A Geographical Study of Seasonal Disease Calendar Models by Period and Country

by

Masako Momiyama (Sakamoto) and Hiroko Kito

Meteorological Research Institute, Tokyo

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Abstract

In the previous paper entitled “High Winter Mortality of Seasonal Diseases” (Papers in Meteorology and Geophysics, Vol. XII, No. 2, 1961), I analyzed and explained the chronological changes in the calendars of seasonal diseases in the first half of the current century in Japan. I further traced the secular trends in the seasonal variation curves of deaths from major maladies and in the summer and winter death indices, thereby to find out the reasons responsible for such noteworthy fluctuations in mortality from diseases. I am inclined to continue my research and analysis by preparing seasonal disease calendars by age group in order to clarify the age structure of high winter mortality in recent years.

In this paper, I try to make seasonal disease calendar models by period on the basis of my studies in mortality variation in five periods (1906-10, 1912-16, 1930-34, 1952-56 and 1957-61) in Japan and models of the same kind by country according to various stages of civilization or socio-economic development—the United Kingdom as a highly advanced, Japan as a less-advanced and Egypt as an under-developed country. I also try to form a tentative modelling of the seasonal variation of deaths from various diseases.

This paper, therefore, is intended to further the analysis and clarification of the ever-higher mortality in the cold season.

1. Chronological Changes in Seasonal Disease Calendars

A comparison of the seasonal disease calendars in the above-mentioned five periods in Japan clearly reveals a series of chronological changes in the mortality of various human ailments.

In the first decade of the current century, the death rate was particularly high in the hot months for almost all the diseases, indicative of the high summer mortality (see Fig. 1). In the case of senile maladies (heart disease, apoplexy, senility, etc.), two mortality peaks were witnessed, one in summer and the other in winter.
Cancer raged in summer, and it is also worth mentioning that mortality was very high—over 200 per 100,000—for such diseases as pneumonia-bronchitis, gastritis-enteritis (including duodenitis and colitis as well) and tuberculosis.

Little difference was seen between 1906-10 and 1912-16. But it is notable that the summer prevalence of heart disease and apoplexy got markedly shorter in the latter period, that their prevalence gradually moved to autumn, and that pneumonia-bronchitis, gastritis-enteritis and tuberculosis again registered the highest mortality.

In 1930-34, noteworthy changes occurred in the calendars of seasonal diseases. First of all, the summer mortality peak disappeared for senile ailments, though the winter summit remained intact.

Such changes got all the more conspicuous after the Second World War or in 1952-56: with the exception of dysentery and gastritis-enteritis, no mortality peak was seen in summer for all disorders, even for so-called summer type diseases like tuberculosis and avitaminosis (beriberi). Whooping cough also took the biggest death toll in winter. As for cancer, the death peak seen in the hot season in the above-mentioned three periods moved to autumn (October and November). The mortality rate declined on the whole. Surprisingly notable was the decrease of deaths from gastritis-enteritis, pneumonia and tuberculosis in this period.

In 1957-61, all diseases but dysentery became “winter maladies”. In one word, only dysentery marked the mortality in summer, and even gastritis-enteritis took the toll in winter.

From the foregoing, it can be concluded that relations between seasonal environments and deaths from diseases did not remain fixed and stable, but under-
went a series of chronological fluctuations, depending upon the changes in socio-economic conditions.

These secular trends in mortality were seen not only in the nation-wide calendars of diseases but also in local calendars of the same kind. As shown in Fig. 2A and 2B, the mortality rate was conspicuously high in the early decades of this century in both Tokyo Metropolis and Iwate Prefecture, but in 1950's most diseases raged in the cold months, taking the highest toll in winter.

For all this, some geographical differences may well be noted: for instance, in Tokyo Metropolis the summer mortality peak remained intact only for dysentery in 1950's as in the case of the whole country, while on the other hand in Iwate Prefecture gastritis-enteritis as well as dysentery prevailed, though for a very short period, in summer (their winter prevalence was much longer, i.e. from mid-December to mid-March). But Iwate Prefecture's recent calendar of seasonal diseases has become much similar to that of Tokyo Metropolis a few years ago, with two death peaks for gastritis-enteritis.

Moreover, an international comparison provides interesting facts. In the 1952–56 calendar of seasonal diseases for the United Kingdom (see Fig. 3), there was a marked mortality peak in winter, strikingly contrasted to the complete blank in the summer areas. In the same period, Japan's calendar still showed the summer prevalence of gastritis-enteritis and dysentery. It is to be recalled, however, that even in the United Kingdom typhoid and the gastritis-enteritis group raged in summer
in 1928-29, though their death toll was considerably small: namely, the calendar of diseases in those days was much like that of Japan in early 1950’s.

2. Typical Seasonal Fluctuations of Mortality and Their Models

Among the 14 diseases listed in the seasonal disease calendars, for some the mortality peak has moved from summer to winter or autumn, and others, which formerly showed two peaks, namely one in summer and the other in winter, have become completely winter diseases. Their mortality curves in the above-mentioned five periods since the start of the current century were carefully traced and tentatively classified in the previous paper (1961). In this paper, their secular trends are analyzed more extensively, thereby to make models for seasonal variation of deaths from specified diseases.

For sake of convenience, the mortality variation was classified into two types, i.e. “transitory” and “reversing”.

1) Transitory type mortality variation

In the seasonal disease calendar featured by the high winter mortality, only cancer falls in this category: the death peak has moved from summer to autumn. In the early decades of this century, this malady took the biggest toll in August and in September in 1930’s, but it now rages in October. In this way, the mortality peak has been moving from the hot to the cool months (Fig. 4a). It still remains to be seen if it will continue moving further to winter as in the case of many other
ailments, or if it will come to stay in fall.

The coefficient of seasonal variation for this disease stood at 0.102 in early 1900's but slips to as low as 0.087 at present, indicative of the diminution of its seasonal variation.

Fig. 4. Seasonal variation of mortality.

Note: This and the following figures are drawn on the basis of monthly death index numbers instead of mortality rates. The monthly mortality rates are converted into the monthly death index numbers as follows:

Monthly death index

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1,200 \times \frac{\text{Monthly mortality rate}}{\text{Annual total of mortality rates}}
\]

It can thus be seen that the annual average and total of the monthly death index numbers come at 100 and 1,200, respectively.
2) **Reversing type mortality variation**

Variation of this type is subdivided into two subtypes, A and B.

As for Subtype A, the summer peak which was seen in summer before the war has caved in and touched the lowest bottom, while on the other hand the winter curve has been getting relatively higher and closed up as a summit (Fig. 4b and 4c). Typical diseases included in this group are gastritis-enteritis, avitaminosis (beriberi), and tuberculosis.

In the case of gastritis-enteritis and avitaminosis (beriberi), seasonal fluctuations were notably high in 1906-10, 1912-16 and 1930-34, with the coefficient of seasonal variation at well over 0.4. After the “reversion”, however, it has dropped to 0.11-0.13 for gastritis-enteritis and to 0.19-0.29 for avitaminosis (beriberi), or one half of the former coefficient. Widely different from these illnesses is tuberculosis, the seasonal death variation of which has been much less sharp.

Diseases of subtype B had two mortality peaks, as already mentioned, in 1906-10 and 1912-16 (in some localities, the summit was higher in summer than in winter). The summer peak getting lower, they now are winter diseases with one peak in the cold season. Falling under this category are senile diseases, namely apoplexy, heart disease and senility.

The coefficient of seasonal variation stood at as high as 0.22 in 1906-10 for apoplexy, but it sagged to 0.11 in 1930-34. Due to the steady curving-up of the winter peak, however, it has recently turned upward to 0.15 or 0.16.

From the foregoing, it may be concluded that the seasonal variation of mortality was fairly high for subtype A in 1906-10 and 1912-16 and dropped appreciably in 1930's, but that it has recently resumed an upturn due to the ever-higher winter mortality. The same has been the case with senile diseases: seasonal variation has again been getting bigger after the postwar “reversion”.

Seasonal variation models of mortality, based upon the chronological studies of the above-mentioned types of diseases, are shown in Fig. 5a—5f. In these figures, cancer is selected as a model for the transitory type; tuberculosis, gastritis-enteritis, and avitaminosis (beriberi), as models for the reversing A subtype; and apoplexy and heart disease, for the reversing B subtype. Their dramatic changes in the past decades can thus be seen graphically.

Factors responsible for such conspicuous chronological variation of deaths from diseases will be studied later and discussed in a new paper.

3. **Models for Seasonal Disease Calendars**

Based upon the chronological studies, I have tentatively made models for the seasonal disease calendars of Tokyo Metropolis in 1900’s, 1910’s, 1930’s, 1950’s, 1960’s and in the near future (see Fig. 6). The mortality rates have been re-classified into four grades, namely 0-40, 40-100, 100-200 and upwards of 200 (instead of 10 grades in the seasonal disease calendars): the breadth of bars shows the rates of mortality.
Fig. 5. Seasonal variation model of mortality.
These models can be said to magnify some prominent features of secular variation.

These models clearly show the extremely high mortality in summer, the two peaks of senile diseases and the big death toll of such maladies as pneumonia, gastritis-enteritis and tuberculosis in the early decades of 1900; and the conspicuous changes occurring in 1930's, i.e. the disappearance of the summer peak for senile ailments, the summer prevalence of dysentery, gastritis-enteritis and pneumonia, and the winter high deaths from senile maladies and respiratory organ disorders.

A complete change has taken place since the war's end. In 1950's, even dysentery and gastritis-enteritis prevailed for a very short period in summer, and all other diseases showed high mortality in the cold season. Cancer alone was an exception: its toll was the highest in fall.

With the turn of 1960's, summer mortality remained relatively high only for dysentery, and even gastritis-enteritis became a winter illness. The death rate conspicuously fell off (less than 100) for pneumonia, gastritis-enteritis, tuberculosis and avitaminosis (beriberi) from the very high grades in the early decades of this century.

The possible pattern of the future seasonal disease calendar can be seen in the graph shown at the right end of Fig. 6: all diseases but cancer will rage in winter, and the mortality gap between senile diseases and others will get wider than ever, as in the case of highly-advanced countries in West Europe. It may well be expected that mortality can be reduced for a number of diseases, but it appears inevitable that cancer, apoplexy, senility, heart disease, etc. will take the ever-bigger tolls. Epidemiological conditions in Japan will thus get much similar to those in the European countries.
Then, let us make seasonal disease calendar models by country in 1950's. The United Kingdom, Japan and Egypt are selected as models for an advanced, a less-advanced and an under-developed country as adequate data are unavailable for international comparison for other countries (see Fig. 7).

It can be seen that the seasonal disease calendar of British type is featured by the high winter mortality of all diseases against the blank space for the hot season, and the wide gap in mortality between senile diseases and others. This may be regarded as a model for highly civilized countries. In the Japanese type model for less-advanced nations, mortality still remains in summer for dysentery and gastritis-enteritis, and the death gap among various illnesses is not so big as in the case of the British type model. In the model calendar for Egypt, an under-developed country, summer mortality is considerably high for gastritis-enteritis, and fairly high for dysentery, avitaminosis, etc., strikingly contrasted to the very low mortality of senile diseases.

From the foregoing, it can be concluded that, broadly speaking, along with the development of human culture (the progress of medical science and technique, the discovery of new drugs, the improvement of medical and health services, the elevation of the living standard, etc.), the summer high mortality has been, and will be, replaced by the winter concentration of deaths, and, moreover, the gap in mortality has been, and will be getting wider between some ailments and others. In other words, the death peak in summer has been getting lower, while on the other hand the winter curve has gradually bulging relatively. This, however, has not been achieved intentionally but has occurred due mainly to the fact that mortality in summer has been tackled much more easily than that in winter.

The question presents itself: What measures should be taken to cope with the ever-higher mortality in the cold months? It appears to be highly difficult to overcome completely the cold climate from the medical point of view. Take for instance apoplexy and heart disease: their former mortality peak in summer has caved in and become a valley, but it has been very difficult to put down their death tolls in winter. The same has been the case with the winter peak of pneumonia-bronchitis deaths (they have had only one summit in the cold months).

All this reveals that the winter cold is likely to bring more evil effects upon
the human body than the summer heat. What is more, the winter high mortality, particularly of senile diseases, will turn upward more than ever in line with the increase of the old age population. To checkmate this deplorable tendency, artificial climate, wintering, and other steps will have to be stepped up for improvement of severe living conditions in the cold season.

Unless medical techniques were renovated fundamentally, mortality from senile diseases could not be reduced appreciably, much less arrested completely. Along with the headway of human culture, mortality may gradually converge on to older age groups, and their death rate will get higher and higher. From the medical and social points of view, after all, it is as essential as anything else to cope with in some way or other the winter cold as one of the important factors responsible for senile weakness.

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References

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モデル化による季節病カレンダーの研究

松本 政子・木藤 黒子

さきに死亡率の“冬季集中”の研究において、日本及び東京都の季節病カレンダーの歴史的変遷—大正、昭和の初期、戦後の三時期にわたって—について若干述べたが、本論ではこの三時期に、さらに明治時代及び現代を加えて五時期にわたるカレンダーの歴史的変遷について考察した。さらに、この五時期にわたる東京都のカレンダーのモデル化及び、1950年代における国別・イギリス、日本、エジプト—のカレンダーのモデル化を試み、また日本のカレンダーを構成する数種の季節病の季節変動カーブのモデル化を試みた。

季節病カレンダーの変遷をみると、明治時代のカレンダーは殆どどの疾病死亡が冬季に流行し、むしろ“夏季集中”の姿を呈していた。しかも心臓病、脳出血、老衰等の成人病は夏と冬の二つの山を持ってい

た。癌も夏に明白な流行期を示した。大正時代は明治と余り変化がないが、昭和の初期になると大部殺し、最も著明な事実としては成人病の流行期が明治、大正と二つに分かれたのが、夏が消失して冬だけ残った事である。一方、戦後になるとカレンダーは全く一変し、これまで夏に流行期を示した疾病は赤痢と腸炎だ
けを残して、あとは全部冬季に集中した。さらに最近のカレンダーの姿は、赤痢だけが最も低い死亡率で夏に残り、腸炎も途中冬に変わった。
こういった五時期にわたる変遷の姿は、モデル化したカレンダー——これは死亡率の階級区分は大部があらかじめ四階級にまとめ、黒線の太い、細いで死亡率の高低を表現してあるため、現実のカレンダーよりは誇張して表現しておく。——によると、一層明白になってくる。
つぎに 1950 年代のイギリス、日本、エジプトの三国のモデル化したカレンダーを比較すると、“冬季集中”はイギリスがもっとも明白にあらわれ、これについては日本である。一方、エジプトは赤痢、腸炎、腸チフス、その他の数種のものがまだ夏季の疾患として残り、後進国としての性格を示している。
つぎに、冬季集中を招来するまでの、季節病変動型式の変遷をモデル化してみた。その結果代表的なタイプは逆転型、移行型として示される。
逆転型“A”これは以前は夏季に季節変動の山があったが、最近では冬季に山を示すように変わったもので、下痢腸炎、脚気、結核などがこれにぞくする。
逆転型“B”昔は夏、冬二つの山があったが、最近では冬だけに山を示すもので、脳出血、心臓の疾患、老衰がこれにぞくする。
移行型：夏から秋に山が移行していくもので、これにぞくするのは癌だけである。