Problems in comparative longevity

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In previous publications we have discussed some of the factors underlying the increased life expectation of the population of England and Wales [1] and the marked sex difference in those surviving to extreme old age [2]. In the present article we compare life expectancy in England and Wales with that in other countries, particularly Japan. We then discuss some of the influences which may be responsible for the variations, and the many problems that remain unsolved.

A most surprising feature is the small range over which life expectancy differs from one country to another in the developed world (Table 1). In Hong Kong, Iceland, Japan and Switzerland, the newborn female can now anticipate a life of over 80 years, while in Australia, the Netherlands, Norway and Sweden her life expectancy is only a year less. In Canada, England and Wales, Finland, France, Germany and the USA it is more than 78 years and even in a country that is less affluent, such as Portugal, it is 76.1 years. In Central and South America and in countries behind the Iron Curtain it is only slightly lower [3, 4].

Life expectancy is increasing in all developed countries. Thus, in the two years 1982-84 it rose in Switzerland by 1.1 years for females and 0.9 for males, in Portugal in the two years 1980-82 by 1.5 years for females and 1.6 for males, and in Australia, Germany and Japan in the seven years 1975-82 by more than 1.5 years for males and females. Over a longer period this change is more striking; since 1900 in France life expectancy at birth has increased by 24.2 years for males and 29.0 for females [5]. In some developing countries the trend is even more marked. In Sri Lanka, during the period 1945-47 life expectancy at birth was 43.8 years for males and 43.1 for females, in 1970-72 it was 63.8 for males and 66.7 for females. Thus, over a quarter of a century, life expectation has increased by 20 years for males and 23.6 for females with a reversal of the slightly more favourable position enjoyed by Sri Lankan males earlier in the century [6].

In all countries the newborn male has a shorter life expectancy than the female (Table 1). The range of sex difference varies; thus in Finland it is 8.3 years, in England and Wales 6.2 and in Japan 5.9. In the remaining countries it is between 5.5 and 8.0 years, except in Israel where it is only 3.3 and in Cuba, the Dominican Republic and Panama where it is 3.7, 4.0 and 4.2 respectively [3, 4].

Table 2 shows the population and its distribution by age in various countries; also included are the birth and death rates, the infant mortality rate and the natural increase (ie excess of births over deaths per 1,000 of the population). In developing countries such as India, Bangladesh and Sri Lanka the birth rate and infant mortality are high and the proportion of the population aged over 65 years is small. This is in direct contrast to what obtains in the developed countries and we do not have to look far for the explanation.

In the Third World there is over-population, poverty, lack of education, inadequate medical care, reluctance to accept contraception and generally poor socio-economic conditions. The high infant mortality, which stems chiefly from poverty and lack of medical care, is insufficient to nullify the high birth rate so there is a high natural growth, and the ever-increasing population exacerbates the lack of available food and medical care. Although the low proportion of the population over the age of 65 is in part due to the high proportion of children, it is also to some extent the result of a high mortality rate and low life expectancy which arise in the main from adverse socio-economic factors. Life expectancy at birth is still less than 60 years in the WHO regions of Africa, South East Asia and the Eastern Mediterranean [3, 7]. However changes are already occurring, as shown in Sri Lanka.

The progressively increasing life span in the developed world reflects continuing improvement in education, living conditions and medical care [1]. The widening gap between male and female life expectation is a further expression of the same influences and of the relative protection of the female from accident, from the hazards of war and from the killing diseases of affluence (now increasing), particularly those caused by smoking and alcohol [2]. The difference of only 3.3 years between male and female life expectancy in Israel is of particular interest and probably arises from the kibbutz pattern of living which is very similar for men and women [8]. The gender difference in life expectancy in Israel outside the kibbutz is small compared with other countries but not as low as in the kibbutz population, suggesting that the Jewish way of living favours a more equal survival of the sexes, particularly in the kibbutz.
Table 1. Life expectancy at birth in different countries.

| Continent | Country            | Year | Male | Female | Sex difference |
|-----------|--------------------|------|------|--------|----------------|
| America   | Cuba               | 1981 | 72.2 | 75.9   | 3.7            |
|           | Dominican Republic | 1982 | 70.5 | 74.5   | 4.0            |
|           | Panama             | 1983 | 72.8 | 77.0   | 4.2            |
|           | United States of America | 1982 | 70.9 | 78.4   | 7.5            |
|           | Venezuela          | 1980 | 65.8 | 71.4   | 5.6            |
| Asia      | Hong Kong          | 1984 | 75.1 | 81.4   | 6.3            |
|           | Israel             | 1983 | 73.1 | 76.4   | 3.3            |
|           | Japan              | 1984 | 74.8 | 80.7   | 5.9            |
| Europe    | Austria            | 1983 | 69.5 | 76.6   | 7.1            |
|           | Bulgaria           | 1983 | 68.4 | 74.4   | 6.0            |
|           | Czechoslovakia     | 1983 | 66.9 | 74.3   | 7.4            |
|           | England & Wales    | 1981 | 71.8 | 78.0   | 6.2            |
|           | Finland            | 1983 | 70.2 | 78.5   | 8.3            |
|           | Germany            | 1984 | 71.3 | 78.1   | 6.8            |
|           | Hungary            | 1984 | 65.1 | 73.3   | 8.2            |
|           | Iceland            | 1983 | 73.4 | 80.3   | 7.2            |
|           | Ireland            | 1981 | 69.1 | 74.8   | 5.7            |
|           | Luxembourg         | 1982 | 68.9 | 76.0   | 7.1            |
|           | Netherlands        | 1983 | 73.0 | 79.8   | 6.8            |
|           | Norway             | 1983 | 72.8 | 79.8   | 7.0            |
|           | Poland             | 1984 | 66.8 | 75.0   | 8.2            |
|           | Portugal           | 1982 | 69.1 | 76.1   | 7.0            |
|           | Rumania            | 1983 | 66.9 | 72.5   | 5.6            |
|           | Scotland           | 1984 | 69.9 | 75.9   | 6.0            |
|           | Switzerland        | 1984 | 73.8 | 80.8   | 7.0            |
|           | Yugoslavia         | 1982 | 67.8 | 73.7   | 5.9            |
| Oceania   | Australia          | 1983 | 72.2 | 79.0   | 6.8            |
|           | New Zealand        | 1983 | 70.8 | 77.0   | 6.2            |

Table 2. Population, and its distribution by age, birth rate, infant mortality and natural increase in various countries in the world.

| Countrya | Year | Population (1000's) | Live birth rate per 1,000 population | Death rate per 1,000 population | Infant mortalityb | Natural increase per 1,000 population | Age in years (%) |
|----------|------|---------------------|--------------------------------------|---------------------------------|-------------------|----------------------------------------|-----------------|
|          |      |                     |                                      |                                 |                   |                                        | 0-14  | 15-64 | Over 65 |
| India    | 1984 | 730,540             | 33.2                                 | 13.3                            | 106               | 19.9                                   | 39.1             | 57.4 | 3.5 |
| Bangladesh | 1984 | 96,730              | 35.1                                 | 12.0                            | 122               | 23.1                                   | 41.2             | 56.0 | 2.8 |
| Sri Lanka | 1984 | 15,606              | 26.1                                 | 6.2                             | 30                | 20.1                                   | 35.3             | 60.4 | 4.3 |
| Argentina | 1983 | 29,627              | 23.9                                 | 8.8                             | 32                | 15.1                                   | 28.2             | 63.2 | 8.6 |
| Brazil   | 1985 | 129,660             | 20.9                                 | 6.2                             | 63                | 14.7                                   | 40.4             | 56.2 | 3.4 |
| Portugal | 1984 | 10,164              | 14.3                                 | 10.4                            | 21                | 3.9                                    | 23.8             | 64.4 | 11.9 |
| Poland   | 1985 | 37,126              | 18.9                                 | 9.6                             | 18                | 9.3                                    | 25.3             | 65.2 | 9.4 |
| England & Wales | 1983 | 49,654              | 12.7                                 | 11.7                            | 11                | 1.0                                    | 19.9             | 64.8 | 15.2 |
| Japan    | 1984 | 120,018             | 12.7                                 | 6.2                             | 10                | 6.5                                    | 22.0             | 68.0 | 10.0 |
| USA      | 1984 | 236,681             | 15.7                                 | 8.7                             | 11                | 7.0                                    | 22.2             | 66.2 | 11.6 |
| Canada   | 1984 | 25,150              | 15.0                                 | 7.0                             | 10                | 8.0                                    | 21.9             | 68.0 | 10.0 |
| Finland  | 1984 | 4,895               | 13.4                                 | 9.2                             | 7                 | 4.2                                    | 19.6             | 68.1 | 12.4 |
| Sweden   | 1985 | 8,243               | 11.3                                 | 10.9                            | 6                 | 0.4                                    | 18.6             | 64.6 | 16.8 |
| Denmark  | 1985 | 1,985               | 10.1                                 | 11.2                            | 7                 | -1.1                                   | 19.6             | 65.7 | 14.7 |
| Switzerland | 1984 | 6,442              | 11.5                                 | 9.4                             | 7                 | 2.4                                    | 17.2             | 68.4 | 14.4 |
| Germany  | 1984 | 61,089              | 9.5                                  | 11.3                            | 11                | -1.8                                   | 16.2             | 69.0 | 14.8 |

*Order dictated by degree of 'development'. bDeaths under 1 year per 1,000 live births.

The explanation of the smaller sex differential in Cuba, the Dominican Republic and Panama is likely to be the predominantly agrarian way of life for both sexes. Non-aggressive and temperate influences operate in the Amish community in the USA and are in part responsible for male life expectation exceeding that of females [2,9], though we do not yet know how long both sexes live. Everywhere, the environment clamours for causal recog-
nition, though Nevo [10] invokes the founder principle for the Amish, the immigrant males 'happening to be' of tougher genetic stock.

Since the 1939–45 war Japan has been the most successful trading nation in the world; the height of the Japanese has increased and they have become more akin to western nations in their outlook and activities. Although Japan has a population 2.4 times larger than England and Wales, it has much the same birth rate and infant mortality. However, the population has a lower percentage aged over 65 than has England and Wales but this will become less evident with the increased life expectation and lower birth rate in Japan.

The main difference between Japan and England and Wales is the mortality rates. In Japan, mortality is only 6.2 per 1,000 compared with 11.7 in this country, so that our natural increase per 1,000 of the population is only 1.0 compared with 6.5 in Japan. Figure 1 and Table 3 show the major causes of death in the two countries. In England and Wales there is a very much higher mortality from ischaemic heart disease, all malignant diseases (particularly carcinoma of the bronchus), chronic obstructive airways disease and accidents and violence. Japanese mortality only exceeds that in England and Wales in carcinoma of the stomach and suicide. The high Japanese death rate from the former remains unexplained. The high suicide rate, about 20,000 deaths annually, has been recorded for the past 35 years [11,12]. Death from stroke, though generally believed to be abnormally high in Japan, is in fact less than in England and Wales [3,13].

Ischaemic heart disease, chronic obstructive airways disease and carcinoma of the bronchus are closely related to cigarette smoking but despite the proportion of smokers in Japan being far greater and of ex-smokers far less than in England and Wales [14] death from these diseases is very much less likely for the Japanese. Mortality from ischaemic heart disease in Japan is the lowest in the world and fell every year from 1968 to 1977 [15] as did the proportion of males and females with abnormal electrocardiographs from 1972 to 1980 [16]. In England and Wales, mortality from ischaemic heart disease is among the highest. Ischaemic heart disease mortality in all occupational groups in Japan is lower than in England and Wales and, though in England and Wales the social classes show widely differing smoking habits, in Japan there is no such variation between socio-economic groups [14].

The work of Gordon [17], Syme [18], and Marmot and his co-workers [19] shows a higher incidence of ischaemic heart disease in Japanese living in Hawaii and a still higher incidence in those living in California than in Japanese living in Japan. These differences suggest some environmental factor present or absent in Japan which is
responsible for the relative immunity to ischaemic heart disease in native Japanese. Marmot suggests that this may be because in Japan management and workers share responsibility, whereas in the USA the chairman or managers bear the stresses and strains and are more susceptible, particularly if they have a type A personality. Stress is a dubious factor in the aetiology of disease but Marmot makes a rather compelling case. The higher incidence of coronary artery disease in Japanese Americans, though in part attributable to higher serum cholesterol, blood pressure and tobacco consumption, is also to some extent due to their adoption of the American way of life [20-23].

Table 3 and Figures 2 and 3 compare mortality caused by the major lethal diseases in England and Wales with that in Argentina, Finland, Poland, Portugal, Switzerland and the USA, from all of which apparently accurate information is available. The mortality from ischaemic heart disease, carcinoma of the bronchus and chronic obstructive airways disease is much higher in England and Wales than in any of these other countries, where tobacco consumption is equally high. We are driven to the suggestion that the inhabitants of England and Wales are more susceptible to the harmful effects of smoking, possibly due to a combination of atmospheric pollution and tobacco, or to the different types or preparation of the tobacco used. Neither Argentina, Finland, Poland, Portugal, Switzerland nor the USA are as densely populated as England and Wales but pollution in Japanese cities is great.

Another possible explanation is the variability in diagnosis and death certification between countries. Because Great Britain led the way in condemning smoking, it may be that there is over-diagnosis of ischaemic heart disease in England and Wales and there could be an element of truth in the feeling that the Royal College of Physicians encourages single issue fanaticism.

If we could solve the riddle of the gender differences, many of the unexplained features of longevity would doubtless be clarified, but at present environmental influences appear at least as or more important than genetic factors. However, from birth to the eighth decade more males than females die each year and in the first decade smoking, the prime adverse environmental influence, is not obviously operative against the male. There are therefore probably biological differences.
Fig. 2. Some major causes of death in England and Wales, Finland, Argentina and the United States.

Fig. 3. Some major causes of death in England and Wales, Poland, Portugal and Switzerland.
Paradoxically, throughout the world more males than females are born and stillbirths in England and Wales have shown a marked male preponderance. In 1984, there were 1,967 males in a total of 3,643 stillbirths giving a male:female ratio of 1:2.1 [24].

Previously, the view was that the conception rate favoured males, but recently external fertilisation of human eggs showed a 1:1 gender ratio, though the numbers (7 females and 6 males) were too small for any conclusions to be drawn [25]. However, in vitro fertilisation will exclude immunological and other intrauterine factors that might act differentially against one gender.

The sex of abortuses is a source of confusion. Males were thought to be the commoner because the Barr body was lacking but this can be the result of maceration, and when the chromosomes were grown the sex ratio veered in the female direction so more girls were spontaneously aborted. The problem is occasionally confounded by maternal rather than aborted tissue being karyotyped and this inevitably gives a female excess [26]. With such contradictory evidence, it is clear that much more information is required as to what exactly occurs at fertilisation.

As matters stand at present, it seems that early in pregnancy the male is more protected than the female but may be more at risk in the outside world. Here, environmental factors, including habits, may switch the ratios in favour of the female.

The Japanese difference may be solved by further studies of, for example, HLA phenotypes and the apolipoproteins—or of dietetic habits. However, in spite of the care which has apparently been taken to make the data comparable in both countries, it is well known that records are difficult to assess and death certificates may be highly erroneous. We have certainly found this in Great Britain where differences in autopsy rates, availability and quality of notes, and death certification are marked [27–33], particularly so in ischaemic heart disease [34]. In babies said to have died from rhesus haemolytic disease we found that the death certification by the house officer or the coding by the Office of Population Censuses and Surveys were inaccurate in one-quarter of cases nine years ago, but, as a result of annual monitoring, accuracy has improved markedly. Increasing the accuracy and comparability of records may prove more rewarding than other more complex and expensive approaches. With more reliable data we should be on firmer ground when discussing differences between countries as regards causes of death.

Acknowledgements
We are grateful to an anonymous donor for a grant to support the research on longevity which we are carrying out with the Royal Holloway and Bedford New College.

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Journal of the Royal College of Physicians of London Vol. 21 No. 2 April 1987 139