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# A Medico-Climatological Study in the Seasonal Variation of Mortality in the United States of America (I)

— Features of Seasonal Variation of Mortality —

by

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## Abstract

In the United States of America, the seasonal fluctuation of the death index by age is found to be rather moderate for all the age groups, and little variation is seen particularly for infants. On the other hand, the death index curve rises for old age groups, though much less sharp than in the United Kingdom and Japan, in the cold season. Generally speaking, the moderate curve of the death index is ascribed to the wider use of the effective room heating system: that is, protected by the artificial weather thus brought about, the American people do not appear to be affected by the seasonal change so markedly as other nations.

It is worth mentioning however, that the death index curve behaves differently for the Whites and Nonwhites. Two peaks appear for the latter, one in summer and the other in winter, whereas only one summit appears in winter for the former. Based upon the extensive study of mortality statistics in Japan and other countries, this can be said to have resulted from the lower standard of living granted to the Nonwhites in the United States.

As the result of our study in the seasonal variation of mortality, particularly that by age group, in the United States, it has become clear that the death index curve in that country widely differs from that in England (including Wales) and Japan. This is a preliminary report, which will be followed by additional analyses.

## 1. Seasonal variation of death index curve by age

### *1) United States of America*

A study in the monthly death index* (the annual average at 100, the annual

* Death Index for the $i$-th month is defined as follows:

$$1200 \times \frac{\text{The death number for the } i\text{-th month in a year}}{\text{Total death number during a year}}$$

total at 1,200) in the five years from 1952 through 1956 reveals that the death index curve draws a nearly straight line, showing almost no seasonal variation for babies under 1 year old, that a small peak appears in summer with June as a center, showing moderate fluctuation, for infants of 1–14 years old and for young people from 15 to 24 years old, and that almost no seasonality can be witnessed for such age groups as 25–34, 35–44, and 45–54 years (see Fig. 1). The coefficient of seasonal variation* comes at not more than 0.035 for these groups as well as babies under 1 year old (see Table 1).

With the increase of age, however, the death index gradually curves up in winter, indicative of the rising seasonal fluctuation. Particularly conspicuous is the upcurve for the age group exceeding 85 years with the variation coefficient at 0.107. Thus, the "total death index," covering all of the age groups, shows a small peak in the cold months with the variation coefficient at 0.055, indicating moderate seasonal fluctuation on the whole.

It is of great interest that a marked difference is seen in the "total death index" curve between the Whites and the Nonwhites. A very low upcurve appears in winter for the Whites, but two peaks, if not steep, appear, one in winter and the other in summer, for the Nonwhites. The variation coefficient is 0.077 for the latter, compared with 0.056 for the former.

### *2) City of New York*

As for the City of New York, the annual death index from 1959 through 1963, though a slight difference is seen by age group, shows a similar trend as that for the whole of the United States (see Fig. 2). The curve is almost straight for babies under 1 year old and for infants from 1 to

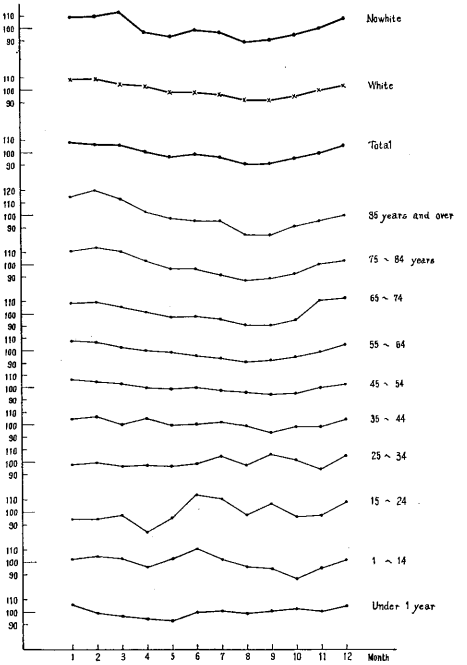


Fig. 1. Seasonal fluctuation of total death index by age United States of America (1952~1956).

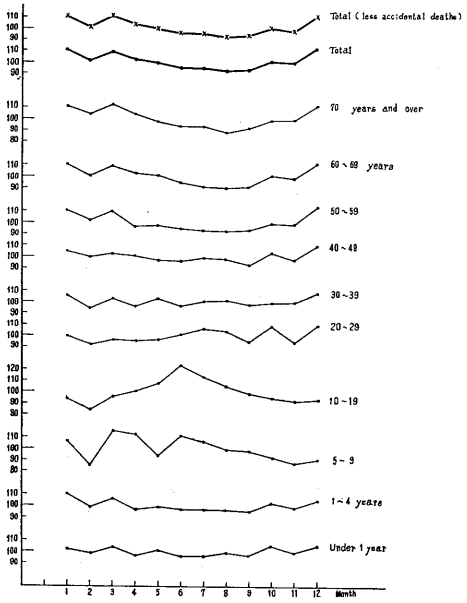


Fig. 2. Seasonal fluctuation of total death index by age New York City (1959~1963).

* Coefficient of seasonal variation is defined as follows:
$c.v.=\sigma/m$, $\sigma$=standard deviation, $m$=mean value.

Table 1. Coefficient of Variation of Mortality by Age, by Country.

| Age | Japan | England & Wales | New York City | Age | U.S.A. |
|---|---|---|---|---|---|
| under 1 year | 0.326 | 0.108 | 0.032 | under 1 year | 0.040 |
| 1～ 4 | | | 0.044 | 1～14 | 0.059 |
| 0～ 4 | 0.243 | | | | |
| 5～ 9 | 0.155 | 0.093 | 0.101 | | |
| 10～19 | 0.106 | 0.082 | 0.097 | 15～24 | 0.081 |
| 20～29 | 0.053 | 0.056 | 0.053 | 25～34 | 0.035 |
| 30～39 | 0.059 | 0.087 | 0.039 | 35～44 | 0.031 |
| 40～49 | 0.082 | 0.096 | 0.044 | 45～54 | 0.038 |
| 50～59 | 0.113 | 0.129 | 0.069 | 55～64 | 0.055 |
| 60～69 | 0.135 | 0.168 | 0.071 | 65～74 | 0.061 |
| 70 years and over | 0.175 | 0.218 | 0.078 | 75～84 | 0.085 |
| | | | | 80 years and over | 0.107 |
| Total | 0.107 | 0.180 | 0.064 | Total | 0.055 |
| Accident | 0.140 | | 0.088 | Accident | |
| Total Accident | 0.132 | | 0.065 | Total Accident | |
| | | | | White | 0.056 |
| | | | | Nowhite | 0.077 |

4 years old, with the variation coefficient at 0.032 and 0.044, respectively. For youth from 10–19 years old, it gradually rises up in summer with June as a summit, indicating relatively noticeable seasonality.

For such age groups as 20–29, 30–39, and 40–49 years old, the death index curve speaks of almost no seasonal change as in the case of infants. The coefficient of variation, therefore, comes at 0.04–0.05.

On the other hand, old age groups, *i.e.* 50–59, 60–69, and 70–79 years old, the winter upcurve gets steeper, indicating the increase of seasonal fluctuation. For 70–79 years old, the coefficient stands as high as 0.098, or twice that for infants and people from 20–49 years old.

The aggregate curve, covering all the age groups, also shows a peak in winter.

## 2. International comparision of death index curves by age

A comparison of the death index curves in the United States and the City of New York with the statistical counterparts in Japan and England (including Wales)

reveals a series of interesting findings. Covering all the age groups, the seasonal variation of mortality in the United States is rather moderate, compared with that in Japan and England. A similar tendency is witnessed also in the seasonal change by age group. Particularly less conspicuous in the United States is the seasonality of mortality for infants under 1 year and old people above 70 years old than in Japan and England (see Figs. 3 and 4).

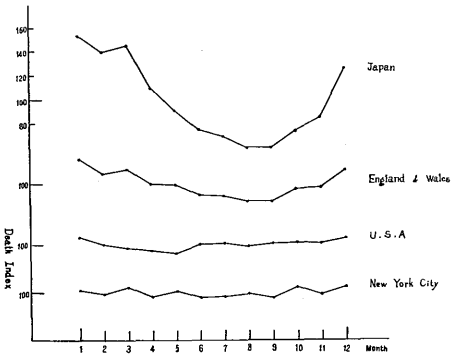


Fig. 3. Seasonal fluctuation of total death index by countries under 1 year (1958~1962).

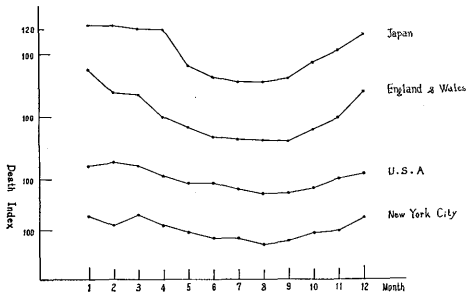


Fig. 4. Seasonal fluctuation of total death index by countries 70 years ~ (1958~1962).

For young people in 10's, 20's and 30's, not much different death index curves are seen in the three countries (Fig. 5).

Generally speaking, the seasonal curve bespeaks the least variation for people in 20's and 30's in all the three countries under study. This is attributed to the fact that most of the population in these age groups are so able-bodied in the prime of life that their mortality is little affected by the cycle of seasons.

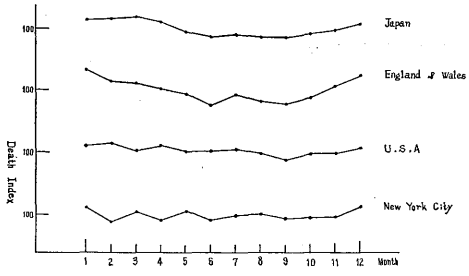


Fig. 5. Seasonal fluctuation of total death index by countries 30~39 years (1958~1962).

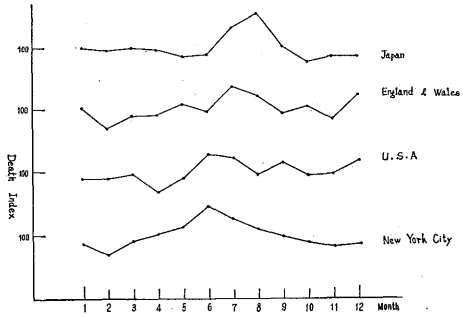


Fig. 6. Seasonal fluctuation of total death index by countries 10~19 years (1958~1962).

For teen-agers, mortality noticeably curves up in summer in the three countries, though the summit appears in June for the United States, in July for England and in August for Japan (see Fig. 6). This might well be ascribed to the marked increase in the hot months of deaths from accidents, including casualties in mountain climbing and swimming. If deaths from such unhappy occurrences are excluded, the

summer peak would disappear completely, and the seasonal variation curve would be much similar to that for youth in 20's and 30's. This is clear from the previous studies in the mortality of teen-agers in Japan.

For babies under 1 year, a notable difference in the seasonality of mortality is seen among the three countries: namely, almost no seasonal variation in the United States contrasted to the considerable fluctuation in Japan, with England showing a moderate change. This much can be noted in the annual variation of the death indices in these countries.

This can be witnessed more clearly in the mortality rate of infants by month. For infants, the monthly mortality rate must indeed be calculated from the numbers of births and deaths per month, but the seasonal variation of infant mortality may be estimated from the seasonal change of the death index for the City of New York because the seasonality of the birth index is quite negligible there. In Japan, however, the high seasonality of births requires that the estimation of the infant mortality rate be adjusted duly, with this fact in mind.

In due consideration of these circumstances, the rate of infant mortality in January and August is calculated for the three countries for comparison. In January, the rate comes at 44.5 or the highest for Japan, at 26.4 for England, and at 26.5 for New York. In August, on the other hand, it stands at 18.4 and 18.7, respectively, for Japan and England, but at 25.7, for New York.

For New York, there is almost no gap in infant mortality between January and August. In England, infant mortality in January is as low as in New York and much lower than in Japan. In August, it is as low as in Japan and much lower than in New York. In both months, England shows noticeably low infant mortality.

The coefficient of seasonal variation is as high as 0.326 in Japan. In England, it slips to 0.108 or one-third of Japan's. It further dwindles to 0.04 in the United States and to 0.032 in New York.

### 3. Two features of infant mortality in U.S.A.

#### *1) Artificial climate and mortality*

What are the reasons responsible for the moderate seasonal variation of mortality, particularly babies under 1 year, in the United States?

The moderateness of seasonal variation means that the cycle of seasons brings about very slight influence to bear upon human deaths. Needless to emphasize, the seasonal variation of mortality comes from a number of factors, but the foregoing international comparison clearly indicates that the most important among them are no doubt climatic factors.

Speaking of the influence of climate upon deaths, it must be noted that artificial climate does affect more keenly upon mortality than natural one, for people usually live in rooms heated by artificial methods, especially in the cold months. In the City of New York, for instance, the system of central heating has developed to the extent that room temperature is kept at 25–28°C even in winter. This means that no change

occurs in room temperature throughout the year, *i.e.* no difference in the influence of artificial climate upon mortality. In the case of infants in particular, there is no need for them to go out of the room in the cold months, and they always live under the artificial climate. It is little wonder that they are seldom affected by the winter cold, with the result of very slight seasonal variation in mortality.

On the contrary, the seasonal variation of infant mortality is deplorably high in Japan: the winter peak is more than twice the summer curve. Tne extremely high winter mortality is ascribed mostly to the inadequacy of Japanese dwellings, especially the lack of well-developed room heating, isn't it?

In England, the infant mortality curve shows a peak in winter, which however is much less steep than that in Japan. That country may be considered as taking the middle-of-the-way course in artificial climate.

### *2) Racial difference between Whites and Nonwhites*

Studying the seasonal variation of infant mortality in the City of New York, we find that there is another factor of great importance which cannot, and must not, be disregarded, namely racial difference between the Whites and the Nonwhites. It has already been mentioned that there is almost no seasonal variation of infant mortality throughout the year. Based upon our previous studies in the seasonal fluctuation of mortality in various countries, however, we may assume that this is merely a phenomenon on the surface of statistical figures, for mortality may curve up in summer for the Nonwhites (as in the less industrialized countries) and in winter for the Whites (as in the highly industrialized countries) so that, with one curve offset by the other, the annual average shows almost no marked variation.

As isolated death statistics for the Whites and the Nonwhites now are not available, it is hardly possible for us to make any definite conclusion on this delicate issue. Our limited surveys in some parts of the United States reveal that mortality, covering

Table 2. Infant Mortality of New York by Area, by Year.

| | 1953 | 1957 | 1958 | 1959 | 1960 | 1963 | 1964 |
|---|---|---|---|---|---|---|---|
| New York City | 24.4 | 25.0 | 26.4 | 26.5 | 26.0 | 25.8 | 26.8 |
| Manhattan | 30.0 | 32.6 | 33.7 | 34.1 | 33.4 | 30.5 | 30.8 |
| Central Harlem | 39.9 | **41.2** | **44.8** | **44.1** | **48.9** | 38.1 | **41.8** |
| East Harlem | 31.9 | 34.6 | 37.7 | **40.0** | 31.3 | 39.1 | 32.9 |
| Kips Bay-Yorkville | 29.6 | 28.4 | 28.6 | 21.1 | 23.1 | 18.6 | 24.6 |
| Lower East Side | 23.6 | 30.1 | 26.9 | 28.8 | 29.0 | 27.0 | 31.5 |
| Lower West Side | 30.6 | 26.8 | 33.6 | 25.7 | 33.9 | 31.5 | 26.1 |
| Riverside | 30.4 | 34.5 | 33.6 | **40.4** | 32.7 | 28.2 | 25.1 |
| Washington Heights | 22.5 | 27.6 | 25.1 | 25.8 | 24.4 | 23.4 | 26.4 |

(From Summary of Vital Statistics, N.Y.)

all the age groups, sometimes shows a very slight upcurve in summer for the Nonwhites. As far as data are available, however, it is proper for us to assume that there is no significant difference in the seasonality of mortality between the Whites and the Nonwhites.

But it must be noted that infant mortality is much higher in Central Harlem (densely populated by the Nonwhites) than in other areas of New York, *i.e.* 44.8, 44.1, 48.9, 38.1 and 41.8, respectively, in 1958, 1959, 1960, 1963, and 1964. (see Table 2). After all is said and done, a serious attempt must be made to conduct an extensive study in the seasonal variation of infant mortality by race as well as age group.

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# アメリカ合衆国における死亡の季節変動に関する研究 (I)

## —季節変動の特性—

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筆者らはアメリカ合衆国における死亡，ことに年令別死亡の季節変動の分析を試みた。その結果，日本や英国に比較して著しくことなる 2, 3 の特性を指摘し，序報的ではあるがそれについての若干の考察を行った。

本研究の最終目的は，これまで試みた日本における死亡の季節変動の研究より導かれた事実，即ち“文化の進展とともに死亡の冬季集中現象が著明になる”ということが，アメリカやイギリスにおいては，いか

なる形態をとるかを実証することにある。さらにこの事実より，死亡の季節変動を通してみた，人間による気候の征服，人工気候の問題等を明らかにすることにある。

アメリカ合衆国の 1952 年より 1956 年に至る 5 カ年間平均の月別死亡指数（年平均 100，年合計 1200）を用いて年令別の季節変動カーブを比較した。

1 才未満のカーブは殆んど一直線であるが 1～14 才，15～24 才では 6 月を中心に小さな山を示し，緩やかな変動がみられる。一方，25～34，35～44，45～54 才の階級は殆んど変動がない。しかし年令の増加とともに冬の指数は高まって季節変動も増し，ことに 85 才以上の高年令では一層著明となる。全年令の変動は冬に山のある緩やかなカーブである。また，これを白人及び黒人にわけてみると，白人の変動は冬季のみ緩やかな山をみるが，黒人の場合は冬と夏の 2 つの緩やかな山をみる。

ニューヨーク市の年令別季節変動をみると——年令の階級区分はやや異なるが——大体の傾向は合衆国のそれと類似する。即ち，一体に季節変動は緩慢で，1 才以下，1～4，20～29，30～39，40～49 の変動カーブは見事にこれを示す。一方 60～69，70 以上は冬季の山が目立ち季節変動は増大する。

以上を通じていえることは，合衆国もニューヨーク市の場合も，日本や英国に比べると死亡の季節変動が概して緩慢であるということである。ことに 1 才未満が季節変動を示さない事実は注目にあたいする。また，高年令においても冬季集中現象の著明な日本，英国とは比較にならぬほどゆるやかである。

死亡の季節変動はさまざまな要因がからみあって決定されるが，気候的要因の大きいことは容易に想像される。気候が死亡に作用する場合，自然の気候そのものよりも，暖房等によって作られた人工気候の影響は一層大きい。アメリカの場合，冬季でも寒さを感じないような室内気候が，死亡の季節変動を緩慢にさせていると考えられる。