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# On the Far Eastern pattern of mortality

**Zhongwei Zhao**
The Australian National University and University of Cambridge

*Since the early 1980s, it has been accepted widely that there is a Far Eastern pattern of mortality, a pattern characterized by excessively high death rates among older men relative to death rates among younger men and among women. It has been regarded as a unique regional mortality pattern, applying primarily to Far Eastern populations. A re-examination of the mortality data of some Far Eastern populations reveals that changes in both age patterns of and sex differentials in mortality have been widely observed. Further, mortality patterns similar to the so-called Far Eastern mortality model have been found in many other populations.*

**Keywords:** model life tables; Far Eastern mortality pattern; age pattern of mortality; sex differentials in mortality; East Asia

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The existence of a Far Eastern pattern of mortality has been accepted widely since the early 1980s (Goldman 1980; United Nations 1982a, 1983; Gragnolati et al. 1999), but the assumption that it is a unique regional pattern has not been substantiated by adequate research and there is evidence to suggest that the assumption is invalid. In this paper, the issue is addressed by examining the major characteristics of the mortality of Far Eastern and other populations.

## The Far Eastern pattern of mortality

The claim that there is a Far Eastern pattern of mortality was made two decades ago. In a paper published in 1980, Goldman suggested that a particular mortality pattern had been found in several Far Eastern populations during the twentieth century. According to her, 'mortality statistics from Korea, Taiwan, Hong Kong, and Singapore suggest a Far Eastern pattern of mortality characterised by excessively high death rates among older men relative to death rates among younger men and among women. This pattern appears to occur nowhere else, at least among countries with reliable mortality statistics and is characterised by highest sex differentials in mortality at older ages to be found anywhere in the world' (Goldman 1980, p. 5).

At about the same time, the Population Division of the Department of International Economic and Social Affairs of the United Nations (UN) evaluated a considerable volume of mortality data collected from a number of less developed countries and areas. They constructed life tables for these populations 'whenever the data appeared of high quality or reliable adjustments could be made' (United Nations 1982a, p. 2). From the 72 life tables (36 for males and 36 for females) produced for 22 populations, the UN identified four mortality 'pattern groups and a few tables which did not fit together well or easily into any other groups'. These patterns were named 'according to the geographical region which is predominant within each pattern group'. The UN referred to one of them as the Far Eastern mortality pattern (United Nations 1982a, p. 5).

For the mortality patterns of Hong Kong, the Republic of Korea, and Singapore, the UN's work duplicated what had been reported by Goldman. In addition, it suggested that a similar mortality pattern existed in Guyana and Trinidad and Tobago. In the two Caribbean populations, however, females also experienced relatively high mortality at adult and old ages and the sex differential in mortality was less observable in these age groups. On the basis of these findings, 'a modified version of Goldman's Far Eastern mortality pattern was included in the United Nations set of model life tables for developing countries', which 'is characterised by excessively high death rates at older ages, compared with younger ages, regardless of sex' (Gragnolati et al. 1999, p. 81).

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In the construction of the UN life tables, the Far Eastern mortality pattern for males was derived from nine empirical life tables including four compiled for two East Asian populations. The pattern for females was derived from only five life tables, none of which was compiled for East Asian populations (Heligman 1984).

The UN's research findings and their model life tables were published in 1982. The UN Far Eastern mortality model itself did not show a particularly large sex difference, but the publication devoted a chapter to sex differentials in mortality in which the high sex ratio of death at older ages observed in Hong Kong, Singapore, and South Korea was specially singled out. In an article published in the following year, the UN's Population Division further emphasized the large sex differential in mortality found in these areas and suggested that this was a region-specific pattern (United Nations 1982a, 1983). Since the publication of Goldman's paper and the UN studies, the Far Eastern mortality pattern has been accepted widely as a special mortality model. It has been discussed in demography textbooks, taught in demography classes, and used by demographers throughout the world.

In 1999, Gragnolati et al. published another article on the Far Eastern pattern of mortality and further emphasized their belief that this pattern existed largely in Hong Kong, Singapore, South Korea, and Taiwan 'at varying periods between 1950 and 1980' and had 'progressively disappeared since that time'. They then made a major effort to examine the cause of the existence and the attenuation of the pattern. According to these authors, 'respiratory tuberculosis is the single most important underlying cause' of the excessive mortality of men at older ages, while liver diseases and cardiovascular diseases might have also contributed to the mortality differentials. 'It seems likely that public health and biomedical improvements (particularly those related to the reduction in mortality from tuberculosis) played a critical role in the attenuation of the Far Eastern mortality pattern' (Gragnolati et al. 1999, p. 81).

According to these authors and the UN Population Division, the following can be said about the Far Eastern mortality pattern. Firstly, a very high sex ratio of mortality at older ages used to exist in Hong Kong, Singapore, South Korea, and Taiwan, and this has been regarded as a major characteristic of the Far Eastern mortality pattern by Goldman and her collaborators. The same view has been taken in the UN publications, although the UN Far Eastern model life tables do not show pronounced sex differentials in mortality. Secondly, the Far Eastern mortality pattern is characterized by excessive older-age death rates relative to younger-age death rates. The discussion of Goldman and her colleagues concentrates mainly on such differences among males, whereas the UN's mortality models show a similar age pattern for males and females. Thirdly, while two Caribbean countries were included in the population groups that were alleged to have exhibited the Far Eastern mortality pattern in the UN publications, this mortality model is largely regarded as region-specific, unique, and having never been found in other countries with reliable mortality statistics. Finally, this mortality pattern was particularly evident in some East Asian populations between 1950 and 1980, and has gradually disappeared since.

The studies mentioned above played a noticeable role in advancing mortality research in East Asia. This was especially the case during the 1980s when mortality data were not readily available for many populations and when investigations of mortality in East Asia were rather limited. The studies of Goldman and colleagues and the UN produced some important observations on mortality patterns in a few East Asian populations and on changes in these patterns during the second half of the twentieth century. Nevertheless, the foregoing discussion suggests a number of questions. For example, the Far Eastern mortality pattern has been widely regarded as a unique regional mortality model, but is it in fact region-specific? If yes, has it ever existed in the two major populations of East Asia, mainland China and Japan? If the principal characteristics of this mortality pattern have been observable for only a few decades in some Eastern and South-eastern Asian populations, could they also have existed in some other populations for a brief period? More generally, should mortality schedules or characteristics that have been identified in a very short period (but may have been prevalent geographically) be used to construct a set of model life tables with a name that has a strong regional flavour? These questions are examined in this paper by means of analyses of mortality data collected from a number of East Asian populations and from other parts of the world. The results challenge some long-established conclusions.

## Data sources and method

The data used in this study are primarily age-specific mortality rates observed in Hong Kong, Japan, Korea (all Korea before 1945 and the Republic of Korea thereafter), mainland China, Singapore, and Taiwan, together with rates observed in many other populations. These data have been obtained largely from the following sources: *Causes of Death: Life Tables for National Populations* (Preston et al. 1972), *Levels and Trends of Mortality since 1950* (United Nations 1982b), and *Demographic Yearbook, Historical Supplement 1948–1997* (United Nations 2000). In addition, mortality data reported by various countries and reported in other UN publications and in scholarly works have been consulted. Although it is not possible in this paper to give a comprehensive assessment of the completeness and reliability of these data, they are believed to be of generally good quality and have satisfied the scrutiny of the UN Population Division, government statistical offices, and many demographers.

In this paper, age patterns of mortality and sex differentials in mortality are examined mainly by graphical comparison of mortality ratios and comparisons of the index of similarity. Since the graphical method is easy to understand and computing the index of similarity is a standard demographic technique (United Nations 1988), details are not given here, although the methods will be explained briefly in the course of discussion.

## Age patterns of mortality

According to Goldman and her collaborators, the Far Eastern mortality model has a very distinctive age pattern—older men experience excessively high death rates relative to those observed among younger men. The UN publications not only emphasized this feature, but also generalized the Far Eastern pattern to females. There are some discrepancies, therefore, between Goldman and her colleagues and the UN in their views on the Far Eastern mortality model for females. Partly for this reason, the following discussion will concentrate on age patterns of mortality observed among males.

In contrast to the Coale–Demeny West model life tables, a higher mortality of older men relative to that of younger men was indeed recorded in the populations studied by Goldman and her colleagues and the UN in some years. But it is not a distinctive pattern that existed exclusively in these populations. Mortality patterns with the same feature have been observed in some other countries, as is evident in Figures 1 and 2.

In the two figures, age-specific mortality ratios for a number of male populations are presented graphically. In computing these ratios, the $_nq_x$ of Coale–Demeny West model life tables (males) is used as the standard. The mortality ratios are calculated using $_nq_x/_nq_x^s$, where $_nq_x$ is the probability of dying of the studied population between ages $x$ and $x + n$, and $_nq_x^s$ is the probability of dying in the same age group in the standard population. The probability of dying from birth to age 4 inclusive is used in calculating the mortality ratio for the first age group. The life expectancies at birth implied by the two standard mortality schedules are 66 and 68 years, respectively. For

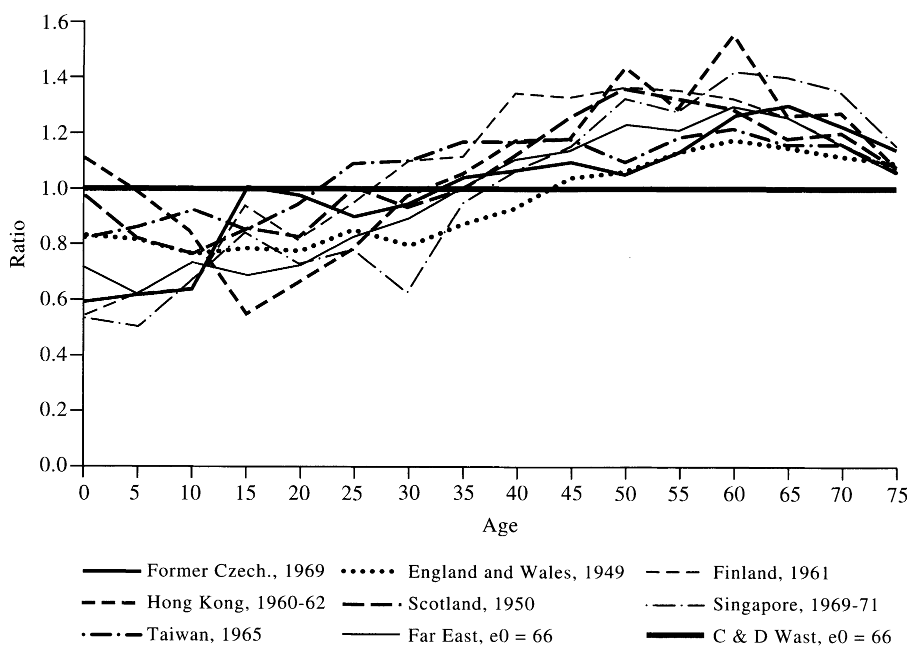


**Figure 1** Age-specific mortality ratios in selected populations
*Sources*: Ministry of Interior of Taiwan (1974), United Nations (1982a, 2000), and Coale and Demeny (1983)

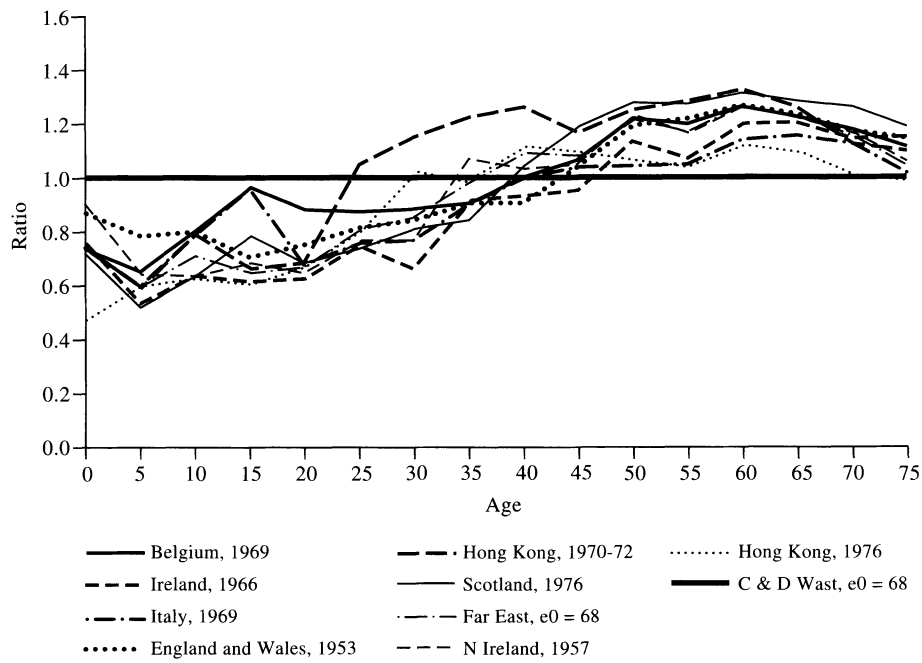


**Figure 2** Age-specific mortality ratios in selected populations
*Sources*: United Nations (1982a, 2000) and Coale and Demeny (1983)

comparison, mortality ratios are also computed for the $_nq_x$ of the Far Eastern mortality model, which has the same life expectancy as that of the selected life tables of the West model. The dark horizontal line represents the standard mortality schedule.

Several observations can be made from these two figures. The mortality data of Hong Kong and Singapore were used in the construction of the UN Far Eastern mortality model. Although data collected from Taiwan were not used by the UN, they have been cited frequently in support of the claim that this mortality pattern exists. Mortality patterns in the three populations are, by and large, similar to that of the UN Far Eastern mortality model. Compared with that model, the mortality ratio for Taiwan is slightly higher at younger ages and lower at older ages. The mortality recorded in Hong Kong in the period 1970–72 among those aged between 25 and 44 is noticeably higher than those in the other populations. It should be noted that life expectancies at birth are not exactly the same in the selected populations. In some cases the discrepancy between the mortality ratio of a real population and that of the Far Eastern mortality model is caused not only by the difference in their age patterns of mortality, but also by the difference in their mortality levels. If a stricter control is imposed on the level of overall mortality, some of these discrepancies become smaller.

Mortality ratios computed for a number of Western countries are also plotted in the two figures. They are very similar to those calculated for the Asian populations in the year of observation and display the major feature of the Far Eastern mortality model—mortality is lower at younger ages relative to older ages than in the Coale–Demeny West model life table. All these populations are widely believed to have followed other mortality models. The historical mortality data for these populations were used by Coale and Demeny in the construction of their regional model life tables, especially those labelled as West. But, when compared with the two listed model mortality schedules, their mortality patterns more closely resemble that of the Far Eastern mortality model. In some cases, they are even closer to it than the three Asian populations.

That mortality patterns in some Western countries conform to the Far Eastern mortality model is surprising, but this could arise from random variations caused by selecting data from a relatively short time period. To assess the reliability of the reported finding, mortality patterns in some Western populations over a period longer than a single year were examined. Figure 3 shows mortality ratios of some Western male populations calculated for a period of 5 years. According to these results, age schedules of mortality observed in Australia between 1960 and 1964, Belgium between 1965 and 1969, England and Wales between 1950 and 1954, Northern Ireland between 1955 and 1959, and Scotland between 1955 and 1959 all closely conformed to the UN Far

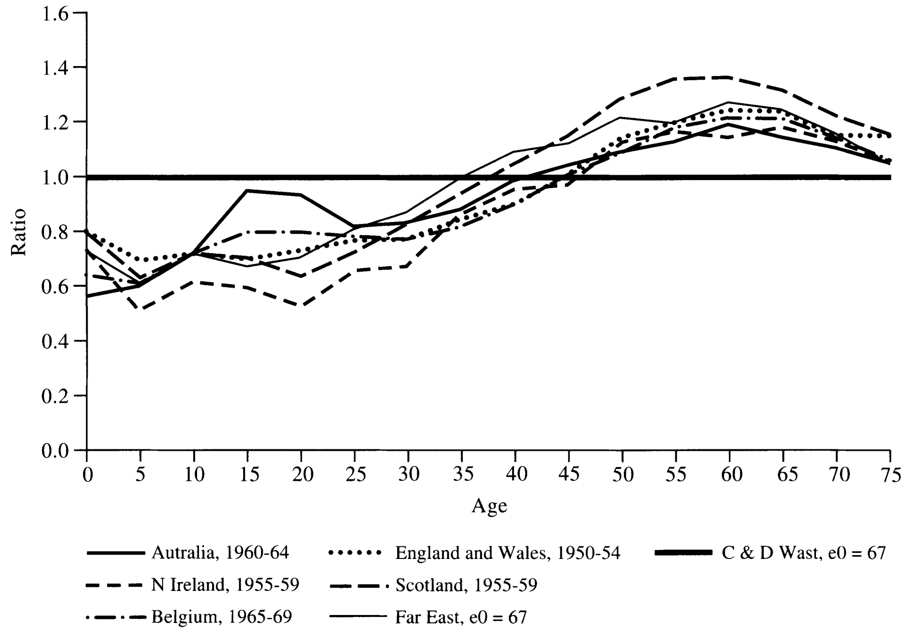


**Figure 3** Age-specific mortality ratios in selected populations
*Sources*: United Nations (1982a, b) and Coale and Demeny (1983)

Eastern mortality pattern and differed considerably from that of the Coale–Demeny West mortality model, further confirming the finding that mortality patterns similar to the Far Eastern mortality model have existed in many Western countries. In fact, this conclusion is true not only for these populations during the years mentioned above, but for an even longer period—a point that will be further discussed later.

Are these results and conclusions dependent on the method used, or would alternative methods lead to different outcomes and conclusions? To investigate this possibility, a number of methods have been applied. The results were generally consistent with those reported above.

Computing and comparing the index of similarity is among the effective ways of studying age patterns of mortality. This index can be calculated as follows. By comparing an age-specific mortality rate of a real population with the rates obtained from all life tables of a given mortality model, the one that is closest to the observed mortality rate can be chosen. Then a life expectancy at birth can be taken from the model life table from which the age-specific mortality rate was selected. A series of such life expectancies, each corresponding to a mortality rate of a particular age group, can be obtained from the entire family of a given mortality model. If the mortality pattern of the population studied is similar to that of the mortality model, these life expectancies will be close to one another, but not otherwise. After these life expectancies have been selected, the following formula can be used to compute the index of similarity, which indicates the goodness of fit between the given mortality model and the mortality pattern of the population studied:

$$I = \frac{\sum_{a}^{b} \left| {}_{n}E_{x} - M \right|}{N}.$$

In the formula, $a$ and $b$ refer to the lower and upper age groups being considered; ${}_{n}E_{x}$ is the life expectancy at birth obtained from a model life table with the mortality rate which most closely matches that of the population studied in age group $x$ to $x + n$; $M$ is the median of all selected life expectancies ${}_{n}E_{x}$; $N$ is the total number of age groups included in the comparison. The index $I$ measures the average absolute deviation of the selected life expectancies from the median. A smaller index figure suggests a better fit than a larger figure between a given mortality model and the mortality schedule of the population studied, and a value of zero indicates a perfect fit. The above procedure can be repeated for each of the UN and Coale–Demeny mortality models, resulting in nine such indices, with each derived from a particular comparison. Examining these indices helps to determine which mortality model fits the empirical mortality pattern best, or to which mortality model the mortality pattern of the population studied conforms most closely.

The result of such comparisons could be distorted under extreme circumstances and needs to be interpreted with caution. For example, a very large deviation between a selected life expectancy and the median may be recorded in one or a few age groups and cause a disproportionate influence. Also, when all nine indices have a relatively large value but the difference between them is relatively small, this shows that the observed mortality pattern differs considerably from all mortality models. In these circumstances, it is less meaningful to claim that the mortality pattern of the population conforms more closely to any particular model. In general, however, these indices can effectively reveal the difference among nine sets of results generated by matching the mortality pattern of the studied population with that of various mortality models.

Table 1 shows indices of similarity for a number of male populations. The nine indices computed for a selected population are presented in a row, with each falling under the abbreviation of the name of a mortality model against which the mortality schedule of the population was compared. For example, the index of similarity derived from comparing Hong Kong's 1960–62 mortality pattern with the Far Eastern mortality model is 1.6. Mortality patterns of all these populations except that of South Korea are displayed graphically in Figures 1 and 2. The same graph was not presented for South Korea because its 1971–75 mortality was relatively high and is less comparable to those recorded in other selected populations.

We start with indices computed for the populations of Hong Kong, Singapore, South Korea, and Taiwan. As expected, the indices calculated by matching their age-specific mortality rates with those of the Far Eastern mortality pattern are all considerably lower than those calculated by matching the rates with other mortality models, suggesting that mortality patterns in the four populations closely resemble the Far Eastern mortality model in the year of observation. This is not a surprise because the latter has been derived largely from the mortality data of these populations. What was not expected, however, was that indices computed for selected Western countries, by matching their mortality experiences with the Far Eastern mortality model, would also be very low. As in the four Asian populations, mortality patterns in these countries all closely conformed to the Far Eastern mortality model in the year when the observation was made.

Table 2 presents indices of the same type computed for a number of Western populations for a longer time. Although the period of observation has been extended to a quarter of a century and the age-specific mortality rate has been calculated for each of the 5-year periods, the results are very consistent with

**Table 1** Indices of similarity between selected populations and various mortality models

| | | The United Nations model life tables | | | | | Coale–Demeny model life tables | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Population | Year | LA | CH | SA | FE | GE | West | North | East | South |
| Hong Kong | 1960–62 | 7.9 | 5.0 | 5.0 | 1.6 | 4.1 | 5.0 | 9.2 | 5.1 | 6.8 |
| Hong Kong | 1970–72 | 6.9 | 3.4 | 4.5 | 0.7 | 3.6 | 3.6 | 8.0 | 3.2 | 5.8 |
| Hong Kong | 1976 | 5.3 | 2.4 | 3.4 | 1.2 | 2.5 | 2.0 | 6.3 | 2.0 | 4.2 |
| Singapore | 1969–71 | 9.8 | 5.9 | 6.8 | 1.7 | 5.8 | 6.4 | 10.3 | 6.3 | 8.3 |
| South Korea | 1971–75 | 11.5 | 7.5 | 8.1 | 2.3 | 6.7 | 7.6 | 11.0 | 8.3 | 9.4 |
| Taiwan | 1965 | 5.6 | 3.1 | 3.8 | 1.7 | 2.3 | 2.8 | 7.1 | 2.6 | 4.6 |
| Belgium | 1969 | 6.9 | 4.0 | 4.7 | 0.8 | 3.7 | 3.3 | 7.6 | 2.9 | 5.5 |
| England & Wales | 1949 | 6.1 | 3.4 | 3.9 | 1.1 | 2.8 | 2.7 | 7.2 | 2.3 | 4.8 |
| England & Wales | 1953 | 6.7 | 4.1 | 4.5 | 0.9 | 3.4 | 3.3 | 7.8 | 3.0 | 5.4 |
| Former Czechoslovakia | 1969 | 7.5 | 4.4 | 5.5 | 1.4 | 4.1 | 4.1 | 8.2 | 3.7 | 6.0 |
| Finland | 1961 | 8.1 | 4.3 | 5.1 | 1.2 | 4.4 | 4.8 | 9.2 | 4.7 | 7.0 |
| Ireland | 1966 | 6.8 | 3.8 | 4.5 | 0.8 | 3.6 | 3.4 | 7.7 | 3.0 | 5.5 |
| Italy | 1969 | 5.4 | 3.0 | 3.2 | 1.0 | 2.5 | 1.9 | 6.5 | 1.7 | 4.2 |
| Northern Ireland | 1957 | 6.6 | 3.5 | 4.1 | 0.6 | 3.4 | 3.2 | 7.7 | 3.0 | 5.5 |
| Scotland | 1950 | 7.0 | 3.5 | 4.3 | 0.8 | 3.4 | 3.8 | 8.4 | 3.7 | 6.0 |
| Scotland | 1976 | 8.8 | 5.3 | 6.0 | 1.6 | 5.1 | 5.2 | 9.5 | 4.9 | 7.3 |

*Notes*: LA = Latin American pattern; CH = Chilean pattern; SA = South Asian pattern; FE = Far Eastern pattern; GE = General pattern.
*Sources*: Mirzaee (1979) and United Nations (1982a, 2000).

**Table 2** Indices of similarity between selected populations and various mortality models

| | | The United Nations model life tables | | | | | Coale–Demeny model life tables | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Population | Year | LA | CH | SA | FE | GE | West | North | East | South |
| Australia | 1950–54 | 6.0 | 3.6 | 4.2 | 1.5 | 3.0 | 2.4 | 6.6 | 1.9 | 4.7 |
| | 1955–59 | 6.0 | 3.5 | 4.3 | 1.2 | 3.1 | 2.4 | 6.5 | 1.8 | 4.7 |
| | 1960–64 | 6.2 | 3.5 | 4.2 | 1.0 | 3.2 | 2.6 | 6.9 | 2.1 | 4.9 |
| | 1965–69 | 6.9 | 4.1 | 4.8 | 1.0 | 3.8 | 3.3 | 7.5 | 2.8 | 5.5 |
| | 1970–74 | 7.0 | 4.3 | 5.1 | 1.3 | 4.0 | 3.3 | 7.4 | 2.7 | 5.6 |
| Belgium | 1950–54 | 5.1 | 2.2 | 3.2 | 1.3 | 2.0 | 2.1 | 6.8 | 1.6 | 4.1 |
| | 1955–59 | 5.1 | 2.5 | 3.1 | 1.2 | 2.2 | 1.9 | 6.6 | 1.4 | 4.1 |
| | 1960–64 | 5.8 | 3.1 | 3.7 | 1.0 | 2.9 | 2.3 | 6.9 | 1.9 | 4.7 |
| | 1965–69 | 6.5 | 3.7 | 4.3 | 0.8 | 3.4 | 3.0 | 7.4 | 2.5 | 5.2 |
| | 1970–74 | 6.5 | 3.8 | 4.5 | 1.0 | 3.5 | 2.8 | 7.1 | 2.3 | 5.1 |
| England & Wales | 1950–54 | 6.9 | 4.1 | 4.6 | 0.9 | 3.6 | 3.5 | 8.0 | 3.1 | 5.6 |
| | 1955–59 | 7.2 | 4.4 | 5.0 | 1.1 | 4.0 | 3.7 | 8.1 | 3.3 | 5.8 |
| | 1960–64 | 7.3 | 4.5 | 5.1 | 1.2 | 4.1 | 3.7 | 8.0 | 3.3 | 5.9 |
| | 1965–69 | 7.4 | 4.6 | 5.1 | 1.2 | 4.2 | 3.7 | 8.0 | 3.2 | 5.9 |
| | 1970–74 | 7.2 | 4.3 | 4.9 | 1.2 | 4.0 | 3.4 | 7.7 | 2.9 | 5.7 |
| Finland | 1950–54 | 7.8 | 3.7 | 5.1 | 1.0 | 3.8 | 4.7 | 9.0 | 4.6 | 6.7 |
| | 1955–59 | 8.1 | 3.9 | 5.0 | 0.9 | 4.2 | 4.9 | 9.2 | 4.7 | 6.9 |
| | 1960–64 | 8.7 | 4.6 | 5.6 | 1.2 | 4.8 | 5.4 | 9.8 | 5.3 | 7.5 |
| | 1965–69 | 9.5 | 5.3 | 6.5 | 1.6 | 5.6 | 6.2 | 10.6 | 6.2 | 8.3 |
| | 1970–74 | 7.8 | 4.3 | 5.4 | 1.7 | 4.6 | 5.2 | 9.2 | 5.3 | 7.7 |
| Northern Ireland | 1950–54 | 5.8 | 2.9 | 3.4 | 1.0 | 2.5 | 2.6 | 7.2 | 2.1 | 4.7 |
| | 1955–59 | 6.8 | 3.6 | 4.2 | 0.7 | 3.5 | 3.4 | 7.9 | 3.0 | 5.6 |
| | 1960–64 | 6.7 | 3.9 | 4.2 | 0.8 | 3.5 | 3.3 | 7.9 | 2.9 | 5.5 |
| | 1965–69 | 6.8 | 3.8 | 4.4 | 0.7 | 3.6 | 3.3 | 7.8 | 3.0 | 5.5 |
| | 1970–74 | 7.3 | 4.4 | 5.2 | 1.2 | 4.1 | 3.6 | 7.7 | 3.1 | 5.9 |
| Scotland | 1950–54 | 7.7 | 4.4 | 5.0 | 0.9 | 4.0 | 4.4 | 8.8 | 4.2 | 6.5 |
| | 1955–59 | 8.4 | 4.8 | 5.6 | 1.0 | 4.7 | 5.1 | 9.5 | 4.9 | 7.1 |
| | 1960–64 | 8.9 | 5.2 | 6.1 | 1.3 | 5.1 | 5.5 | 9.8 | 5.4 | 7.6 |
| | 1965–69 | 8.5 | 4.9 | 5.6 | 1.2 | 4.8 | 5.0 | 9.3 | 4.7 | 7.1 |
| | 1970–74 | 8.7 | 5.2 | 6.0 | 1.4 | 5.0 | 5.2 | 9.5 | 4.9 | 7.2 |

*Notes*: LA = Latin American pattern; CH = Chilean pattern; SA = South Asian pattern; FE = Far Eastern pattern; GE = General pattern.
*Source*: United Nations (1982b).

what we have learned above. Without a single exception, all 30 observations made in Australia, Belgium, England and Wales, Finland, Northern Ireland, and Scotland between 1950 and 1974 suggest that mortality patterns in these populations were very close to the UN Far Eastern mortality model. In contrast to the claim that it 'appears to occur nowhere else, at least among countries with reliable mortality statistics' (Goldman 1980, p. 5), in fact this mortality pattern has existed in many parts of the world. If the mortality patterns of these Western populations (in the selected years) cannot be described as conforming to the Far Eastern mortality model, their mortality schedules must be given a new name, because they are far less similar to other existing mortality models.

## Sex differentials in mortality

In addition to its 'particular' age pattern, Goldman and her collaborators suggested that the Far Eastern mortality model is also characterized by 'large sex differences in death rates' at older ages, which occur 'only in Far Eastern populations' (Goldman 1980, p. 17). This view has been further promoted by UN publications (1982a, 1983). While it might be possible to examine this claim by comparing sex ratios of death observed in real populations with those of the Far Eastern mortality model, this comparison has not been undertaken for the following reasons.

In an observed population, sex differentials in mortality can be easily measured by comparing mortality recorded for males and females in a given period. But there is no such link (existing at the same time and therefore comparable) between model life tables for males and females. One might select, for males and females, model life tables with the same life expectancy at birth and examine sex ratio of death in different age groups. Even if this were a meaningful operation, selecting model life tables against which the observed mortality differentials could be compared would be difficult. Furthermore, the UN publication suggested that the high sex ratio of deaths recorded in Hong Kong, Singapore, and South Korea was a region-specific feature, but female mortality schedules that were somewhat different from those observed in these populations were used to construct the Far Eastern mortality model for females. If we select, for males and females, model life tables with the same life expectancy at birth and compute sex ratios of death using ${}_nM_x^{\mathrm{m}}/{}_nM_x^{\mathrm{f}}$ (where ${}_nM_x^{\mathrm{m}}$ and ${}_nM_x^{\mathrm{f}}$ represent mortality rates of males and females in the age group $x$ to $x + n$, respectively), then the pattern observed in the Far Eastern mortality model is fairly similar to that derived from the Coale–Demeny West model schedule. Finally, the sex ratio of mortality computed (using the above procedure) for the Far Eastern mortality model changes noticeably as the level of life expectancy increases. For example, the sex ratio of death for those under age 1 is 1.15 when life expectancy at birth is 35 years for both males and females. But it decreases to 0.47 when life expectancy at birth increases to 75 years. Similarly, the sex ratio of death for those aged between 40 and 44 is 1.14 when the life expectancy is 35, but falls to 0.73 when the life expectancy rises to 75. This changing pattern creates further uncertainties in using the Far Eastern mortality model to compare the sex ratio of death.

As a result of these considerations, sex differentials in mortality of the Far Eastern mortality pattern are examined only by comparing sex ratios of death recorded in populations generally assumed to have followed this model with ratios in populations assumed not to have followed it. Figures 4 and 5 compare sex ratios of age-specific mortality rates (computed using ${}_nM_x^{\mathrm{m}}/{}_nM_x^{\mathrm{f}}$) recorded in some Asian populations with those observed in other countries. A ratio with a value greater than one indicates that the mortality of males is higher than the mortality of females and vice versa. These and the figures discussed later include mortality data for people aged between 5 and 74 only. This is largely because, in some of the populations, mortality rates of those under age 1 and of those between 1 and 4 are not listed separately, and because, in some cases, the recorded infant mortality rates are unreliable. Similar problems exist with the mortality rates for very old ages.

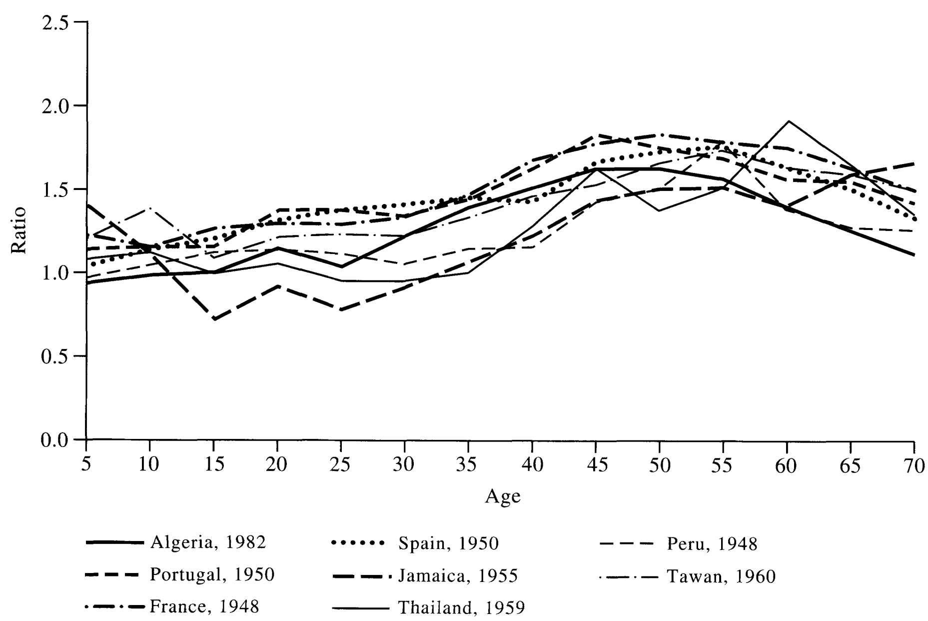


**Figure 4** Sex ratio of mortality by age in selected populations
*Sources*: Preston et al. (1972), Ministry of Interior of Taiwan (1974), and United Nations (2000)

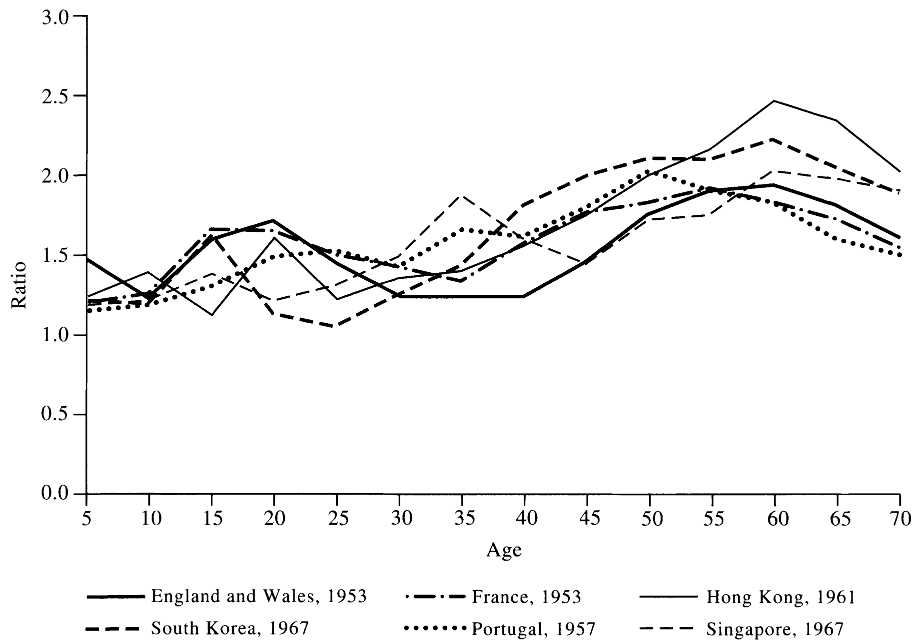


**Figure 5** Sex ratio of mortality by age in selected populations
*Source*: United Nations (2000)

The Asian populations included in this comparison are those of Hong Kong of 1961, Singapore of 1967, South Korea of 1967, and Taiwan of 1960. Given that the 1960s was a period when the so-called Far Eastern mortality pattern was prominent in these populations, plots of their mortality differentials by sex might be expected to be unusual and easily distinguishable from those of other populations. This, however, is not the case. Sex ratios of death recorded in Algeria, France, Jamaica, Peru, Portugal, Spain, and Thailand in the selected year are plotted in Figure 4. The patterns of mortality by sex in these populations are similar to the pattern observed in Taiwan in 1960. In Figure 5, sex mortality differentials in England and Wales, France, and Portugal are graphically compared with those in Hong Kong, South Korea, and Singapore. Although sex ratios of death at older ages are slightly higher in Hong Kong and South Korea than in the other populations, the listed populations exhibited a similar pattern in their sex differentials in mortality in the year when the observation was made. These results suggest that the claim that sex differentials in mortality in the four East and South-east Asian populations have a distinctive character may be incorrect.

Just as age patterns of mortality are determined by the relative levels of mortality at various ages and the change in such relations, sex differentials in mortality are affected by the relative levels of, and changes in, the mortality of males and females. Because mortality changes of the same magnitude may not take place simultaneously among males and females or at all ages, variations and changes in age and sex patterns of mortality are common. This can be further illustrated by changes in sex differentials in mortality in a number of populations over a longer period.

Figures 6–9 show sex ratios of age-specific mortality rates in Australia, England and Wales, France, and Portugal. None of these populations has displayed a single pattern in their sex differentials in mortality over the period under consideration. Indeed, the pattern has gone through considerable changes in all four countries. In the early period, sex ratios of mortality in younger age groups were fairly close to or slightly higher than one. The chance of survival was fairly close for males and females under age 30. In contrast, mortality among middle-aged and old men was markedly higher than that experienced by women. During the period that followed, there was a general increase in the difference in mortality between males and females. The large sex differential at older ages relative to that at younger ages became more noticeable. Examples include Australia in 1933, England and Wales in 1940 and 1950, France in 1936 and 1948, and Portugal in 1940. Since these dates, however, the large mortality difference observed at older ages has been replaced gradually by an even higher sex ratio of death for children and young adults, as shown by the graphs for the later period.

Figures 10–13 show similar graphs for Hong Kong, Singapore, South Korea, and Taiwan. Mortality data from South Korea, like those from Japan and mainland China, which will be discussed later, indicate the occurrence of changes in sex differentials

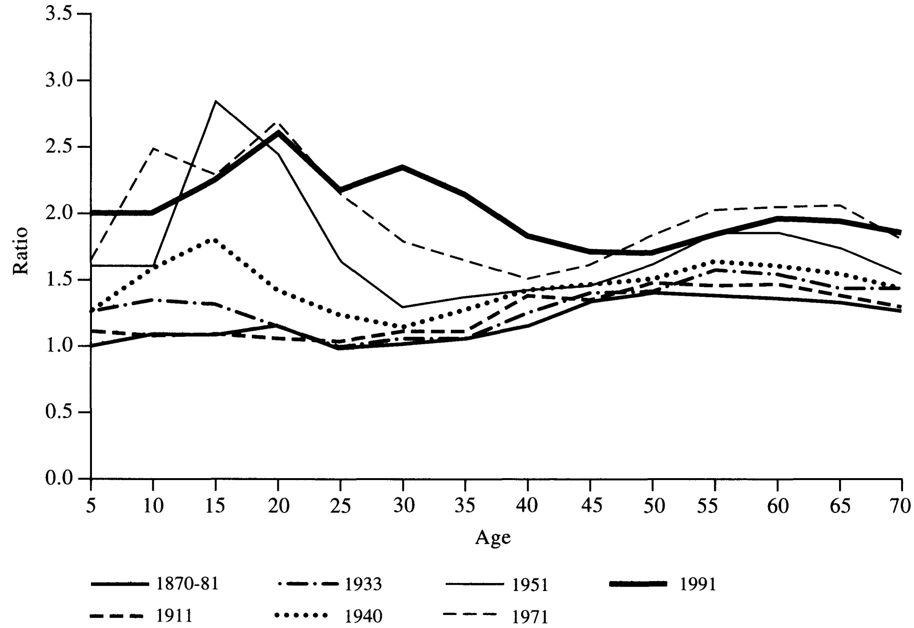


**Figure 6** Sex ratio of mortality by age in Australia 1870–1991
*Sources*: Preston et al. (1972), Vamplew (1987), and United Nations (2000)

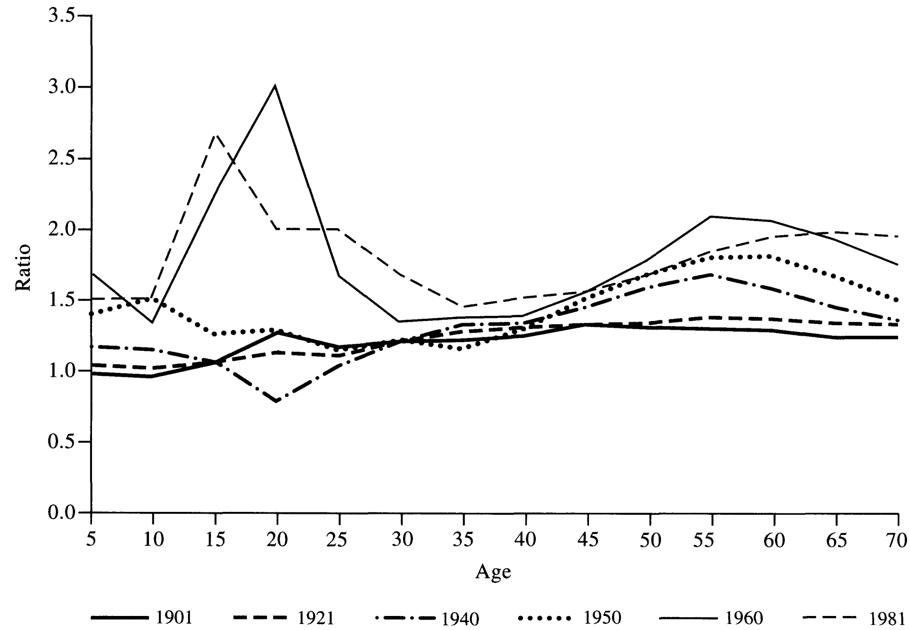


**Figure 7** Sex ratio of mortality by age in England and Wales 1901–81
*Sources*: Preston et al. (1972) and United Nations (2000)

in mortality broadly similar to those observed in the four Western populations. That is to say, in the early period, sex ratios of mortality in these three populations were also relatively low at younger ages but somewhat higher at older ages. Subsequently sex differentials in mortality at older ages became more noticeable, for example, in South Korea in 1948 and 1960, in Japan in the mid-1930s and later 1940s, and in mainland China in the early 1980s. In the period that followed, however, sex differentials in mortality among children or in the middle-aged population became more prominent. In Taiwan, the sex ratio of mortality at older ages was relatively high in 1910 and relatively low in 1950. Apart from that, changes in mortality patterns in Taiwan have, by and large, followed a similar track. In the cases of Hong Kong and Singapore, no conclusion can be drawn about sex differentials in mortality before 1950 owing to the

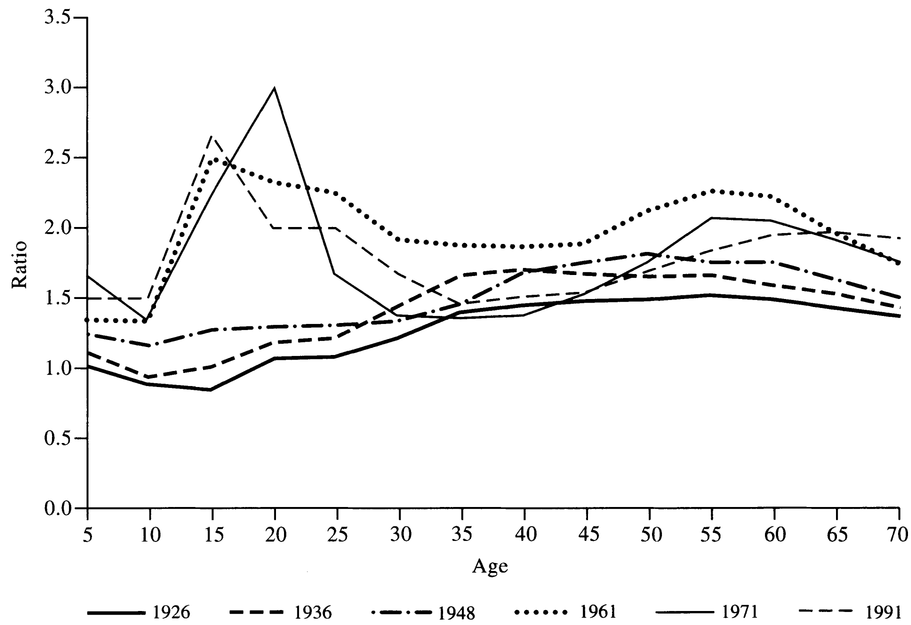


**Figure 8** Sex ratio of mortality by age in France 1926–91
*Sources*: Preston et al. (1972) and United Nations (2000)

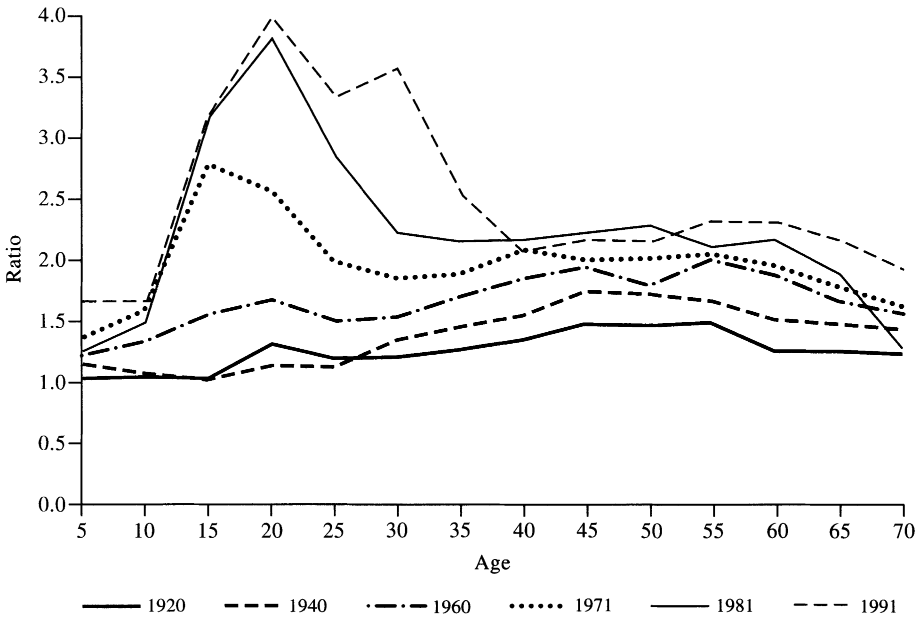


**Figure 9** Sex ratio of mortality by age in Portugal 1920–91
*Sources*: Preston et al. (1972) and United Nations (2000)

absence of detailed data. It is therefore less clear whether they were similar to those recorded in other populations in the early period. But, since reliable mortality data became available, changes in the mortality patterns in these populations seem to have been broadly similar to those observed in the second and third stages as described above.

While changes in sex differentials in mortality do not follow identical paths in all these populations, similar trends can be observed in some of them. The most obvious difference between these populations is not that each population or region has a distinctive pattern of sex differentials in mortality, but rather that they experienced similar patterns at different times.

Despite the fact that changes in sex differentials in mortality in some of these populations are broadly similar, it is not suggested here that such changes have a universal pattern. However, it is interesting to note that, while there are exceptions, the high sex ratios of death at older ages relative to the ratio at younger ages were recorded in most of the selected


**Figure 10** Sex ratio of mortality by age in Korea 1925–95
*Sources*: Kwon (1977) and United Nations (2000)

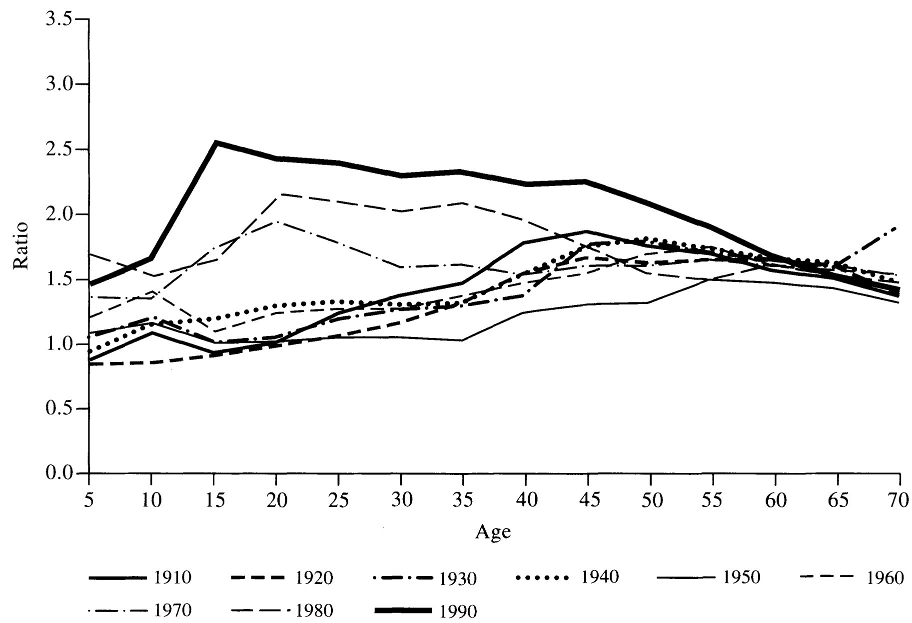


**Figure 11** Sex ratio of mortality by age in Taiwan 1910–90
*Sources*: Ministry of Interior of Taiwan (1974), Mirzaee (1979), and Directorate General of Budget, Accounting and Statistics of Taiwan (2000)

populations at a time when their life expectancies at birth were between 55 and 65 years. One might speculate that, at this stage of the demographic transition, mortality decline among older females tends to be faster than that among their male counterparts. Subsequently, a considerable gap between the mortality rates of males and females still exists in these age groups and becomes even larger in some populations, but it is not as pronounced as those observed among children and young adults. In the younger age groups, the fall of mortality among females becomes more dramatic than that among males, which is most likely to be related to the differences in their lifestyles and risk-prevention behaviour. If this is indeed the case, the sex differentials in mortality depicted by the so-called Far Eastern mortality pattern are not an indication of a particular regional mortality feature, but rather a feature that is to some extent related to change in mortality at a certain phase of its transition.

Admittedly, in comparison with those in other populations, the sex ratios of death at older ages

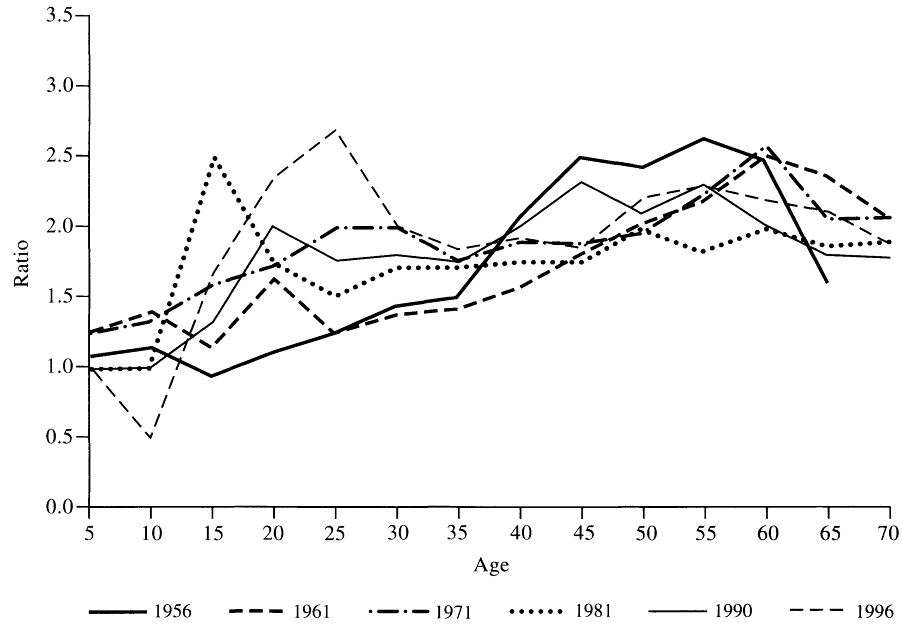


**Figure 12** Sex ratio of mortality by age in Hong Kong 1956–96
*Sources*: Benjamin (1961) and United Nations (2000)

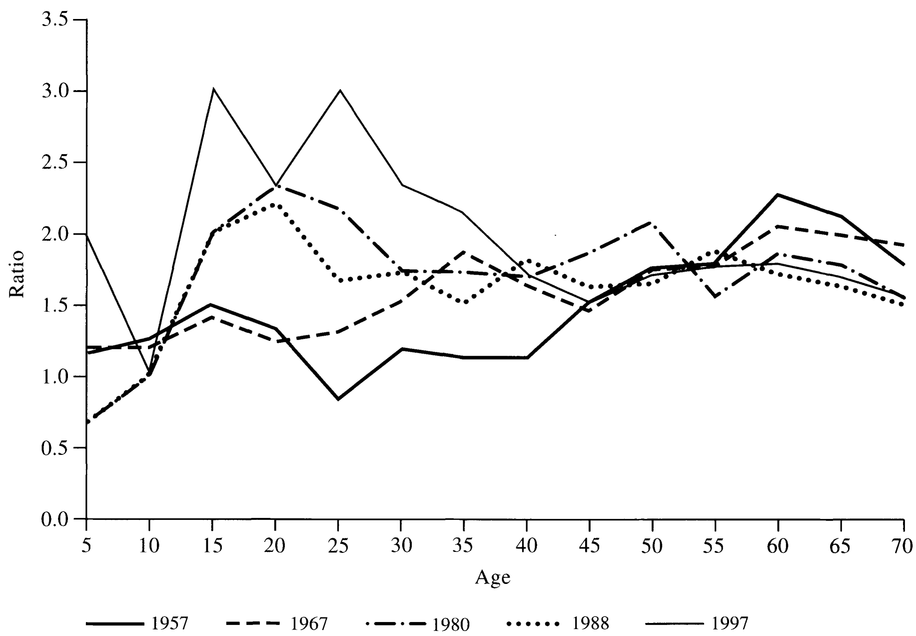


**Figure 13** Sex ratio of mortality by age in Singapore 1957–97
*Source*: United Nations (2000)

observed in Hong Kong and South Korea around the middle of the twentieth century were somewhat high. But whether this can be regarded as representing a unique regional mortality pattern is questionable, especially as similar mortality patterns have been observed in many other populations. In identifying regional mortality patterns and constructing model life tables, we are in general trying to find some characteristics that are relatively stable. In this respect, the Coale–Demeny model life tables have done better because they were derived from many more empirical life tables compiled over a much longer period when mortality changes were relatively slow. If demographic patterns like those found in these East Asian populations between 1950 and 1980 are to be regarded as a regional mortality pattern, one might argue that the high sex ratio of death observed among young adults in Portugal in the 1980s and early 1990s (which is higher than those recorded in other populations although showing a similar pattern) should also be accepted as a Portuguese mortality model. In summary, the UN and Goldman and her collaborators were correct in pointing out that a relatively high sex ratio in mortality at older ages existed in Hong Kong, Singapore, South Korea, and Taiwan around the mid-twentieth century. However, it appears to be incorrect to suggest that this represents a distinctive regional mortality pattern restricted primarily to East Asia.

## Mortality patterns in Japan and mainland China

Because this paper is about the Far Eastern mortality model, it would not be complete if mortality patterns in the two largest East Asian populations, those of Japan and mainland China, were not examined. While the following discussion is brief and based on limited information, it may shed some light on the issue.

Mortality in Japan was relatively high in historical populations. In the populations examined by Jannetta and Preston (1991) and Saito (1997), life expectancies at birth varied between 30 and 40 years before 1870. Some scholars have reported that life expectancies in other historical populations were higher than 40 years, but, judging from the fact that most of the available studies have not dealt effectively with the problem of under-registration of infant deaths, actual life expectancies in the populations studied were very likely to have been lower.

The overall mortality levels for males and females were fairly close in most of the populations examined to date. In some cases, the mortality of females was higher than that of males. In the populations studied by Jannetta and Preston (1991), Saito (1997), and Tsuya et al. (1999), the difference between the life expectancies of males and females was small. It was less than 3 years during the period before 1870. However, this does not mean that sex differentials in mortality did not exist. In comparison with males, women generally had a higher mortality when they were aged between 15 and 44 and a lower mortality at ages 45–64. These differences were similar to those observed in some Western countries in the past and smaller than those observed in Hong Kong, Singapore, South Korea, and Taiwan in the 1960s and 1970s. In other age groups, the pattern was less clear.

Because of the under-registration of those who died young, reliable information on infant mortality is difficult to find. But Jannetta and Preston's work revealed that infant mortality in Hida villages was high, around 300 per 1,000 before 1870. For the purposes of this paper, mortality patterns in other age groups have been examined by comparing age-specific mortality rates reported by Saito, Jannetta and Preston, and Tsuya et al. with mortality schedules of the Coale–Demeny regional model life tables and the UN model life tables. The results show that age patterns of mortality in these populations were closer to Coale–Demeny North, or in some cases South, model life tables than to other mortality models. Thus, according to the evidence summarized here, the so-called Far Eastern mortality pattern does not seem to have existed in pre-industrial Japan.

Detailed mortality data were collected in Japan throughout the twentieth century. They demonstrated that mortality patterns went through considerable changes. Sex differentials in mortality recorded in the mid-1930s and 1940s and age patterns of mortality observed in the mid-1960s were similar to those of the Far Eastern mortality pattern. But they were closer to other mortality models during the rest of the twentieth century.

In China, mortality was high before the mid-twentieth century. Life expectancy at birth was around 30 years in some historical populations, which is lower than that found in pre-industrial Japan. This conclusion is supported both by death rates computed from remaining genealogical records and life tables constructed from surviving population registers (Zhao 1997). The high mortality was observed not only among ordinary people, but also in the Qing imperial lineage. For example, according to Lee and his collaborators, the mortality experienced by royal personages born before the early eighteenth century was very close to that recorded in the peasant population surveyed in mainland China around 1930. At some ages, for females aged from 10 to 34 and for males aged from 30 to 54, higher mortality levels were observed in the Qing imperial lineage (Lee et al. 1993, 1994).

Sex differentials in mortality in historical China were broadly similar to those found in Japan in the past. In most of the populations investigated to date, mortality rates of females in comparison with those of males were higher at younger ages and lower at older ages. The male–female mortality crossover generally took place when people were in their late 30s or early 40s (the age was somewhat lower in Taiwan in the early twentieth century). In the population of Taiwan and particularly in the Qing imperial lineage, sex ratios of death at older ages (40–64) were markedly high (Mirzaee 1979; Goldman 1980; Lee et al. 1993). But in most of the other populations being studied, sex differentials in mortality were not so different from those observed in Australia, France, or Japan in the early twentieth century. There were also populations in which the pattern of sex differentials in mortality was considerably different from those reported above. For example, in the population of Beijing First Health Demonstration District, the sex ratio of mortality was close to one for those under age 10. But among those older than this, death rates among females were higher in all groups during the period between 1929 and 1933 (Campbell 2001). In the population studied by Chen in Yunnan in the 1940s, higher mortality among males was observed from birth to age 64 (Chen 1946).

Age patterns of mortality in historical Chinese populations show a mixed picture too. For example, from 1935 to the early 1970s, mortality rates of males recorded in Taiwan closely resembled the Far Eastern mortality pattern, which provides perhaps the strongest support to the UN Far Eastern mortality model. Campbell's study of mortality in mainland China also indicates that, in some historical populations, mortality schedules observed in certain age groups were closer to the Far Eastern mortality pattern than to other mortality models. It should be noted, however, that the indices of similarity computed by Campbell were largely based on the population aged 15–64 (Campbell 1997). Including more age groups or entire age ranges would have changed the conclusion at least in some cases. For example, during the early 1930s, mortality patterns observed among those aged 10 and above were closer to the Far Eastern mortality model in both the population of Beijing First Health Demonstration District and the population of Nanjing. But when those below this age were included, the indices of similarity suggest that mortality patterns in the two populations conformed to the UN South Asian model (The Statistical Division of the National Government (Taiwan) 1971; Campbell 1997).

While the above findings show that in some historical Chinese populations, mortality patterns, particularly of those between ages 15 and 64, were similar to those of the Far Eastern mortality model, patterns dissimilar from the model can also be found. In the population studied by Chen in Yunnan in the 1940s, the age pattern of the mortality of males more closely resembled that of the Coale–Demeny North model life tables. When mortality patterns observed in the Chinese peasant population around 1930 (either according to the data published by the Chinese government in 1936 or according to the life table constructed by Barclay and his colleagues) are compared with all UN and Coale–Demeny model life tables, they too are less similar to the Far Eastern mortality model (The Statistical Division of the National Government (Taiwan) 1971; Barclay et al. 1976).

The Chinese government has conducted a number of mortality surveys and censuses since the mid-twentieth century, and two observations can be drawn from their results. Firstly, there have been significant changes in the age pattern of mortality over the past 50 years. Noticeable changes of this kind have been revealed by other studies, for example, the study of the population of Beijing by Campbell (2001). Secondly, while age patterns of mortality and sex differentials in mortality similar to those of the Far Eastern mortality pattern were recorded during certain periods, mortality patterns in the population were closer to other mortality models most of the time.

In summary, evidence collected from Japan and mainland China further confirms the finding that changes in mortality patterns have been observed widely and that the characteristics of the Far Eastern mortality pattern have been recorded in many populations. But the evidence is not sufficient to confirm the existence of a set of unique regional mortality characteristics that can plausibly be called the Far Eastern mortality pattern.

## Concluding remarks

Detailed investigations into mortality patterns in East Asia and their changes were rather limited in the 1970s and early 1980s. Goldman and her colleagues and the Population Division of the UN have played an important part in advancing our knowledge on these issues with their examinations of morbidity and mortality patterns in this area and the recent transitions in these patterns. However, as demonstrated in this paper, their conclusions about the Far Eastern mortality pattern need amendment.

In contrast to the claim that the major characteristics of this mortality pattern are regional phenomena and that they have not been found elsewhere, in fact mortality patterns similar to those suggested by the Far Eastern mortality model have existed in other parts of the world. This is particularly true for the age schedule of the mortality model, which, compared with other UN or Coale–Demeny mortality models, is far closer to the mortality pattern found in many developed countries between 1950 and 1974. Another important conclusion drawn from this and some other studies is that considerable changes in both age patterns of and sex differentials in mortality have occurred in many countries. Just as the East Asian populations have never consistently followed the Far Eastern mortality schedule, scarcely any population exists with a mortality pattern that has continued to conform to a single mortality model (Zhao 2003).

Model life tables, especially the Coale–Demeny regional model life tables, are widely used in demographic research. The author acknowledges that a mortality model does not necessarily refer to all of or only the regions indicated by its name, and that this (particularly with regard to Coale–Demeny model life tables) has been generally accepted by demographers. However, it is important to make two points about this.

First, at the time of its construction, it was explicitly claimed that the Far Eastern mortality model represented a unique pattern found in only some East and South-east Asian populations. Moreover, the simplification of the discussion of the Far Eastern and other UN mortality models found in many demographic papers and textbooks helps to create and maintain a strong impression that these models are in fact region-specific, although the evidence provided in this paper shows that, at least for the Far Eastern mortality pattern, this is not so. Second, while specialists who work on mortality issues may have been aware of some of the problems addressed in this paper and are cautious in their application of these mortality models, other people, including some demographers, are not so familiar with these important particulars. In practice, misuse and mis-interpretation of these mortality models are frequent occurrences. Evidently there is a need to counteract some common misapprehensions on this subject.

Demographers have been interested in regional mortality patterns and their variations for a long time. It is a research area of considerable importance and is particularly significant in the investigation of mortality transitions. In the past, many populations lived in a state of relative isolation. They had diverse lifestyles and diets, engaged in different types of social and economic activities, and were exposed to particular natural environments and health hazards. Many factors that affected a population's health had a clear geographical boundary, which meant that regional mortality patterns with distinct characteristics were likely to become established. In these circumstances, region as a proxy for many factors that directly affected mortality levels and patterns could be used effectively in the study of mortality. During the last 100 years, however, the world has increasingly become a closely related international community owing to the integration of the world market and the improvement of transportation and communication. Many old regional barriers, physical and non-physical, have been broken down. The majority of the world population no longer lives in isolation. Increasingly, international efforts have been made to combat diseases and improve public health. As a result of these changes, identifying a regional mortality pattern has become more difficult and the use of region as a summary indicator in the study of mortality has become less effective than before.

In contrast to the situation one or two centuries ago, when demographic conditions were relatively stable in many populations, the twentieth century witnessed an unprecedented mortality decline. The life expectancy of the world's population rose from around 30 years in 1900 to 66 years at the end of the century. In many less developed countries, the fall in mortality took place mainly in the second half of the century, and was more dramatic than the earlier decline recorded in developed countries. Along with this rapid transition, mortality patterns have undergone considerable changes in many populations. In this situation, identifying the trend of the changes in mortality patterns and the causes underlying these changes is at least as important as identifying the mortality patterns that characterize different regions of the world.

## Notes

1 Zhongwei Zhao is at the Demography and Sociology Program, Research School of Social Sciences, the Australian National University (zxz300@coombs.anu.edu.au) and the Cambridge Group for the History of Population and Social Structure, University of Cambridge (zz101@cam.ac.uk).

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