Disorders Which Shorten Life

Disorders Which Shorten Life

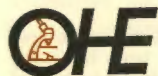A review of mortality trends
for those between
the ages of 15 and 44

ⓒHE

Office of Health Economics

62 Brompton Road   London SW3

Cover illustration by courtesy of the Chartered Insurance Institute.

The legend under the policy heading reads as follows: 'A tripod with an antique lamp round the bright flame of which a moth flutters, the lamp being the emblem of life, and the moth hovering round it shows the uncertainty of its duration. Two infants admire the moth unconscious of its danger. An elegant female with a stork by her side as the emblem of maternal tenderness strives to turn their attention to the temple of Minerva, placed in the distance on the top of the celebrated Rock the Acropolis behind which stood the treasury of Athens.'

Disorders Which Shorten Life

THE productivity of any community, both in economic and social terms, depends largely upon young men and women aged 15 to 44. At work, it is within these thirty years that the mental and physical powers of the individual generally reach a peak. This is the period of life in which members of society should make their greatest economic contribution, when the seeds of schooling are brought to fruition. Socially, these years are associated with marriage and the raising of a family. For women, they correspond with the child-bearing years. For men they cover the period of life which involves the economic and social responsibilities of bringing up young children and providing a home.

This paper concerns mortality among young adults aged 15 to 44. This mortality causes the nation a serious economic and social loss and, more personally, severe hardship and suffering among dependent relatives including children and old persons. The paper excludes consideration of those under working age—infants and children—who have been discussed previously[1,2]. It also excludes those above the age of 44; by the middle forties individuals begin to pass into a new phase, symbolised by the menopause in women, in which the degenerative diseases start to become significant in both sexes and in which patterns of mortality and morbidity rapidly begin to alter.

Although the first thirty years of adult life form a social and economic whole, there are wide variations in mortality, and it is necessary to consider certain sub-groups separately.

Overall Trends

In 1934, 63,000 persons aged from 15 to 44 years died. By 1964 the number had fallen to 24,000, equivalent to a little over one in a thousand. Some 100 years ago the rate was eight

3

OHE publications still available :

Cover illustration by courtesy of the Chartered Insurance Institute.

The legend under the policy heading reads as follows: 'A tripod with an antique lamp round the bright flame of which a moth flutters, the lamp being the emblem of life, and the moth hovering round it shows the uncertainty of its duration. Two infants admire the moth unconscious of its danger. An elegant female with a stork by her side as the emblem of maternal tenderness strives to turn their attention to the temple of Minerva, placed in the distance on the top of the celebrated Rock the Acropolis behind which stood the treasury of Athens.'

Disorders Which Shorten Life

THE productivity of any community, both in economic and social terms, depends largely upon young men and women aged 15 to 44. At work, it is within these thirty years that the mental and physical powers of the individual generally reach a peak. This is the period of life in which members of society should make their greatest economic contribution, when the seeds of schooling are brought to fruition. Socially, these years are associated with marriage and the raising of a family. For women, they correspond with the child-bearing years. For men they cover the period of life which involves the economic and social responsibilities of bringing up young children and providing a home.

This paper concerns mortality among young adults aged 15 to 44. This mortality causes the nation a serious economic and social loss and, more personally, severe hardship and suffering among dependent relatives including children and old persons. The paper excludes consideration of those under working age—infants and children—who have been discussed previously[1,2]. It also excludes those above the age of 44; by the middle forties individuals begin to pass into a new phase, symbolised by the menopause in women, in which the degenerative diseases start to become significant in both sexes and in which patterns of mortality and morbidity rapidly begin to alter.

Although the first thirty years of adult life form a social and economic whole, there are wide variations in mortality, and it is necessary to consider certain sub-groups separately.

Overall Trends

In 1934, 63,000 persons aged from 15 to 44 years died. By 1964 the number had fallen to 24,000, equivalent to a little over one in a thousand. Some 100 years ago the rate was eight

Figure 1

All causes, death rate per million living, by age, 1841 to 1964, England and Wales.

Source: Registrar General's Statistical Review of England and Wales 1964, Part I.

Death Rate Per Million
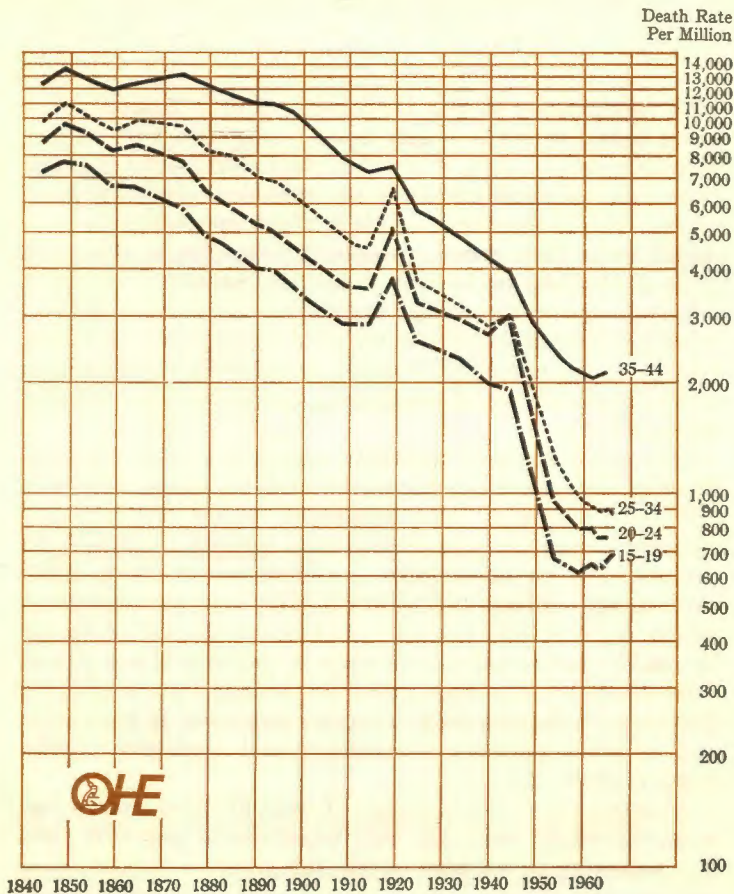
Note: (1) Five year averages 1841 to 1960, annual rates 1961 to 1964.
(2) Logarithmic scale.

4

Table A

Average percentage decrease per year in death rates, by age, 1863 to 1963, England and Wales.

	15–19 % per year	20–24 % per year	25–34 % per year	35–44 % per year
1863–1898	2·1	1·8	1·4	0·6
1898–1933	1·1	1·1	1·7	1·9
1933–1953*	6·4	5·9	4·9	3·8
1953–1963	0·2	1·7	2·8	1·0
*1933–1953 excluding war years	8·1	8·7	6·9	4·4

times as high as in 1964 and even twenty years ago it was more than twice as high.

For the first ten years or so after records began in 1841 there was no overall reduction in death rates, nor, for those aged from 15 to 19 and from 35 to 44, has there been any reduction for the past five years. For over a hundred years between those periods, except for the war years†, there has been a continuous decrease (Fig. 1). From the 1860's until the 1930's improving medical, economic and social conditions and the development of the public health services, brought a steady lowering of the death rates. From the 1930's to the 1950's the speed of improvement changed greatly (Table A). This acceleration was to a considerable extent brought about by the control of infections by a combination of social advances, preventive medicine programmes and specific chemotherapy. Had it not been for this abrupt improvement over the long-term trends, the current death rates for young adults would not have been reached until about the end of this century.

†During the war years many young men and women were in the armed forces (nearly five million by 1944). Only deaths of civilians occurring in England and Wales were recorded and the population used for calculating mortality rates was the civilian population. Unfortunately, the civilian population was heavily weighted with people who were not fit for service and with servicemen discharged, usually for medical reasons. This factor (introduced for men from 1915 to 1920 and from 1939 to 1949 and for women from 1941 to 1949) distorted the age-specific death rates for those aged 15–44. Thus the rates for these years should be treated with great caution. The period of the first world war also included the 1919 influenza epidemic, and both wars involved a degree of social disturbance.

Figure 2

Leading causes of death, all persons, 15–44, 1904 to 1964, England and Wales.

(a) Death rates per million living, and (b) Deaths by specified cause as proportion of all deaths.

Source: Registrar General's Statistical Review, various years.
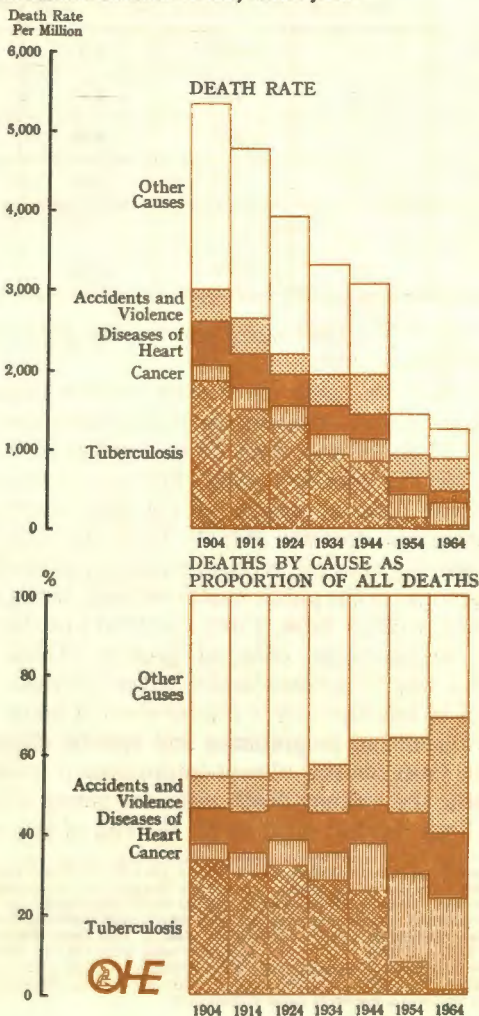
Table B

Leading causes of death, by sex and age, 1964, England and Wales.

Source: Registrar General's Statistical Review of England and Wales, 1964, Part I.

		Death rate per million			Percentage of all deaths		
		15–24	25–34	35–44	15–24	25–34	35–44
Cancer	M	99	196	575	10	18	23
	F	71	186	765	17	27	43
Accidents	M	617	360	327	60	33	13
	F	125	78	93	29	11	5
Diseases of heart	M	26	128	749	2	12	30
	F	12	66	233	3	9	13
Diseases of	M	50	72	172	5	7	7
nervous system	F	35	65	173	8	9	10
Suicide	M	63	115	151	6	11	6
	F	27	68	103	6	10	6
Diseases of respiratory system	M	48	45	138	5	4	6
	F	29	31	96	7	4	5
All other causes	M	130	177	359	12	15	15
	F	127	210	315	30	30	18
Total	M	1033	1093	2471	100	100	100
	F	426	704	1778	100	100	100

The pattern over the last 100 years has been largely the same for infants[1] and children[2], although for infants the improvement was not apparent until the turn of the century. Child death rates fall with increasing age and reach the lowest level at the 10–14 year old age group. From then onwards death rates rise with age (Fig. 1)*.

Taking the 15–44 year old age group as a whole, Figure 2 shows the main causes of death over the past 60 years. By far the most important feature has been the reduction in

*Figure 1 conceals the fact that for each of the age groups shown the death rate for women has, in this century, been lower than that for men. Also, since 1959, the death rate among 20–24 year old men has been higher than that among 25–34 year old men. This is primarily due to the greater incidence of deaths from accidents among the younger adult men.

Figure 3

Tuberculosis (Respiratory system), death rate per million living, by sex and age, 1851 to 1964, England and Wales.

Source: Registrar General's Decennial Supplement, England and Wales 1931, Part III. Registrar General's Statistical Review of England and Wales 1962, Part III; 1963, Part I and 1964, Part I.
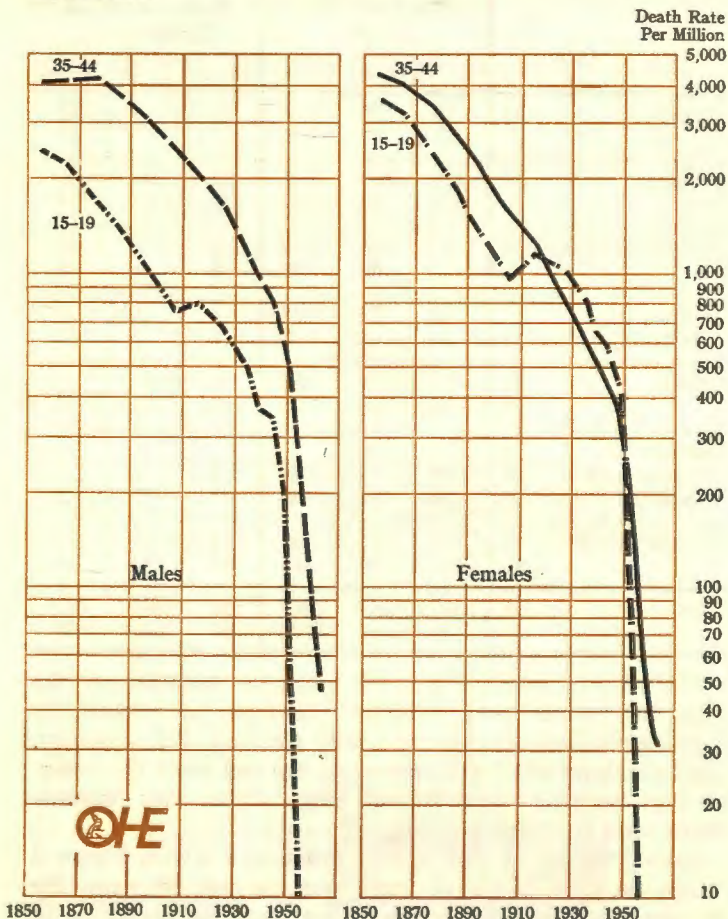
Note: (1) Age groups 20–24 and 25–34 are not shown in order to facilitate graphic presentation.
(2) From 1956 onwards the rates for the 15–19 age group are beyond the scale of the graph.
(3) Ten year averages 1851 to 1930, five year averages 1931 to 1960, four year average 1961 to 1964.
(4) Logarithmic scale.

8

deaths from tuberculosis over this period. In 1904 the death rate was 1858 per million population accounting for one third of all deaths. By 1964 the death rate was 16 per million population or one in a hundred deaths from all causes. More young adults died from tuberculosis in 1924 than died from all causes in 1964. Deaths from pneumonia and deaths among women during pregnancy and childbirth have also fallen sharply. The recorded death rate from diseases of the heart has fallen to less than half the 1904 rate probably to a large extent through the control of throat infections and consequent prevention of rheumatic heart disease. The recorded death rates from cancer, accidents and suicide have shown little change. However, with the control of traditional infections, cancer, accidents and heart disease are now the three leading causes making up 24, 22 and 16 per cent respectively of all deaths. These causes account for nearly two thirds of all deaths of young adults; but there are wide variations between the three age divisions and between the sexes (Table B).

Tuberculosis

Figure 3 shows the decline in death rates from tuberculosis over the past century. The death rate for each age group fell consistently in the hundred years from 1850. This was associated with improved standards of living, public health measures and sanatorium treatment. Then, during the late forties and early fifties, this progress was rapidly accelerated and mortality for each age group fell sharply.

In 1943 streptomycin was isolated and three years later in 1946 para-amino-salicylic acid (PAS) was discovered. These, together with the more recent discovery of isoniazid, have revolutionised the treatment of tuberculosis. In addition to treatment, detection by means of chest radiology and sputum examination, and prevention by means of B.C.G. vaccination, have completely altered the pattern of the disease. Mortality, particularly among the youngest adults, has been cut so drastically that by 1964 only 2 women aged 15–19 died from tuberculosis. Thirty years before, in 1934, 1412 had died.

An unusual disparity has occurred between the sexes. For those under 20 the rate for women, until very recently, has always been higher than the male rate—in the 1940's and 1950's almost double, although for those aged 35–44 the

Figure 4

Pneumonia, death rate per million males living, by age, 1861 to 1964, England and Wales.

Source: Registrar General's Decennial Supplement, England and Wales 1931, Part III. Registrar General's Statistical Review of England and Wales, various years.

Death Rate Per Million
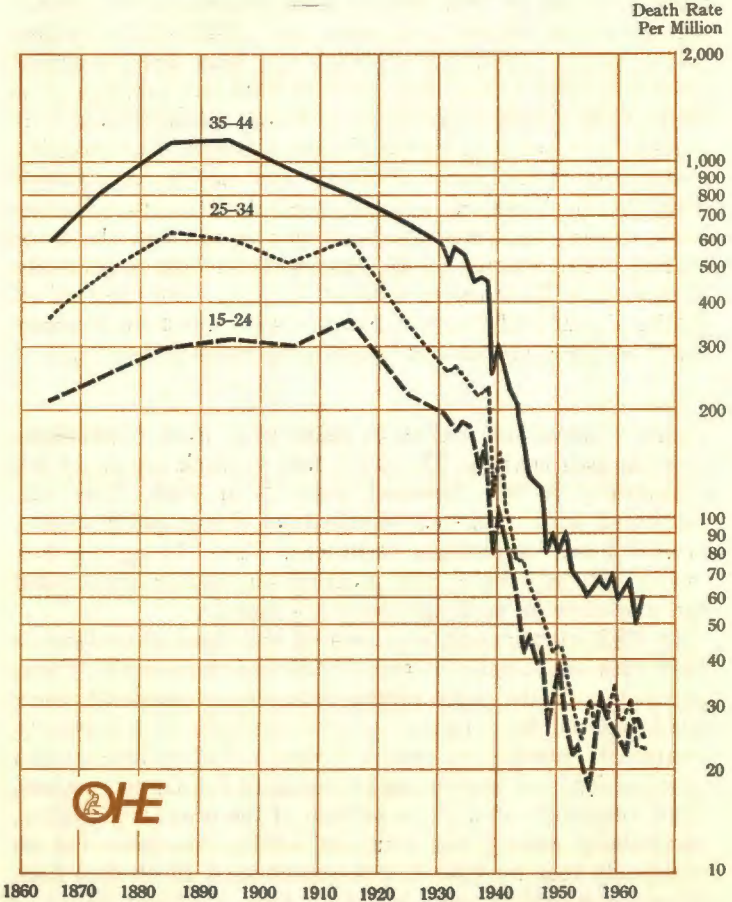
Note: (1) Females rates are similar and in order to facilitate graphic presentation are not shown.
(2) Ten year averages 1861 to 1930, annual rates 1931 to 1964.
(3) Logarithmic scale.

10

female rate has been and still is substantially lower. This may, in part, be a reflection of the increased risks which young tubercular women face during pregnancy and childbirth.

Pneumonia

Figure 4* summarises mortality due to pneumonia over the past century. In the three age groups shown, the recorded death rates rose steadily during the second half of the nineteenth century and fell gradually during the first part of the present century. Thus by about 1930 the rates were similar to those recorded for 1860. These rates then fell steeply from the late 1930's until the mid-1950's since when they have remained relatively constant. As with tuberculosis, the steady decline up to the 1930's can be ascribed to rising standards of medicine and public health measures. With the introduction of the sulphonamides in 1939, penicillin a few years later and the broad spectrum antibiotics in the late 1940's and early 1950's it is reasonable to attribute the greater part of the abrupt improvement in death rates in recent years to chemotherapy.

The 15–44 year old age groups have benefited relatively more than the other ages of man. The rate among men is now about one tenth of that of the early 1930's. However, the constancy of the rates (apart from the increases during influenza epidemic years) since the mid-1950's must be viewed with concern. There is a sharp contrast, for instance, between the very low death rates due to tuberculosis, and the levelling off of death rates from pneumonia. It has been suggested that this may be due to a residual pattern of disease, different from the acute pneumonias which responded so dramatically to chemotherapy. There may now be a residue of patients whose lives have been saved by antibiotics, but whose lungs have been severely damaged by chronic bronchitis and other conditions. Many of these cases may eventually contract infections, which because of the lung damage fail to respond to treatment, and result in death from pneumonia. Alternatively, it has been suggested that the high rates may be due largely to inaccurate certification of the cause of death. There is certainly a need to investigate further this surprisingly high residual death rate from pneumonia among young adults.

*Only death rates for men are shown. The rates for women are similar.

Figure 5

Maternal mortality, death rate per 100,000 total births, 1860 to 1964, England and Wales.

Source: Derived from Registrar General's Decennial Supplement, England and Wales 1931, Part III. Registrar General's Statistical Review of England and Wales, various years.
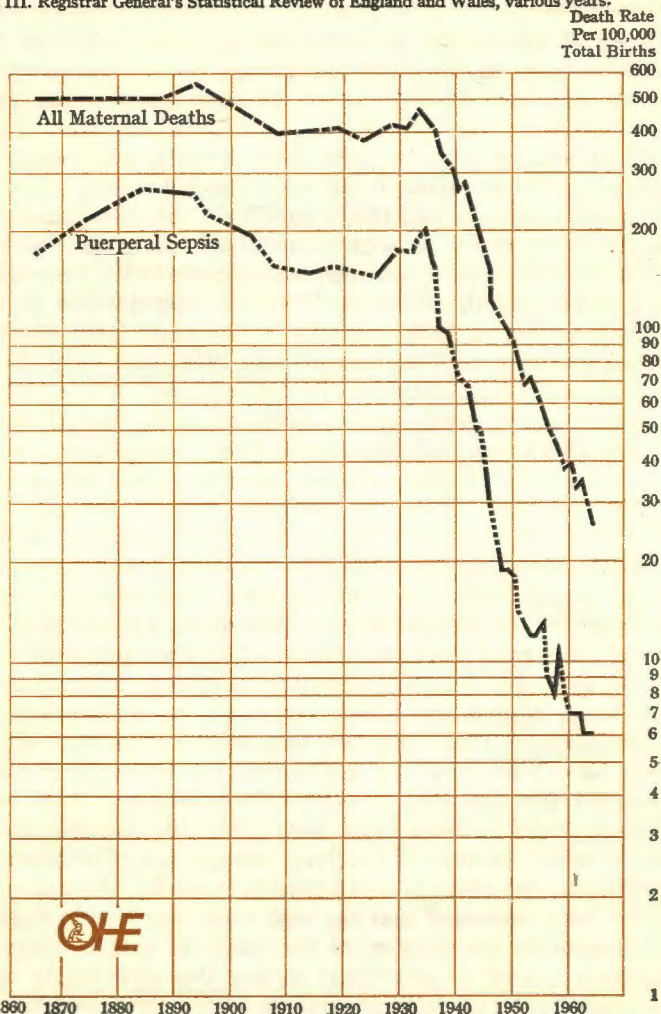
Note: (1) Ten year averages 1861 to 1890, five year averages 1891 to 1930, annual rates 1931 to 1964.
(2) Logarithmic scale.

Maternal Deaths

For women, the ages between 15 and 44 correspond closely with the childbearing years. Deaths during pregnancy and childbirth have always accounted for a significant proportion of deaths among women in this age group. In 1904 nine per cent of deaths were from this cause and in 1964 the figure was two per cent.

The reasons for the decline are once again complex. Among them are social and economic improvements, rising standards of medical care, including the greater number of midwives and district nurses. As with tuberculosis and pneumonia, chemotherapy has played an important part in the reduction of maternal mortality rates. Figure 5 shows the deaths per 100,000 births. With the greatest progress between 1890 and 1910 the death rate fell slowly from 1860 to the early 1920's. For the next ten years there was an alarming rise due to puerperal sepsis. For each year from the 1860's up till the mid-1930's between 1 in 200 and 1 in 250 mothers died in pregnancy or childbirth. But from the mid-1930's onwards the rising trend was reversed; the rate has since been decreasing at over nine per cent per year. This decline was due largely to the new possibility of controlling puerperal sepsis, which was formerly responsible for a large part of maternal deaths, and to the more general availability of blood transfusions. The introduction of the sulphonamides, more acceptable antiseptics and the use of blood transfusions did not merely speed up an already declining death rate; they actually reversed an upward trend.

Nevertheless even now there is little room for complacency. Although in 1964 only 1 in 4000 births resulted in the death of the mother there were some 227 such deaths. A proportion of these deaths might have been prevented had the mother herself made better provision for her medical care during pregnancy and childbirth. An enquiry[3] in 1961–1963 concluded that some 38 per cent of maternal deaths had avoidable factors, of which one quarter involved the mother's refusal or inability to make adequate arrangements in advance.

Diseases of the Heart

This group of diseases includes rheumatic heart disease, arteriosclerotic and degenerative heart disease and hyper-

13

Figure 6

Diseases of the heart, death rate per million living, by sex and age, 1931 to 1964, England and Wales.

Source: Registrar General's Statistical Review of England and Wales, various years.
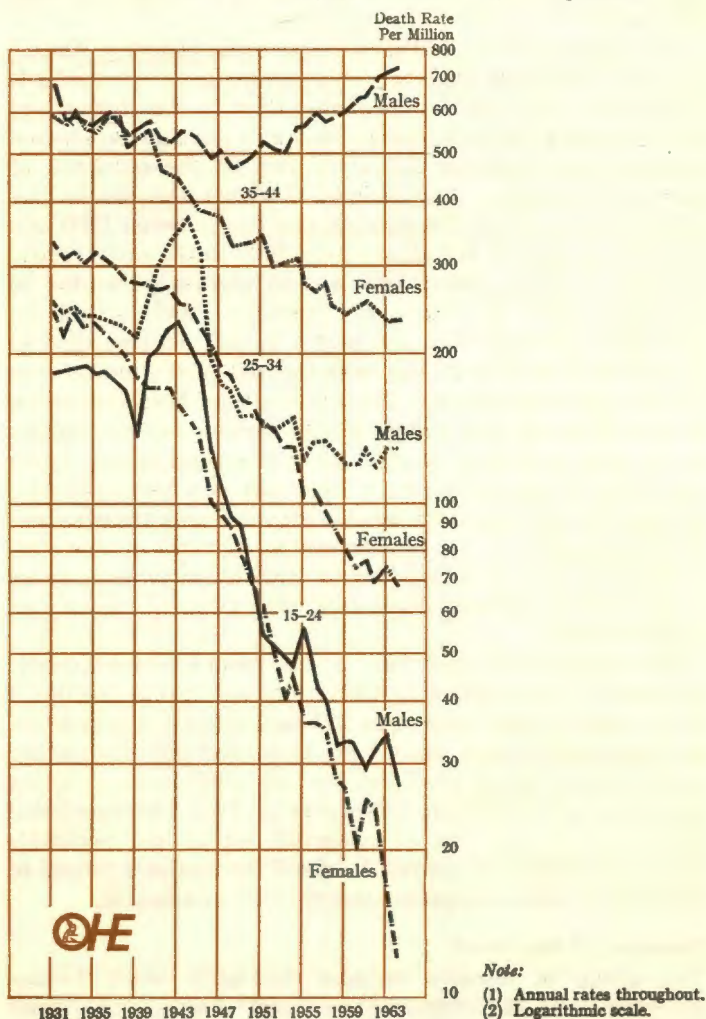
tensive heart disease. Mortality rates from 1931 to 1964 are shown in Figure 6. Male and female rates for the youngest age group have fallen sharply. The 25–34 year old rates also show a marked downward trend although less than that of the younger group. At these ages chronic rheumatic heart disease formerly contributed the largest proportion of deaths and the rates have fallen mainly because of the reduction of this disease. Chronic rheumatic heart disease, which is caused by rheumatic fever, has diminished as rheumatic fever has declined in severity and incidence. Rheumatic fever itself is caused by streptococcal throat infections and the control of these infections by antibacterial therapy has contributed substantially to the rapid fall in mortality from rheumatic heart disease since the late 1930's.

The war years were an exception to the downward trend among men between the ages of 15 to 34. This was probably because those whose hearts had been damaged by rheumatic fever in childhood were rigorously excluded from the armed services, and therefore considerably increased the proportion of such people in the civilian population (see footnote, page 5).

The rise in death rates among 35–44 year old males (Fig. 6) is primarily due to coronary heart disease. As men approach middle-age this disease accounts for the greater part of all deaths from heart disease. The recorded mortality rate for this disease has risen substantially particularly in the last fifteen years among men aged 35–44.

Research in the treatment of heart disease has made considerable progress in recent years. Replacement of diseased heart valves by grafting those taken from cadavers or animals has become established practice. Artificial valves have been used with success for seven years and the models in current use are satisfactory and have made some contribution to the reduction in deaths from rheumatic and congenital heart disease. Prophylactic surgery of the coronary arteries to eliminate atherosclerotic narrowing is now also beginning to take its place in the treatment of coronary disease. Anticoagulants are being used to prevent thrombosis following heart surgery. However, it is still too early for these most recent, and potentially dramatic, advances to have made much impact on the mortality rates from heart disease in Britain.

Figure 7

Malignant neoplasms, death rate per million living, by sex and age, 1936 to 1964, England and Wales.
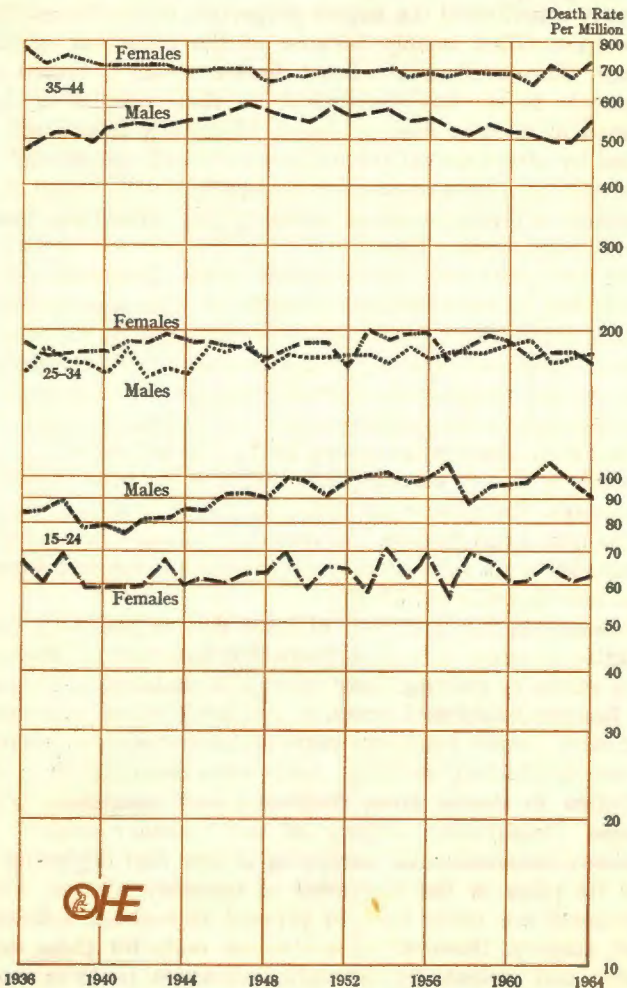
Note: (1) Annual rates throughout.
(2) Logarithmic scale.

Cancer

Death rates from cancer have remained substantially the same for the past thirty years (Fig. 7); but with the decrease in deaths from diseases such as tuberculosis, cancer now accounts for one quarter of all deaths at these ages. Generally the incidence of cancer rises with age but there are differences in the rate of increase between the sexes. For 15–24 year olds the male death rate is higher than the female death rate. For 35–44 year olds, however, the death rate among females is higher than that among males—over one third as high again in 1964. For females of this age it accounts for almost one half of all deaths. This is largely the result of the cancers associated with the anatomy of women which include cancer of the breast and of the womb. The age groups and sexes thus are affected by differing cancers in varying degrees. Briefly, leukaemia and brain tumours are those which particularly affect the younger adults, cancer of the lung and stomach the middle-aged men, and cancer of the breast, uterus and ovaries the middle-aged women. There has been a contrast between the three most important sites of cancer over the years. Recorded deaths from cancer of the stomach have declined, those from cancer of the breast have remained constant and those for cancer of the lung have increased steadily. Most other cancers have declined. Although, so far, there has been no revolutionary breakthrough either in the discovery of the underlying causes of cancer or in prevention or cure, important advances have been made. Radiotherapy, surgery and chemotherapy are all being used with success in treating certain types of cancer and there is now surveillance of some members of the population for the pre-symptomatic detection of cervical cancer. Simply because a major breakthrough is still awaited, it is wrong to regard cancer as being either inevitable or beyond treatment.

Violent Deaths

Accidental and violent deaths are sometimes referred to as 'new epidemics' and 'social diseases'. One in three deaths among 15–44 year old men and one in six of women at these ages result from accidents or suicide. Together these now constitute a greater proportion of deaths among the 15–44 year olds than any other group of causes. Nevertheless, recorded mortality rates from these causes for the age group as a whole

17

Figure 8

Suicide, death rate per million living, by sex and age, 1861 to 1964, England and Wales.

18
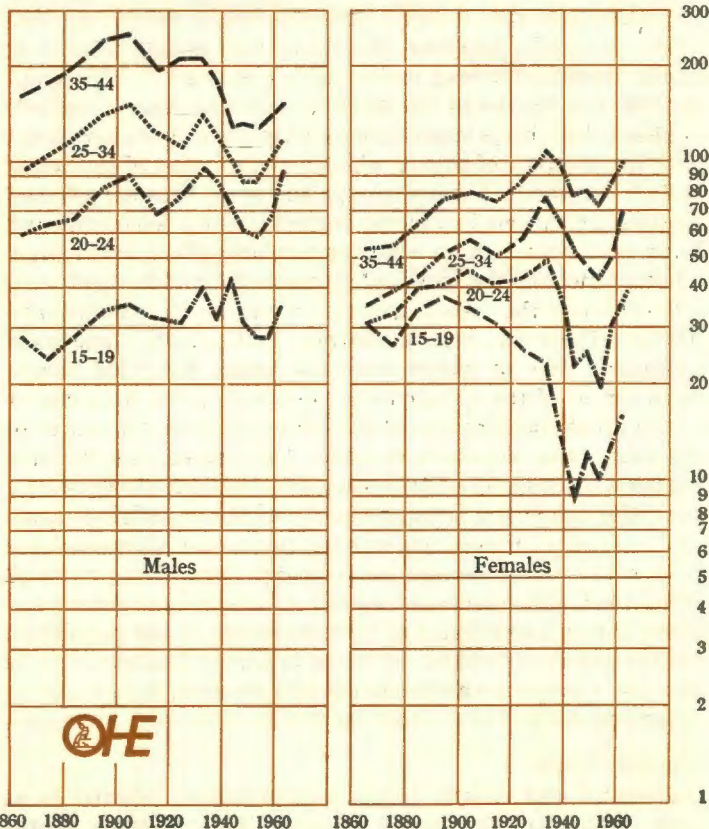
are little different to those which prevailed one hundred years ago. The agents which cause the accidents or are used in suicide have, however, radically altered.

Suicide among the 25–34 year olds constitutes one in ten of all deaths. The reliability of suicide statistics is often questioned, particularly as, until 1961, suicide was a criminal offence and affected burial rights.

From Figure 8 it will be seen that mortality rates rise with age and that the age specific male rates are higher than the female rates—twice as high at ages 15–34. The rate recorded for older men is similar at the end of the hundred year period to that recorded at the beginning; for younger men it is higher. For women the reverse is true; at the younger ages the recorded rate has fallen considerably but at the higher ages it has risen.

Two distinct cycles can be seen, one with a peak just after the turn of the century and a trough round about the First World War, the other with a peak in the early 1930's at the depth of the economic depression and a trough in the 1940's and early 1950's. Since then there has been a steady rise in recorded suicide rates at all ages.

The aetiology of suicide is a most complex problem, and the importance of social and cultural factors is well established. Social isolation, feelings of comparative inadequacy, unstable relationships, social and economic crises or extreme deviations from the normal are some of the factors which it has been suggested may lead to a state of mind in which a person seeks to take his own life. However, the same social situations will, of course, only lead to suicide in a minority. The epidemiology of suicide has been extensively studied, but it is not easy to use such knowledge as has been acquired to prevent suicide in individual members of high risk groups.

As well as changes in overall rates, large changes have occurred in the method of suicide; Table C compares 1964 with 60 years before. Three quarters of suicides committed today are by poisoning—a majority of which are by domestic gas. Sixty years ago drowning, firearms, hanging and poisoning were the most common methods.

Accidental deaths (and those from violent causes excluding suicide) follow the pattern of those from suicide, with rises around 1905 and during the thirties (Fig. 9). The latter rise

Figure 9

Accidents and violence other than suicide, death rate per million living, by sex and age, 1861 to 1964, England and Wales.

Source: Registrar General's Decennial Supplement, England and Wales 1931, Part III. Registrar General's Statistical Review of England and Wales, various years.
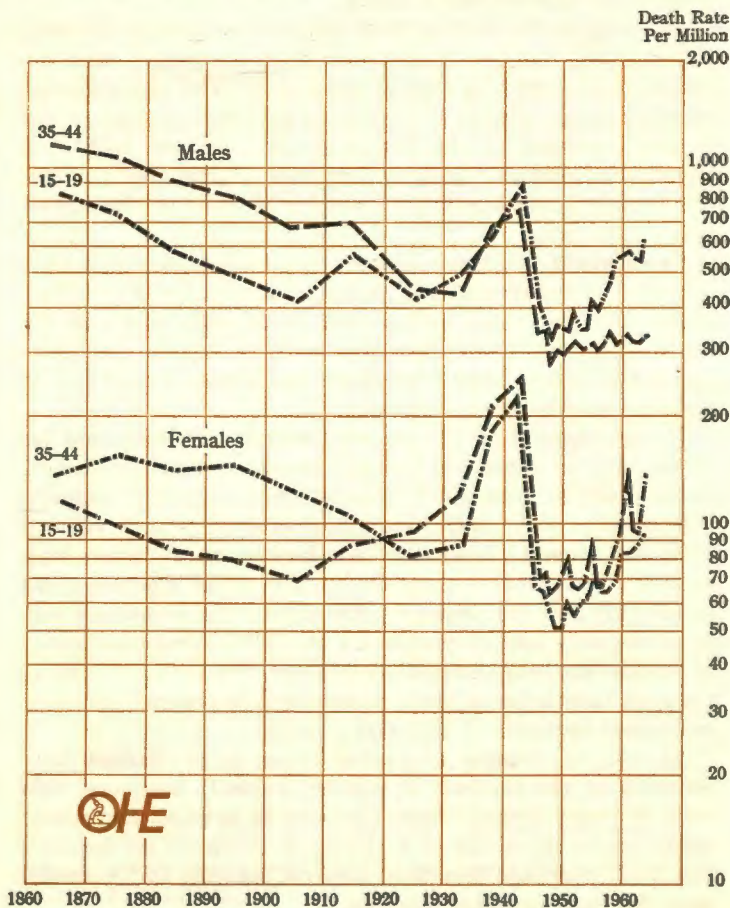
Note: (1) Age groups 20–24 and 25–34 are not shown in order to facilitate graphic presentation.
(2) Ten year averages 1861 to 1930, five year averages 1931 to 1945, annual rates 1946 to 1964.
(3) Logarithmic scale.

20

Table C

Deaths from suicide according to external agent, all persons, 15–44, 1904 and 1964, England and Wales.

Source: Registrar General's Statistical Review of England and Wales, 1904 and 1964, Part I.

	Death rate per million		Percentage of total	
	1904	1964	1904	1964
Drowning	24	4	26	5
Weapons and implements	22	4	23	4
Poisoning	21	67	22	76
Hanging	17	8	18	9
Other methods	9	5	11	6
	93	88	100	100

continued on during the Second World War but the rates include civilian war casualties. Since the end of the war the rates have risen sharply particularly among young men and women aged 15–19 where they have roughly doubled. For men this has more than offset the reduction in deaths from other causes since 1950 and has resulted in a small rise in the total death rate. In 1964 accidents were responsible for nearly two-thirds of all deaths among men aged 15–24. Even so, the recorded rates among the older men are substantially lower now than they were one hundred years ago, among young men and the older adult women slightly lower and it is only among the youngest female group, the 15–19 year olds, that there has been any increase. It is interesting that until the twenties the 35–44 year olds had a higher mortality rate from accidents than the 15–19 year olds and since then a lower one; in 1964 the rate for male 15–19 year olds was about double that for male 35–44 year olds.

A major cause of the increase since the war has been the more widespread use of the motor car and motor cycle. Figure 10 shows this increase which is particularly marked among the young, due mainly to motor cycle accidents, and which must be viewed with considerable alarm. Even so, apart

Figure 10

Motor vehicle accidents, death rate per million living, by sex and age, 1931 to 1964, England and Wales.

Source: Registrar General's Statistical Review of England and Wales, various years.
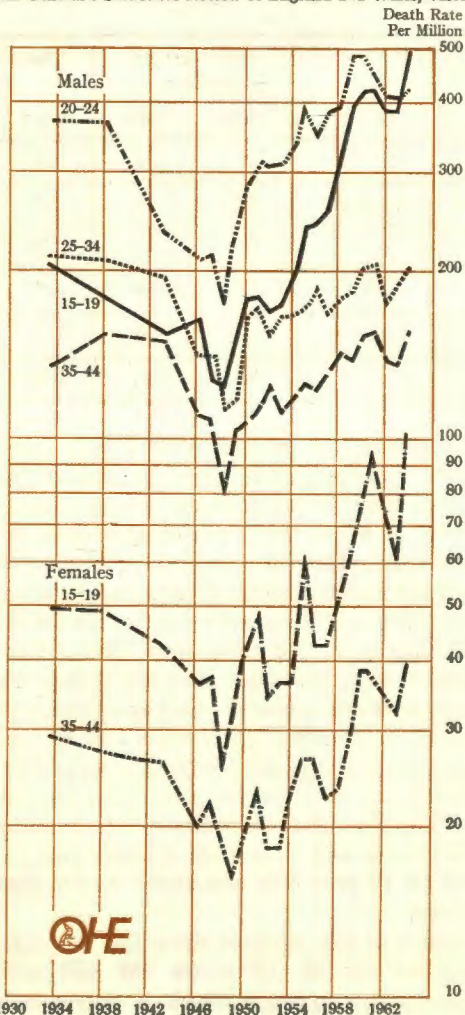
Note: (1) Female age groups 20-24 and 25-34 are not shown to facilitate graphic presentation.
(2) Five year averages 1931 to 1945, annual rates 1946 to 1964.
(3) Logarithmic scale.

22

Table D

Deaths from accidents according to external causes, all persons 15–44, 1904 and 1964, England and Wales.

Source: Registrar General's Statistical Review of England and Wales, 1904 and 1964, Part I.

	Death rate per million		Percentage of total	
	1904	1964	1904	1964
Drowning	67	15	23	6
Traffic	62	174	21	66
Mines and quarries	42	6	15	2
Falls	26	14	9	5
Burns and scalds	15	6	5	2
Poisoning	13	18	5	7
Other causes	64	32	22	12
	289	265	100	100

from this age group, the death rates for men are little or no higher now than they were in 1938 despite a fourfold increase in the number of vehicles on the roads.

While death rates from accidents generally have not increased over the past hundred years they conceal a change in emphasis between type of accident. Table D shows the rates for the years 1904 and 1964. Death rates due to traffic accidents have trebled, although even in 1904 one in five of all accidents were caused by vehicles—including trains and horses. Accidents in mines and quarries, drowning, falls and burns have all been reduced.

Accidents can be divided into three main categories, domestic, traffic and industrial accidents. Although the highest incidence of domestic accidents is among children and old people, at least eight per cent of the 4200 deaths from accidents occurring in 1964 among men aged 15–44 were attributed to domestic accidents; the comparable figure for women was at least 21 per cent of the 900 deaths. Traffic accidents, which in 1964 accounted for 63 per cent of accident deaths in this age group, and industrial accidents, which accounted for 13 per

cent of accident deaths among 15–44 year old men, both have many causes, and have been the subject of much research and publicity.

Nevertheless, in view of the increasing hazards of modern life, including the advent of the motor car, electricity and modern industrial and domestic machinery, it is remarkable that death rates from accidents have not increased over the last sixty years. That they have not must be attributed in part to legislation and its enforcement, and the efforts made by the voluntary societies, research institutes, industry and others. The control of road traffic and the engineering of roads, influenced by the Road Research Laboratory, have had important bearing on traffic accidents. The control of industrial conditions and their supervision by the factory inspectorate and Industrial Safety Officers; the regulation of conditions in the mines, and in the building and construction industry (four persons died in the construction of the Forth road bridge in the 1960's; 75 years before, 57 people lost their lives in building the Forth railway bridge); the educational function of the police and the establishment of the British Standards Institute have all been of great significance. Legislation to prevent domestic accidents includes such Acts as the Heating Appliance (Fireguards) Act of 1952* and the Consumer Protection Act of 1961 and many others. The accident prevention societies, such as the Royal Society for the Prevention of Accidents, have exerted a strong influence by propaganda and encouragement.

In addition, once accidents have occurred much can now be done to prevent them from becoming fatal. Improved medical services, surgical techniques, the widespread use of antibiotics, anaesthetics and blood transfusions, more efficient ambulance and casualty reception centres have all contributed. Once a casualty has reached hospital alive it is now the exception for death to ensue. By contrast, in the 1930's, when there were fewer specialist accident departments, when infections could not be controlled, and when surgery was restricted by the limited range of anaesthetic techniques available, casualties were more liable to die in hospital. However, there is still much room for improvement.

*Despite legislation concerning fireguard regulations, a recent survey revealed that only about one in five families in the country complied with these regulations.[4]

Social and Economic Benefits

THE social and economic benefits so far brought about by the abrupt improvement in young adult mortality rates which occurred in the late 1930's (Table A), and the future benefits which are possible if there is further progress, are substantial. Such benefits occur in a variety of different fields.

An estimate can be made of the number of lives saved of those who would otherwise have died in young adulthood had the rapid improvements in health not taken place. This estimate can be made by calculating the difference between the actual death rates since 1933 (which reflect the rapid improvement) and those which would have obtained if the long-term trends from 1898 to 1933 (showing slowly improving rates) had persisted over the last thirty years. The difference represents the number of lives saved by the abrupt acceleration in the reduction of death rates brought about largely by the reduction in incidence of infectious diseases.

The result is shown in Table E. It presents the estimated number of lives saved in two ways. First, as the number of lives saved in 1964, the annual rate; second, as the total cumulative number of persons saved over the thirty year period (after allowing for subsequent mortality). For each of these groups of survivors, the table shows their estimated age distribution.

Thus, in the year 1964, this estimate shows that the change in mortality trends resulted in saving the lives of some 20,000 young adults. In total some 325,000 persons are living now who would otherwise have died as young adults over the past thirty years had an abrupt reduction in mortality not occurred in that period.

One method of establishing the economic benefits the community has obtained from this improvement in the mortality trends of young adults is to calculate the contributions these survivors make to national income[5]. 20,000 young adult lives saved each year means the preservation of their future careers, and thus not only their current earnings but also the present value of their future earnings must be considered. As well as earning, the survivors also consume and thus the present value of their future personal consumption should be deducted to show the net gain to the national income. The expectation of

Table E

Age distribution in 1964 of 'survivors'; (a) single year 1964 'survivors', and (b) cumulative 1934 to 1964 'survivors', England and Wales.

Age in 1964	'Survivors' in single year (1964)	Cumulative 'survivors' 1934 to 1964
15–19	4000	11,800
20–24	4400	28,600
25–34	6200	94,000
35–44	4900	99,600
45–54	—	58,300
55–64	—	26,100
65–74	—	6,500
Total	19,500	324,900

working life and of years in retirement of the survivors in each age group is shown in Table F. Allowing for the different activity rates for age and sex, the present value of the future earnings of these survivors totals £180 million each year*. The present value of their future consumption amounts to £70 million, thus giving a net gain to the national income of £110 million a year. The net gain is large because of the high expectation of economically active years of young adults. This contribution to national income is one of the many gains which may be set against annual expenditure on health, and it indicates the order of magnitude of the economic gain obtained each year through lowering the mortality rates among young adults.

However, in many respects, this approach has limitations. It involves many implicit assumptions concerning the manner in which the reduction in mortality of young adults affects

*For each sex and age group separately the future earnings of an individual was obtained by multiplying average earnings per year by the expected future number of working years. This was then multiplied by the number of survivors in that age group. Allowance was made for activity rates in employment and future earnings were discounted at a rate of five per cent. The value of future consumption was obtained by estimating average consumption per capita and multiplying this, similarly discounted, by the future number of years of expected life.

Table F

Expected number of future person-years of 1964, 15–44 years old survivors, by age, England and Wales*.

Age of 1964 survivors	Total expected future person-years	Person-years before retirement age	Person-years after retirement age
15–19	230,000	182,000	48,000
20–24	229,000	175,000	54,000
25–34	279,000	201,000	78,000
35–44	169,000	109,000	60,000
Total	907,000	667,000	240,000

national income which are far from satisfactory. It also tends to focus attention on a single figure and fails, therefore, to highlight the many varied aspects of the social and economic gains obtained.

Because of the limitations of this approach, it is perhaps more important to consider also the gains from the point of view of individuals rather than in terms of contributions to the national income. It is this field where the economic and social considerations are combined.

The reduction of mortality is not in itself the creation of a new economic asset for the individual; it is the preservation of an asset which already existed. In this sense, it can be regarded as a 'loss stopping' operation. The possibility of premature mortality is a risk which confronts all individuals. The abrupt improvement in young adult mortality rates in the 1930's represented a substantial reduction in the risks faced and, therefore, in an economic sense, a reduction for all in the costs involved in bearing this risk.

The costs in meeting premature mortality risks can be considered, therefore, in terms of life insurance, and in this field there is ample evidence of the gains obtained. Table G

*For each sex and age group separately life expectancy was derived from the mid-point of the group. This expected number of years was then divided between the number of years expected before and after retirement age (65 for men and 60 for women). Each of these was then multiplied by the number of survivors in each of the age groups in 1964.

Table G

Temporary life assurance (without profits) for one year. Premium to secure £1000 sum insured, 1930 to 1966, Great Britain.

Year of entry	Age next birthday		
	20	30	40
1930	£7·00	£7·33	£7·67
1950	£7·46	£7·54	£8·91
1955	£6·00	£6·00	£7·00
1960	£6·00	£6·00	£6·68
1963	£3·75	£3·75	£4·00
1966	£4·00	£4·00	£4·22

Note: The years shown are those in which a revision of premiums was made. The 1940 revision is unobtainable. From 1961 onwards male and female rates were differentiated, the figures given for 1963 and 1966 have thus been averaged.

summarises the premiums charged by a large assurance society for a one year temporary life assurance since 1930.

The premiums show reductions of some 45 per cent over the period*, which represents a saving of approximately £3 a year for each £1000 insurance cover sought.

These savings on insurance premiums can be used as a basis for estimating the economic gains which all individuals obtain through reductions in mortality risks. It cannot be done through consideration of average amounts of insurance carried, since ability to insure reflects income rather than obligations. It is, however, possible to calculate a premium which would adequately insure a man against death and compare the 1930 premium with that for 1966. A man aged 30 whose earnings of £900 per year were terminated by premature death would have to invest a capital sum of £13,500 to provide an equivalent income for his dependants for the remaining 35 years of what would have been his working life. This sum could be equated to his working life's capital value. His annual

*The decline in premiums does not reflect exactly the decline in mortality risks because of the effect of inflation on management costs.

premium would now be £54 per year to insure for the provision of such a sum on premature death. In 1930 he would have had to pay over £94 per year. Thus the reduction in insurance premiums, which reflects the reduction in mortality rates, would represent for the individual an annual saving of over £40. About one third of this reduction is due to the accelerated decline in mortality since the 1930's. For all male workers aged 15 to 44 this would mean that the acceleration in the decline of mortality represented a saving of £140 million a year. It is interesting that this different concept produces a figure compatible with the £180 million based on the present value of the future earnings of male and female survivors.

It would of course be extremely rare in practice to have such high levels of insurance cover; indeed there is no justification for them because after death finance for personal consumption need no longer be provided*. Nevertheless, this calculation gives an indication of the cost of fully covering the personal economic risk of premature death.

The broad issues of protection by insurance highlight the social losses consequent upon premature mortality. However, it is the question of dependants which is probably the dominant consideration, and where the greatest social benefits are felt. The reduction of premature mortality has correspondingly increased the average duration of marriage and reduced the numbers of widows and parentless children. It is estimated that in 1963 some 20,000 children lost one or both parents under the age of 45. Had mortality in the young adult age groups remained at the 1933 level this figure would have been 38,000 higher. Indeed, the classical pattern of 'orphanages' has to some extent given way to one of homes catering as much for children from broken as from bereaved families.

These substantial gains can be set against, and help to bring into perspective, the amounts spent on the health services. Expenditure on health has substantially reduced the risks facing individuals and the costs of bearing such risks.

An attempt to set a money value on the loss of a married man's life is made by the courts when assessing damage under the Fatal Accidents Act. This is calculated on the annual value of the dependency multiplied by a number of years' purchase. The former is based on his yearly earnings less his own personal consumption and the latter on such factors as his age, his expectation of working life, the expectation of his dependants lives and the remarriage possibilities of his widow. In the case of wage earners with steady jobs awards over the last few years, quoted by Kemp, have varied between £2500 and £10,500. An example given is of an award made in 1962. A timber porter aged 30 died leaving a widow aged 29 and a son of 5. He had been earning over £19 per week and the value of the dependency was set as £625 per annum. A 12 year purchase was estimated and £7750 was awarded, £1000 to the son and £6750 to the widow.

The Continuing Challenge

OVER the past thirty years the pattern of mortality in young adults has altered dramatically. The infections have largely been controlled. Now cancer, accidents, heart disease and suicide have been left as the four major causes of death. Between them, they are responsible for about 17,000 deaths a year among those aged 15 to 44; that is seven out of ten of all deaths in this age group. Their prevention is an urgent priority both because of the personal suffering for which they are responsible and because of their high economic cost. This need for urgency is highlighted by the fact that the sharp fall in mortality at these ages since the 1930's has levelled off, and that there is even some indication of the start of a rising trend especially for those under 20 and over 35.

Basically, there are two approaches to this challenge. The first is the search for new knowledge. For both cancer and heart disease research prospects are brighter at present than ever before. Much progress has already been made and there are real hopes that there may soon be discoveries leading either to prevention or cure. In the case of heart disease these may involve both surgery and pharmacology. In the case of cancer they include immunology and chemotherapy. In addition, for each of these diseases and for accidents and suicides there is scope for epidemiological research to identify high risk groups and thus make possible surveillance, early diagnosis or perhaps the application of preventive measures.

This leads onto the second and more immediate approach, which concerns the wider application of existing knowledge and techniques. This means, first, the more general availability of special facilities, such as intensive care units for coronary cases, or centres for screening for cancer of the cervix. Second, it means wider application of safety considerations in design, and the extension of community services to prevent suicide, such as those provided by the Samaritans. Third, it means further education, both for the professions and more especially for the public. For example, a greater awareness of the effect of cigarette smoking as a cause of lung cancer, personal detection of possible cancer symptoms calling for medical examination and publicity concerning the availability of cervical screening procedures are three measures which can

help in the case of cancer. For diseases of the heart, education could be undertaken to alter the living habits of 'high risk' subjects, such as keeping down weight, reducing cigarette smoking, taking regular but moderate exercise and regular holidays. Education in the field of accidents has much scope; there should be more campaigns for safety on the roads, in factories and at home, and to reduce the dangers of modern machinery. In this sense, the significant remaining causes of death among young adults involve social as much as medical considerations. The degree to which an individual risks death from accidents or suicide, for example, depends largely on the way he lives his life. To some extent, also, a person can reduce his chances of dying from coronary disease or lung cancer by modifying his personal behaviour. It is possible that, in the short term, greater reductions in mortality could be achieved as a result of influencing the behaviour of young adults than as a result of technical medical progress.

Yet education alone is not always enough. Greater knowledge does not necessarily lead to modified behaviour; often it may be necessary to back up health education with properly enforced legislation. In addition, by improvements in the design of cars and machinery, in the planning of new cities and in the design of new houses, either industry or the Government may voluntarily take account of factors which can lead to greater safety and lower premature mortality.

However, all these approaches cost money, some more than others. The techniques of modern heart surgery require a highly specialised team of workers and this means that the cost of treatment is very high, perhaps several thousand pounds for one operation. Pharmaceutical research leading to a single new effective and safe medicine is now estimated to cost an average of almost £2 million. On the other hand, legislation to make fireguards compulsory cost little (although the guards themselves and enforcement of the law may be expensive).

In the past, the obstacles to improved health and prolongment of life tended to be technical ones. For example, a man with seriously diseased or damaged heart valves could not be saved; nor, in another field, had the epidemiological connection between smoking and lung cancer been established. Recently, the problem has been tending more to become a social and

economic one. This will be even more true in the future, and the question of priorities must arise. The conquest of some illnesses will bring greater benefits than others; the cure of a young person is more rewarding, in economic terms for the community as a whole, than that of someone approaching the natural end of his life. Such considerations must not be the deciding factors; but they cannot altogether be ignored in allocating our resources. While in humanitarian terms it can be said that each life has equal value; in practice, a decision sometimes has to be made as to whether to save the life of a thirty year old or a sixty year old.

Against this background, research and health education leading to the prevention of mortality in the younger age groups must appear more rewarding than that prolonging the lives of those already retired. But, as so often, the issues are complex. Judged purely from the national point of view, even some young patients may, because of their illness, never again be able to contribute significantly to the economy. Indeed, the lengthening of their lives may well result in an economic liability rather than an asset for the community. In the case of surgery, many new lifesaving techniques are enormously costly in terms of money and skilled manpower, and are so scarce that they can often be made available only to a few of those who could benefit from them; it is natural to use them first for those individuals who are fitter and who will benefit *most* from them. By contrast, a different situation arises when expensive pharmaceutical research has led to the discovery of a new lifesaving medicine. The individual cost of the pharmaceutical treatment is relatively low, and such treatment can, therefore, generally be made available at once for the fit and for the frail alike; no attempt could or should ever be made to restrict its availability only to those who are economically active. Thus, although it is possible to show impressive economic gains by the reduction of premature mortality, other factors must also be taken into account, and the greatest benefits of medical progress are likely, in fact, to accrue not to the community but to the individuals and their families.

References

1. *Infants at Risk*. Office of Health Economics, 1964.
2. *The Lives of Our Children; A Study in Childhood Mortality*. Office of Health Economics, 1962.
3. *Report on Confidential Enquiries into Maternal Deaths in England and Wales*, 1961–1963. Reports on Public Health and Medical Subjects. No. 115. Ministry of Health. H.M.S.O., 1966.
4. *House of Lords. Parliamentary Debates* (Hansard) Official Report, 12th April, 1961. H.M.S.O., 1961.
5. e.q. WEISBROD B. A., *Economics of Public Health*. Pennsylvania Press, 1961.
6. KEMP, D. A. McI., KEMP, M. S. AND McOUSTRA, C. J. C. *The Quantum of Damages. Vol. 2. Fatal Injury Claims*. Sweet & Maxwell Ltd., 1962.

Office of Health Economics

The Office of Health Economics is an independent organisation founded in 1962 by the Association of the British Pharmaceutical Industry with the following terms of reference:

1. To undertake research to evaluate the economic aspects of medical care.

2. To investigate, from time to time, other health and social problems.

3. To collect data on experience in other countries.

4. To publish results, data and conclusions relevant to the above.

The Office of Health Economics welcomes financial support and discussions of research problems with any persons or bodies interested in its work.

ROCK LIFE ASSURANCE COMPANY.

3209.   **Whereas** Hannah Mansfield, of Tittleham, in the County £600.
of Devon, Widow,

is desirous of making an Assurance with the ROCK LIFE ASSURANCE COMPANY in the Sum of Six   (Nonclass.)
hundred pounds   upon the Life of Ann Margaret Foreman, wife of Charles   (Term Year)
Foreman of the 5th Regiment   for the Term of seven   Years, commencing on this
Fifth   Day of June 1818   and ending on the Fourth   Day of
June 1825   both Days included; and hath declared had the said Ann Margaret Foreman
did not exceed the Age of thirty five Years on the   Day of   May 1818
; that she had   had the Small-Pox or Cow-Pox, had   had the Gout; had   suffered
a Spitting of Blood; and was not then afflicted with any Disorder which tended to shorten Life; in the truth of which
the said Ann Margaret Foreman   hath subscribed to Attestation. Now whereas the said Hannah
Mansfield   hath paid at the Office of the said Company the sum of Six Pounds Thirteen
Shillings,   as a Premium for one whole Year, commencing from the Date of this Policy; Now know all men
by these Presents, that if the said Ann Margaret Foreman   shall die at any Time
within the Term of one Year, commencing on this Fifth   Day of June 1818
and ending on the Fourth   Day of June 1819   both days included; or if the
said Hannah Mansfield her Executors, Administrators, or Assigns, shall, in the Event of the said Ann
Margaret Foreman   living beyond the said Term of one Year, pay at the Office of the said Company, the
like Premium on or before the Fifth   Day of June   in every subsequent Year, during the Term of
this Assurance, the Funds and Property of the said Company shall be subject and liable, according to the Provisions
of the said Company's Deed of Settlement, bearing Date the Twentieth Day of August, One Thousand Eight
Hundred and Seven, to pay and satisfy, within Three Calendar Months after satisfactory Proof shall have been
received at the Office of the said Company of the Death of the said Ann Margaret Foreman
in Case such Death shall happen at any Time within the Term of seven   Years, commencing on this Fifth
Day of June 1818 and ending on the Fourth   Day of June 1825 both Days in-
cluded, unto the said Hannah Mansfield her Executors, Administrators, or Assigns, the Sum of Six
hundred pounds

Provided always, (and this Policy of Assurance is granted upon this express Condition), that in case the said
Ann Margaret Foreman shall die upon the high Seas, unless in passing direct from one Part of the United
Kingdom to another, as specified in the said Deed of Settlement, without previous Licence from the Court of
Directors of the said Company to go upon the Seas, or shall go beyond the Limits of Europe, or shall enter into
any Military or Naval Service, without previous Licence from the said Court of Directors for that Purpose; or if any
Thing averred either in the Declaration or Attestation hereinbefore mentioned to have been made, shall be untrue, or
if the Referees are proved to have knowingly given false testimonials, this Policy shall be null and void.

In Witness whereof, we, three of the Directors of the Rock Life Assurance Company, have hereunto set our
Hands and Seals at the Rock Life Assurance Office, in Bridge Street, Blackfriars, London, this Fifth
Day of June   in the Year of our Lord One Thousand Eight Hundred and eighteen

Ent
Entered Wakefield

Signed and Delivered, (being
first duly Stamped) in