closer look at the factors associated with adult mortality.

Three Score and Ten

> The days of our years are three score years and ten.
>
> Psalms 90 : 10

According to the Bible, the normal life span for humans was 70 years. This was not an absolute upper limit: the psalmist did hold out the possibility of 80 years "by reason of strength." Neither was this life expec-

tancy in the technical sense of the term (the average number of years lived by all persons born at a particular time). Indeed, life expectancy in the biblical era was probably less than 35 years. A more plausible interpretation is that this was the "expected" life span in the sense that people could not expect to live beyond that age, assuming they were among the fortunate ones who survived the perils of infancy, childhood, and young adulthood.

In this sense the estimate has remarkable force, even today. In the United States more than half of those who reach the age of 70 will die during the subsequent decade, and after 80 the death rate becomes very high indeed. The great increase in life expectancy that has occurred in developed countries over the past two hundred years has been the result primarily of reductions in death rates at early ages, not in the lengthening of the "normal" life span.

Life expectancy is now almost exactly 70 years in the United States, and slightly higher in some other countries. Comparison of life tables from various countries at various times suggests that as life expectancy rises from 35 to 70, about four-fifths of the increase is contributed by reductions in death rates under 70 and only one-fifth comes from reductions in death rates at age 70 or above.

We have already reviewed the significant reductions in infant mortality that have been achieved in this century. The fall in death rates for children over the age of 1 year has been even more impressive. For ages 1 through 4 the decline has been almost 5 percent annually; this means that on the average the death rate for this group has been halved every 15 years since 1900. For the 5-to-14-year-old group the annual decrease has been at about 3.5 percent, more rapid than the annual 3 percent decline in infant mortality over the same period.

The decrease in the child death rate has been particularly striking since the 1930s as the result of advances in medicine. One by one the dread diseases of childhood—pneumonia, influenza, diphtheria, typhoid fever, polio, and so on—have succumbed to immunization or powerful new drug therapies. The reduction in parental grief and fear brought about by rising living standards and medical advances surely stands as one of the greatest achievements of industrial society. Today, the risk of death in all the years between 1 and 20 combined is appreciably less than in the first year alone!

Although most Americans can now expect to reach the age of 70, about four in ten do not. An examination of the causes of death in adolescents and young adults (ages 15–24), in early middle age (35–44), and in late middle age (55–64) will give us a clearer understanding of the role economic and social factors play in early death and what medical care can and cannot do to prevent them.

YOUTH: AGES 15–24

Adolescents and young adults are on the whole extremely healthy. Their strength, energy, capacity to go without sleep, withstand the elements, and shake off minor infirmities are the envy of their elders. In the United States their chances of dying from "normal" diseases are very small indeed. Unfortunately, their overall probability of death is not that small, especially for males. Because the sex differential in mortality is so large in the United States, it is given an extended discussion later in this chapter. For the moment we shall concentrate on *male* deaths, highlighting the differences associated with age and color.*

Suppose we consider 100,000 American males age 15. The following figures show how many will die from selected causes and all causes before they reach the age of 25, assuming that the latest available death rates (1968) continue unchanged. †

Expected Number of Deaths per 100,000 from Ages 15 through 24

CAUSE OF DEATH	WHITE MALES	NONWHITE MALES
Motor accidents	807	661
Other accidents	310	545
Suicide	113	82
Neoplasms	103	82
Homicide	75	771
Influenza and pneumonia	29	58
Heart diseases	28	69
All causes	1,690	2,777

The most striking aspect of these data is the tremendous loss of life from accidents, especially motor accidents. Of every one hundred thousand American males age 15, about 1,100 will lose their lives in ac-

* The data are for whites and nonwhites; blacks account for about 95 percent of nonwhite male deaths at the ages discussed in this chapter.

† All the United States mortality statistics presented in the following pages are calculated from data in Department of Health, Education, and Welfare *Vital Statistics of the United States*, vol. 2, *Mortality*, Part A, Table 1–9: Death Rates for 69 Selected Causes, by 10-Year Age Groups, Color, and Sex (Washington, D.C.: Government Printing Office, 1968).

cidents before reaching 25; more than half of those deaths will involve automobiles. "Epidemic" is almost too weak a word to describe this situation; when polio was at its worst, the death rate from that disease among males ages 15 to 24 was less than one twentieth as high. To be sure, polio causes illness as well as death, but the disabilities and impairments resulting from auto accidents also far exceed the number killed.

Also striking is the fact that *homicide* is the leading cause of death among young black males; indeed, it continues to be a significant cause of death right up through middle age. Thus if you are a 15-year-old black American male, your chances of being a homicide victim sometime before you reach 55 are thirty out of a thousand—more than triple the risk of your dying from tuberculosis.

Among young white males, suicide claims almost as many victims as do neoplasms (cancer and related illnesses) and heart disease combined. When one considers that many auto deaths might well be classified as suicide, it is apparent that the self-destructiveness of young American males is a major health problem today. The suicide rate for young black males is lower than for whites, but has been increasing at a faster rate.

Accidents, suicide, homicide—deaths from violence in one form or another account for *three out of every four* male deaths in this age group. Twenty years ago, the overall death rate among this age group was 15 percent lower, and the rate for violent deaths was 40 percent lower! The increase since then can hardly be attributed to a deterioration in medical care. On the contrary, the treatment of trauma is an area of medicine that has seen particularly significant advances, and there are undoubtedly many victims of violence being saved today who would have died two decades ago.

Numerous theories have been advanced to explain the increase in violent deaths among the young—affluence, the Vietnam war, the decline in religious belief, overly permissive parents, and so on—but the only thing we can be certain of is the increase itself. The suspicion also exists that the self-destructiveness of the young is a symptom of more widespread problems in society at large.

Among all U.S. males, deaths from accidents, suicide, and homicide account for one in every ten. Moreover, the cost to society of these deaths is relatively much greater than those due to other causes because so many of them involve men who had many productive years ahead of them. One frequently used measure of the economic cost of premature death is based on the earnings a man would have realized had he lived, discounted to take account of the fact that a dollar in hand is worth more

than the expectation of a dollar sometime in the future. When deaths are weighted in this way, we find that violent deaths accounted for about 25 percent of the economic cost of all male deaths in 1968, compared to only 17 percent of the cost in 1960.

THE PRIME OF LIFE: AGES 35–44

By the time a white male American reaches 35 years of age, his chances of dying in a motor accident are less than half of what they were when he was 20. As we can see from the following figures, however, deaths from violence continue to take a heavy toll, still accounting for almost three out of every ten deaths.

Expected Number of Deaths per 100,000 from Ages 35 through 44

CAUSE OF DEATH	WHITE MALES	NON-WHITE MALES
Heart diseases	999	1,831
Neoplasms	507	803
(lung cancer)	(146)	(285)
Motor accidents	351	596
Other accidents	321	787
Suicide	232	126
Cirrhosis of liver	188	557
Homicide	98	1,146
Influenza and pneumonia	79	422
All causes	3,458	9,203

Diseases of the heart become the number-one cause of death at about age 35 and continue to hold that position from then on. Between ages 35 and 45 approximately one white male out of every hundred dies of a heart attack or related disease. Among black males the figure is approximately two out of a hundred. Neoplasms, especially lung cancer, also become significant among American males at age 35. Cirrhosis of the liver, which is usually attributable to alcoholism, is another major cause of death, exceeding even lung cancer in number of fatal victims. The *total* impact of smoking and drinking on health is thus apparently very great: in addition to the toll from lung cancer and cirrhosis, there are such other effects as the contribution of cigarettes to heart disease and of alcohol to motor accidents.

The differential between non-whites and whites at ages 35–44 is very

pronounced; however the rates for non-whites may contain some upward bias because of substantial underenumeration of black males of this age in the Census of Population. The numerator in the death rate ratio (the number of deaths) is more accurately measured than the denominator (the population).

LATE MIDDLE AGE: AGES 55–64

By age 55 the risks of death of American males increase appreciably, as can be seen in the following figures:

Expected Number of Deaths per 100,000 from Ages 55 through 64

CAUSE OF DEATH	WHITE MALES	NONWHITE MALES
Heart diseases	9,940	11,679
Neoplasms	4,697	6,484
(lung cancer)	(1,848)	(2,148)
Cerebrovascular disease	1,196	3,519
Cirrhosis of liver	645	677
Other accidents	508	945
Influenza and pneumonia	505	1,210
Motor accidents	382	628
Suicide	348	120
Homicide	62	508
All causes	21,902	32,607

The chances of dying between ages 55 and 64 are much greater than during the entire period between ages 15 and 55. The major reason is the sharp increase in the chances of succumbing to a heart attack. For white males the death rate from this cause is ten times what it is at ages 35–44, and it accounts for half of all deaths in this age group. The death rate from lung cancer is also more than ten times greater than at ages 35–44. In both cases, behavior *earlier in life* may have started the fatal process, the consequences of which are realized only after several decades.

One unusual difference between whites and nonwhites that is worth noting concerns their respective rates of suicide: the white rate is higher for all three age groups discussed here and the differential tends to increase with age. Such statistics seem to contradict the belief that low income and related problems are major causes of suicide; they suggest that an individual's perception of what constitutes low income may depend as much, or more, on expectations as on absolute dollar amounts.

COMPARISON WITH SWEDEN

Some insight into the health problems of American males can be obtained by comparing the white American death rates already presented with comparable rates for Swedish males, whose rates are among the most favorable in the world.*

Expected Number of Deaths per 100,000 Swedish Males at Various Ages

CAUSE OF DEATH	15–24	35–44	55–64
Heart diseases	22	369	5,293
Neoplasms	110	343	3,159
Cerebrovascular disease	6	76	950
Cirrhosis of liver	—	50	204
Other accidents	228	287	426
Influenza and pneumonia	25	30	310
Motor accidents	335	197	285
Suicide	140	427	520
Homicide	9	4	9
All causes	1,045	2,286	13,410

At ages 15–24, the U.S. rate is 62 percent higher than the Swedish rate; thus the differential between white American males and Swedish males is as large as that between U.S. nonwhites and whites. The major reason for the white American–Swedish differential is the high rate of violent deaths in the United States. Violent deaths show a differential of 83 percent, while the excess of white American over Swedish nonviolent deaths is only 16 percent. The motor accident death rate for white American males, for example, is about two-and-one-half times that for Swedish males.

In the 35–44 age group the pattern changes. The overall differential (white American-Swedish) is still 51 percent, but deaths from violence are only 10 percent greater in the United States. The differential at early middle age is because deaths from heart disease at this point are almost three times as likely in the United States as in Sweden. The excess of deaths from this cause alone accounts for well over half of the total excess in the white male American death rate in the age group. By ages

* The Swedish mortality statistics presented in the following pages are calculated from data in United Nations, *Demographic Yearbook 1967* (New York: United Nations, 1968), Tables 5 and 25.

55–64 the U.S.-Swedish differential is 63 percent, and the U.S. rate for heart diseases is still double the Swedish rate.

A reasonable inference from these comparisons is that the huge mortality difference between the two countries is not connected to the quantity or quality of medical care. At younger ages the difference is mostly attributable to violent deaths, and at middle age the excess is primarily due to heart disease, which is probably related to diet, exercise, smoking, and stress. Given our present state of knowledge, even the most lavish use of medical care probably would not bring the U.S. rate more than a small step closer to the Swedish rate. Of course, as our knowledge grows this situation could change. For instance, some progress is being made in sorting out genetic factors that increase one's likelihood of suffering a heart attack, research that could lead to early detection of susceptible persons and possibly to preventive measures that would reduce their risk. At present, however, the greatest potential for reducing coronary disease, cancer, and the other major killers still lies in altering personal behavior.

THE CORRELATION WITH SCHOOLING

One of the most striking findings of recent research on the socioeconomic determinants of health in the United States is the strong positive correlation between health and length of schooling. This result holds for several types of health indexes ranging from mortality rates to self-evaluation of health status and for comparisons of individuals or populations such as cities or states. It also holds after allowing for the effects of such other variables as income, intelligence, and parents' schooling.

This relationship *may* reflect a chain of causality that begins with good health and results in more schooling. In the most detailed investigation yet undertaken of this subject, however, Michael Grossman has shown that the reverse hypothesis—that more schooling leads to better health—stands up well under a number of critical tests.[10] One of Grossman's most interesting findings concerns the relationship between schooling and premature death. Suppose you were studying, as he was, a group of white men in their thirties and you wanted to predict which ones would die in the next ten years. According to his results, educational attainment would have more predictive power that any other socioeconomic variable—including income and intelligence, two variables that are usually highly correlated with schooling.

Of course, neither Grossman nor anyone else is certain *why* or *how* schooling affects health. It may result in more sensible living habits; it

may contribute to more effective use of medical care; or it may help people absorb new information about health and medical care more rapidly.

One possibility is that the completion of formal schooling increases self-confidence and thus reduces the stress associated with many social and work situations. Among business executives, for instance, it would not be surprising if those who work their way up from blue-collar positions are more prone to heart disease and ulcers than those who enter the executive suite via graduate schools of business. Another possibility is that both schooling and health are aspects of investment in human capital. Differences among individuals and their families in willingness and ability to make such investments may help explain the observed relationship.

So far all research on the relationship between health and schooling has utilized retrospective statistical analysis and thus is lacking in the precision and definitiveness of controlled experiments. Such research has nevertheless suggested an important connection between an individual's behavior and his health. Additional support for this view emerges from a consideration of male–female differences in mortality, the subject of the following section.

The "Weaker" Sex

Judged by that harshest and in some sense most significant of all tests, the ability to survive, females are clearly much stronger than males. In all developed countries and at all ages the female death rate is appreciably below that of the male. This fact has significant economic and social consequences. For instance, by age 60, when female life expectancy is still 20 years, more than one out of five American females is a widow and another 10 percent are single or divorced with very little prospect of remarriage. An exploration of the extent of and variations in the sex differential in mortality rates at different ages and for different populations provides new insights into some current major health problems in the United States and their relation to economic and social factors.

THE AGE PATTERN

The excess of male over female deaths varies considerably with age. The differential is manifest even before birth, with the fetal death

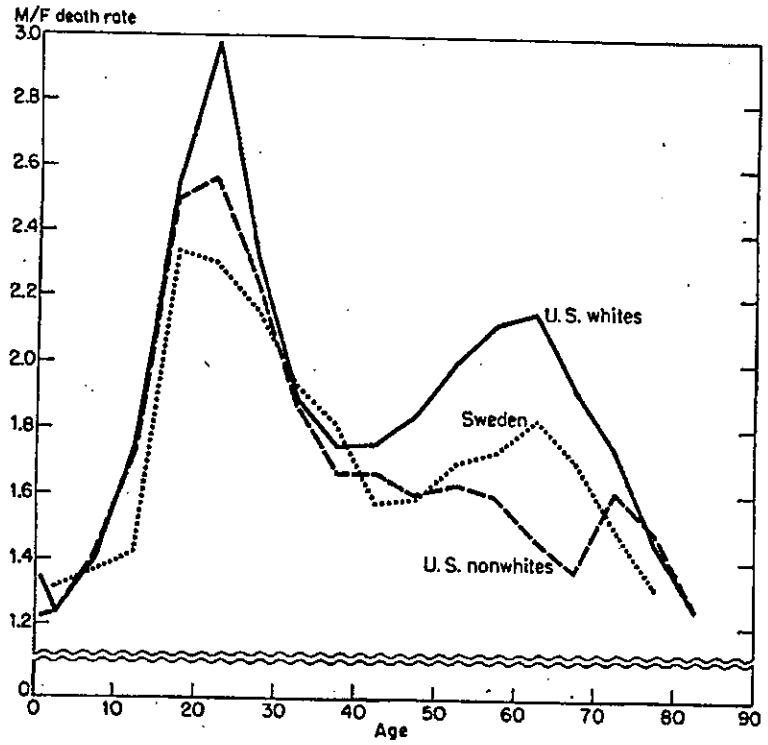

Figure 1
Male-Female Death Rate Ratio, 1967–68

SOURCES: U. S. Public Health Service, *Vital Statistics of the United States*, vol. 2, *Mortality* (Washington, D.C.: Government Printing Office, 1967, 1968) and U. S. Public Health Service, *Statistical Abstract of Sweden* (Washington, D.C.: Government Printing Office, 1971).

rate of males running about 10 percent above the rate of females. Since this differential emerges before the child's sex is known, there are clearly some biological differences at work in addition to the cultural and social factors that come into play after birth.

In the United States infant mortality among males is about one-third higher than for females, and throughout childhood the excess is in the range of one-third to one-half (see Figure 1). At age 15 the differential starts to rise sharply. Males between 15 and 24 have a death rate which is

almost triple that of females, largely because of the high rate of violent deaths among males that we previously described. Indeed, if we exclude violent deaths, the differential is only 40 percent—about the same range as for infants and children.

The differential begins to fall during the late 20s and continues to do so until about age 40, at which point the male death rate is about 75 percent above the female rate. Then it begins to rise again, so that by age 60 the probability of death for males is more than double that for females. At this age the high incidence of heart disease in males is the principal cause of the differential. The male death rate from heart diseases is more than triple the female rate, while the differential for all other causes is only about 50 percent.

In old age the differential declines again, but even at ages 80–84 the male death rate is 25 percent above the female rate. Thus, over the entire life span the average differential is more than 75 percent, with the smallest differences at very young and very old ages and the biggest differences in the early 20s and early 60s.

VARIATIONS IN THE PATTERN

Although the basic shape of the age pattern is similar for most populations, there are some significant differences within the United States and between the United States and other countries that are worthy of attention. At young ages the differential of one-third to one-half is fairly constant for all developed countries and for different parts of the United States, suggesting that some inherent biological difference is the primary explanation. After age 15, however, the size of the differential varies considerably, both within the United States and among developed countries. This variation is probably related to an interaction between biological and socioeconomic factors.

As Figure 1 indicates, the male/female mortality ratio in Sweden for young adults is appreciably lower than for U.S. whites. Again, at ages 45–65 the ratio is considerably lower in Sweden. In both cases the high ratio for U.S. whites is attributable to relatively high death rates for males, while female rates approach those found in Sweden. As noted previously, among young males the excess deaths in the United States over Sweden are primarily the result of accidents, and in the 45–65 age group the excess is primarily due to heart disease. Although attempts are frequently made to link the lower mortality rates in Sweden to differences in medical care systems, it seems unlikely that these differences are selec-

tive for males and females or that they play a significant role in the lower incidence of accidents and heart disease in Swedish men.

Among U.S. whites the largest sex differentials in mortality are in small southern towns; the smallest are in the suburbs of large northern cities. At young ages, before sex-linked behavioral patterns have had an opportunity to emerge, there are no significant regional differences. For instance, under age 15 the excess of male deaths is 37 percent in the nonmetropolitan counties of the South Atlantic and 36 percent in the metropolitan counties (without central city) of the Middle Atlantic.* At ages 15–64, however, the differentials are 137 percent and 82 percent, respectively. As in the case of the United States–Sweden comparison, it is extremely unlikely that these differences in male/female ratios can be attributed to medical care, income, or the like. The most promising hypothesis is that sex-role differentiation in work and consumption varies sufficiently from one population to another to have significant implications regarding mortality.

The above data are consistent with the view that as female life-styles become more like those of males, differentials in mortality narrow. One study that foreshadows such a trend examined unexpected deaths from heart attacks. In the decade 1949–59 the ratio of male to female deaths of this type was 12 to 1, but in the period 1967–71 the ratio was only 4 to 1. In the recent period a majority of the females who died of heart disease were heavy smokers, while only 10 percent had not smoked at all.[11]

MARITAL STATUS

One particularly interesting aspect of sex-related mortality is its relationship to marital status. In all developed countries the unmarried have significantly higher death rates than the married, and this differential is much greater for males than for females: on the average, unmarried males ages 45–54 in developed countries have *double* the death rate of their married counterparts. For females the marital status differential is only 30 percent.

One possible explanation for this is that "life" is produced more efficiently in a husband-wife household and that it is the female who plays the more important role in the process. Thus females who are single, widowed, or divorced can cope almost as well as married women,

* The South Atlantic census division consists of Delaware, Maryland, Virginia, District of Columbia, West Virginia, North Carolina, South Carolina, Georgia, and Florida. The Middle Atlantic division consists of New York, New Jersey, and Pennsylvania.

whereas males without spouses seem to be at a much greater disadvantage. One study, moreover, has found a positive effect of the wife's schooling on the husband's health after allowing for many other related variables such as husband's schooling, I.Q., and income.[12]

To be sure, the thread of causality need not run entirely from marital status to health. The marriage market may be selective with respect to health, tending to leave those with poor life expectancy unmarried. This relationship varies considerably from one country to another, however. In the United States about 13 percent of males ages 45–54 are unmarried, and their death rate is 123 percent higher than that of like-aged married males. In the same age group in England and Wales a smaller fraction (11 percent) are unmarried, but their death rate is only 53 percent above the rate for married males. Just as the male-female mortality ratio is higher in the United States than in nearly all other developed countries, so is the unmarried male–married male ratio higher. There is something about life in the United States that is hard on men, particularly on unmarried men. In the United States the probability of death in middle age for an unmarried man is about five times that for a married women! In England the comparable ratio is only about 2.75.

Among unmarried males in the United States (and in most other developed countries) divorced men have the highest death rate and widowers the next highest, while single men come closest to the married rate. Why should the rates for widowed and divorced men be so much higher than for single men? It could be adverse selection (i.e., the sick and the unstable are the ones who do not remarry). However, the earnings of widowed and divorced men are just as high as the earnings of single men, which tends to refute this hypothesis. Another possible explanation is a decreased desire to live after the loss of a wife. When we examine the mortality ratios of divorced to single males and of widowed to single males by cause of death, we find the highest ratios recorded for suicide, motor accidents, cirrhosis of the liver, homicide, and lung cancer—all causes where a self-destructive behavioral component is very significant. At the other end of the scale, the widowed and divorced rates come closest to the single in the categories of vascular lesions, diabetes, leukemia and aleukemia, and cancer of the digestive organs—all diseases in which identified behavioral decisions play a smaller role.

One does not ordinarily look to poets for insights into health care, but Edna St. Vincent Millay surely expressed a profound truth when she wrote:

Love cannot fill the thickened lung with breath,
Nor clear the blood, nor set the fractured bone;
Yet many a man is making friends with death
Even as I speak, for lack of love alone.[13]

A Tale of Two States

In the western United States there are two contiguous states that enjoy about the same levels of income and medical care and are alike in many other respects, but their levels of health differ enormously. The inhabitants of Utah are among the healthiest individuals in the United States, while the residents of Nevada are at the opposite end of the spectrum. Comparing death rates of white residents in the two states, for example, we find that infant mortality is about 40 percent higher in Nevada. And lest the reader think that the higher rate in Nevada is attributable to the "sinful" atmosphere of Reno and Las Vegas, we should note that infant mortality in the rest of the state is almost exactly the same as it is in these two cities. Rather, as was argued earlier in this chapter, infant death rates depend critically upon the physical and emotional condition of the mother.

The excess mortality in Nevada drops appreciably for children because, as shall be argued below, differences in life-style account for differences in death rates, and these do not fully emerge until the adult years. As the following figures indicate, the differential for adult men and women is in the range of 40 to 50 percent until old age, at which point the differential naturally decreases.

Excess of Death Rates in Nevada compared with Utah, Average for 1959–61 and 1966–68

AGE GROUP	MALES	FEMALES
<1	42%	35%
1–19	16%	26%
20–39	44%	42%
30–39	37%	42%
40–49	54%	69%
50–59	38%	28%
60–69	26%	17%
70–79	20%	6%

The two states are very much alike with respect to income, schooling, degree of urbanization, climate, and many other variables that are frequently thought to be the cause of variations in mortality. (In fact, average family income is actually higher in Nevada than in Utah.) The numbers of physicians and of hospital beds per capita are also similar in the two states.

What, then, explains these huge differences in death rates? The answer almost surely lies in the different life-styles of the residents of the two states. Utah is inhabited primarily by Mormons, whose influence is strong throughout the state. Devout Mormons do not use tobacco or alcohol and in general lead stable, quiet lives. Nevada, on the other hand, is a state with high rates of cigarette and alcohol consumption and very high indexes of marital and geographical instability. The contrast with Utah in these respects is extraordinary.

In 1970, 63 percent of Utah's residents 20 years of age and over had been born in the state; in Nevada the comparable figure was only 10 percent; for persons 35–64 the figures were 64 percent in Utah and 8 percent in Nevada. Not only were more than nine out of ten Nevadans of middle age born elsewhere, but more than 60 percent were not even born in the West.

The contrast in stability is also evident in the response to the 1970 census question about changes in residence. In Nevada only 36 percent of persons 5 years of age and over were then living in the same residence as they had been in 1965; in Utah the comparable figure was 54 percent.

The differences in marital status between the two states are also significant in view of the association between marital status and mortality discussed in the previous section. More than 20 percent of Nevada's males ages 35–64 are single, widowed, divorced, or not living with their spouses. Of those who are married with spouse present, more than one-third had been previously widowed or divorced. In Utah the comparable figures are only half as large.

The impact of alcohol and tobacco can be readily seen in the following comparison of death rates from cirrhosis of the liver and malignant neoplasms of the respiratory system. For both sexes the excess of death rates from these causes in Nevada is very large.

The populations of these two states are, to a considerable extent, self-selected extremes from the continuum of life-styles found in the United States. Nevadans, as has been shown, are predominantly recent immigrants from other areas, many of whom were attracted by the state's

Excess of Death Rates in Nevada compared with Utah for Cirrhosis of the Liver and Malignant Neoplasms of the Respiratory System, Average for 1966–68

AGE	MALES	FEMALES
30–39	590%	443%
40–49	111%	296%
50–59	206%	205%
60–69	117%	227%

permissive mores. The inhabitants of Utah, on the other hand, are evidently willing to remain in a more restricted society. Persons born in Utah who do not find these restrictions acceptable tend to move out of the state.

Summary

This dramatic illustration of large health differentials that are unrelated to income or availability of medical care helps to highlight the central themes of this chapter—namely:

1. From the middle of the eighteenth century to the middle of the twentieth century rising real incomes resulted in unprecedented improvements in health in the United States and other developing countries.
2. During most of this period medical care (as distinct from public health measures) played an insignificant role in health, but, beginning in the mid-1930s, major therapeutic discoveries made significant contributions independently of the rise in real income.
3. As a result of the changing nature of health problems, rising income is no longer significantly associated with better health, except in the case of infant mortality (primarily post-neonatal mortality)—and even here the relationship is weaker than it used to be.
4. As a result of the wide diffusion of effective medical care, its marginal contribution to health is again small (over the observed range of variation). There is no reason to believe that the major health problems of the average American would be significantly alleviated by increases in the number of hospitals or physicians. This conclusion might be altered, however, as the result of new scientific discoveries. Alternatively, the *marginal* contribution of medical care might become even smaller as a result of such advances.
5. The greatest current potential for improving the health of the American people is to be found in what they do and don't do to and for themselves. Individual decisions about diet, exercise, and smoking are of critical importance, and collective decisions affecting pollution and other aspects of the environment are also relevant.

These conclusions notwithstanding, the demand for medical care is very great and growing rapidly. As René Dubos has acutely observed, "To ward off disease or recover health, men as a rule find it easier to depend on the healers than to attempt the more difficult task of living wisely." [14]

The next three chapters focus specifically on medical care: physicians, hospitals, and drugs. As discussed in Chapter 1, problems concerning the cost of care and access to care are high on the agenda of the American people. The following chapters provide the background for understanding these problems and for analyzing them from the economic point of view.