Why Do More Old People Die in Winter?

P. R. WOODHOUSE

Clinical Gerontology Unit
Addenbrookes Hospital, Cambridge, UK.

Summary

More elderly people die in winter than in summer. This phenomenon is present in many parts of the World including Hong Kong and is not necessarily related to climate. Cardiovascular and respiratory diseases make up 90% of excess winter deaths in England and Wales. Cold exposure, infections and alterations in haemostatic mechanisms may contribute to the extra deaths in winter from circulatory disease. However, the aetiology of the seasonal variation in mortality is poorly understood and prevention is limited to advising the elderly to keep warm in winter. Central heating may be especially beneficial. Further research is required on this fascinating topic.

Introduction

"Whoever wishes to pursue properly the science of medicine must proceed thus. First he ought to consider what effects each season of the year can produce;" . . . "For with the seasons men's diseases, like their digestive organs, suffer change. "These words are translated from the Hippocratic writings of 400-500 BC[1] and vividly demonstrate that the physicians of that period had a keen awareness of the effects of season and climate on health. In Ancient Greece there would have been a summer predominance of infectious illnesses such as malaria and gastroenteritis, (hence the reference to digestive organs). However, in modern advanced societies, these illnesses have declined in incidence and severity and with them, the summer peak in mortality has disappeared[2]. Instead, there is a winter peak in death rate which accounts for 20,000 to 50,000 excess deaths annually in winter in England and Wales, compared to summer or autumn[3]. Geriatricians may not be surprised to learn that approximately 80% of these extra deaths occur in people aged 65 years and over[4]. The elderly not only have the highest crude death rates but also greatest seasonal variation in death rates. The chance of dying in winter rather than summer increases with age after young adulthood[2]. For young people the risk of dying is greatest in summer when accidents are more common. However, the winter peak is also present in infant mortality in many countries[2]. It appears that the very old and the very young are the most sensitive to the effects of season on health. This review concentrates upon the elderly.

The seasonal variation in mortality is by no means confined to England and Wales or even to countries with cold winters. Indeed, it has been reported in localities as different as Kuwait and Siberia[5,6]. Table 1 shows the Excess Winter Death Index (EWDI) for selected countries and Hong Kong based on data from the United Nations Demographic Yearbook, 1985[7]. The EWDI is definted as the percentage excess of deaths in the four winter months of highest mortality, (December to March for the northern hemisphere, June to September for the southern hemisphere), compared to the mean of the preceeding autumn and following summer[3]. The higher the EWDI, the greater the winter excess of deaths. It can be seen that the seasonality of mortality is present to a greater or lesser degree in many countries with widely differing climates. Paradoxically, several warm countries have high EWDIs and vice versa. The reader will note that Egypt has a negative EWDI. This is because, in common with many other underdeveloped countries, Egypt retains a prominent summer peak in mortality was well as a smaller winter peak. Hong Kong's EWDI is almost as high as that of England and Wales and the monthly death rates further compared in Figure 1. The similarity between the curves is striking, especially when one considers the geographical, climatic, ethnic, and social difference between Hong Kong and the UK.

Table 1. Mean Excess Winter Death Index (EWDI) for Selected Countries and Hong Kong.

	Years for which data available.	EWDI
England & Wales	1976-84	21
USSR	1976-84	8
Norway	1976-84	9
West Germany	1976-84	8
Italy	1976-84	19

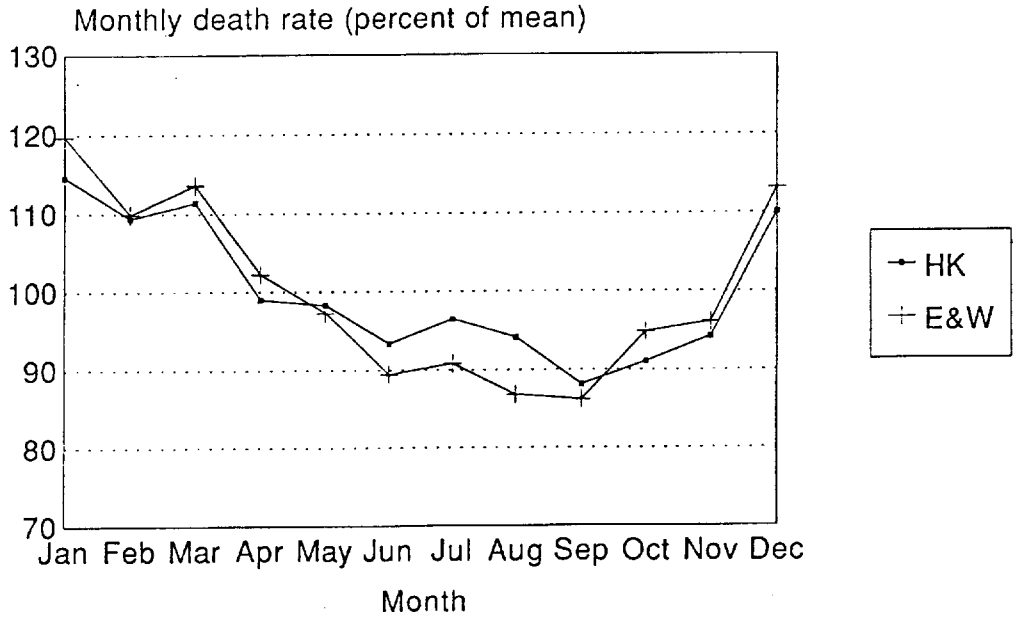
Iceland	1976-84	1
Portugal	1976-83	26
Hong Kong	1976-83	18
Korea	1977-82	13
Japan	1976-84	17
Canada	1976-83	7
USA	1978-82	9
Chile	1976-83	18
Australia	1976-84	20
New Zealand	1976-84	25
Tunisia	1976-82	19
Egypt	1976-80	-12

Mortality data from United National demographic Yearbook, 1985.
After Curwen (3) with modifications and additions.
For explanation of EWDI, see text.

Composition of Seasonal Mortality.

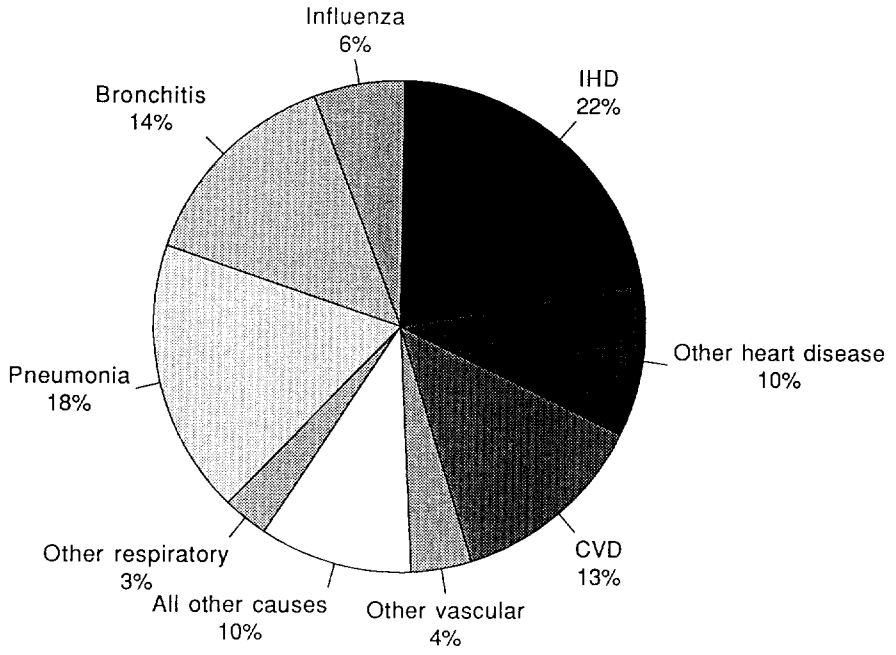
Curwen[4] has shown that approximately 90% of the extra deaths in winter in England and Wales are due to circulatory and respiratory diseases. Many viral respiratory pathogens are more prevalent in the winter months and deaths from respiratory disease show the greatest amplitude of seasonal variation. However, circulatory dieases also contribute to the extra mortality in winter and, because of the higher crude death rates for stroke and hearth disease, they make up the largest category of excess deaths (Figure 2). Douglas et al[8] recently reported on the composition of seasonal mortality using Scottish data and produced broadly similar results, with circulatory diseases forming 52% of the total.Accidental hypothermia causes only a tiny proportion of winter deaths in the elderly and is usually a marker for other serious disease[9]. Surprisingly. cancer deaths show very little seasonal variation[8], contradiciting the argument that winter carries off the weakest in a population. Indeed, after a bad winter with many excess deaths, there is not the decrease in death rate the following summer which would be expected if this argument were true [4].

Figure 1. Monthly death rates for Hong Kong (HK) and England and Wales (E&W) 1976-83.



Data from United Nations Demoqraphic Yearbook, 1985

Figure 2. Composition of Excess Winter Deaths by Cause.



Derived from mortality figures for England and Wales 1968-75, Curwen (4).
IHD=Ischaemic Heart Disease; CVD=Cerebrovascular Disease.

An obvious question is whether an increased mortality in winter is truly brought about by an increased incidence of disease or by a greater likelihood of fatal outcome. It has also been suggested that the apparent raised mortality from ischaemic heart disease in winter is due to people with heart disease dying from intercurrent respiratory infections which, as previously mentioned, are strongly seasonal[10]. Death certification would naturally record heart disease and a spurious seasonal variation in recorded heart disease mortality would result. Subsequent evidence has disproved this argument. From instance, Bull[11] showed that hospital admissions for vascular diseases increased in cold weather and, of the patients admitted with myocardial infarction, only 11% had coexistent respiratory disease and only 4% had pneumonia. The winter excess in hospital admissions has been confirmed by other authors for myocardial infarction[12], stroke[13] and all vascular diseases[14]. Admission rates give good indirect evidence of a seasonal variation in incidence. In a small sub-group of the Medical Research Council Trial of long-trem anticoagulant therapy, Rose[15] was able to provide actual incidence data showing a seasonal variation in myocardial infarction.

Unfortunately, the composition of winter mortality in Hong Kong cannot be ascertained from the United Nationas Yearbook. General mortality statistic reveal some differences between Hong Kong and the UK. In particular, ischaemic heart disease is a much less common cause of death in Hong Kong while stroke assumes a greater importance. A further investigation into the causes of seasonal mortality in Hong Kong might, therefore, be a fruitful area for research.

Why is there a Seasonal Variation in Cardiovascular Disease?

The causation of the seasonal variational in vascular disease is not understood despite the attentions of several authors over many years. A number of possible explanations exist and these are reviewed, in turn, below:

Cold The most obvious characteristic of winter is that it is colder than the rest of the year. The effect of temperature on mortality rates has, therefore, been studied extensively. Many authors have found a strong inverse relationship between environmental temperature and vascular disease mortality[2,3,15,16]. In one of the earliest papers on the subject, Bean and

Mills[17] even suggested that: "Migration out of northern cold and storms, either temporarily or permanently, is strongly indicated for every patient of limited cardiac reserve whose finacial means permit such a course." Unfortunately, this would not be a practical means of mass disease prevntion. Curwen [3] developed a regression model to predict excess winter deaths in England and Wales and found that for each degree celsius by which the winter was colder than average, there were 8000 more deaths. Bull and Morton, in their important series of papers [18-20], also showed that sustained cold weather was associated with higher death rates from myocardial infarction and stroke. In addition, they found that cold ambient temperatures 1 to 2 days before death from myocardial infarction and 3 to 4 days before death from stroke were more relevant than tempertures on the day of death. This would seem to indicate that environmental temperature exerts an effect at the onset of these diseases, (generally it takes longer to die from a stroke than a myocardial infarct). They demonstrated that variation in death rate was related to ambient temperature for nearly all disease groups other than cancer and that the relationship was strongest for vascular and respiratory diseases. They were also able to illustrate an approximately linear inverse relationship between minimum daily temperature and death rates from stroke, myocardial infarction and respiratory disease. This relationship held true throughout the normal range of temperatures encountered in England and Wales and was more marked in those over 60 years of age. Using data from New York they also showed that at greater extremes of ambient warmth and cold, deaths increased exponentially. Rogot and Padgett [16] produced similar mortality date for other parts of the USA which suggested that acclimatization to a given range of temperatures tended to take place in local populations. This may help explain why seasonality of mortality is evident in Kuwait despite winter temperatures equivalent to summer temperatures in Scotland[5].

Despite the evidence implicating cold exposure in precipitating cardiovascular disease it should be remembered that many other meteorological, physiological and behavioural factors are inextricably linked to environmental and that these factors may be more important. Of the climatic factors studied, snowfall [16], air pollution[15], rainfall[15] and sunshine[11] have all shown associations with mortality, albeit weaker associations than ambient temperature. However, in a recent study the seasonality of hospital admissions for stroke was more strongly related to wind chill (combining wind speed and air temperature) than to temperature alone[13].

Infection Winter excess deaths in England and Wales are closely associated with influenza epidemics, (which always occur in winter), as well as with ambient cold[3,4]. Intriguingly, most of the excess deaths happening at the time of epidemics are not registered as being due to influenza. It has been shown that 67% of deaths associated with influenza are registered as being due to respiratory diseases but, significantly, 31% are due to circulatory disease[21]. 82% of all deaths are in those over 65 yeras of age.

Could acute vascular diseases sometimes be triggered by infections such as influenza? From mortality data, Bainton et al [22] suggested that influenza might precipitate myocardial infarction. However, using simiar data from New Zealand, others have failed to show any relationship between coronary and respiratory disease mortality[23]. Nevertheless, many small case-control studies have linked various infections with vascular diseases. Spodick et al [24] found that patients with acute myocardial infarction more often complained of symptoms suggestive of preceeding viral respiratory illness than controls. Another study revealed an increased prevalence of preceeding infection in young and middle-aged patients suffering from stroke[25]. Specific organisms such as coxsackie B virus[26,27] and chlamydia TWAR[28], have occasionally been implicated in the causation of myocardial infarction. Even dental infections have been found to be more common in patients suffering acute myocardial infarction[29].

There is tentative evidence that various infections may make certain acute vascular events more likely. Since both influenza and many other respiratory infections are more common in winter, it may be that they contribute to the excess of coronary and cerebrovascular events in winter by some unknown mechanism.

Clotting The haemostatic mechanism may be involved in the seasonal variation in vascular disease. Deep venous thromboses following surgery and limb arterial emboli have been shown to be more common in winter[30,31]. Stout and Crawford[32] recently reported a seasonal variation in plasma fibrinogen levels in elderly subjects. It is already known that raised fibrinogen levels predict an increased risk of myocardial infarction[33] and may also be a risk factor for ischaemic stroke[34]. Fibrinogen concentration is influenced by many factors including infection but the reason for seasonal variation is unclear. A possible means by which cold could bring thrombosis was discovered by Keatinge et al in laboratory experiments[35]. When young adult volunteers were exposed to mild surface cooling, blood viscosity, platelet counts and red cell counts increased.

Other Factors Several other factors may contribute to the seasonality of vascular disease mortality. Total cholesterol levels appear to vary seasonally with a zenith in December and a nadir in June[36]. Blood pressure also tends to be slightly higher in winter [37]. Even relative deficiency of vitamin D in winter has been put forward as a cause for the seasonal fluctuation in cardiovascular disease incidence[38]. Indeed, vitamin D levels may be lower in patients suffering myocardial infarction than in controls[39] but there is no other evidence to support this theory as yet.

Any or all of the above theories may be relevant. Seasonal rhythms permeate many physiological mechanisms and therefore the explanation of the seasonal rhythm of death may well be complicated.

Prevention of Seasonal Mortality

It is difficult to begin in attempts to reduce the seasonal excess of deaths in the elderly since the causation is so poorly understood. The widespread use of central heating in the Northern USA and Scandinavia has been linked to reduced seasonal mortality in these countries[2]. However, Keatinge[40] found marked seasonal mortality persisting in elderly people with unrestricted home heating. Also, Alderson[41] demonstrated a greater seasonal swing in deaths in the institutionalised elderly when one would have expected their heating to be good. Nevertheless, the weight of evidence suggests that cold exposure is important and it seems purdent to recommend that the elderly who live in the colder parts of the World should keep warm in winter. Lloyd [42] has suggested that the best advice might be to keep all rooms in a house evenly heated rather than to maintain just one warm room. From physiological principles he argues that sudden changes in temperature may be the most damaging and he emphasises the need for adequate clothing, food intake and exercise. It should be noted that remonstrations to keep warm might seem ridiculous to the people of countries such as Kuwait, where the winters are pleasantly warm, and where they too suffer from seasonal variations in mortality. Perhaps prevention and treatment of infection may prove to be equally important in the light of further research.

Conclusion

The seasonal variation in mortality in the elderly has been highlighted. This phenomenon is seen throughout the World including Hong Kong. Some theories on the causation of winter cardiovascular deaths have been discussed although no firm conclusions have been possible. In the present state of knowledge, the elderly in areas with cold winters should be recommended to keep warm by using adequate heating and clothing and by maintaining adequate calorie intake. In Hong Kong, further investigation of the composition of winter mortality and seasonal variation in risk factors for these diseases would be very interesting. Comparison with a country such as the UK might then yield a better insight into the causes of seasonal mortality in both communities.

References

1. Hippocrates. Airs, waters, places. In: Hippocrates (transl. Jones, W.H.S.). William Heineman. London. 1923; Vol 1, p.71.
2. Sakamoto - Momiyama M. Seasonality in Human Mor- tality. University of Tokyo. 1977.
3. Curwen M. Excess winter mortality: a British phenom- enon? Health Trends 1990/91; 4: 169-75.
4. Curwen M. Seasonal variations in mortality: the effect of influenza and temperature. In: Trends in respiratory mor-tality 1951-1975. London. HMSO, 1981. (OPCS Series; DH1 no. 7).
5. Douglas AS, A1-Sayer H, Rawles JM. Allan TM.Seasonality of disease in Kuwait. Lancet 1991; 337:1393-97.
6. Melnikov VN, Shorin YP. Seasonal variations of cardio vascular mortality in relation with the month of birth. Bull Siberian Division USSR Acad Med Sci 1990; 2: 41-4.
7. 1985 Demographic Yearbook. United Nations. New York. 1987.
8. Douglas AS, Allan TM, Rawles JM. Composition of Seasonality of Disease. Soct Med J 1991; 36: 76-82.
9. Woodhouse PR, Keatinge WR, Coleshaw SRK. Factors associated with hypothermia in patients admitted to a group of inner city hospitals. Lancet 1989; Nov 18: 1201- 4.
10. Anderson TW, Le Riche WH. Cold weather and myocardial infarction. Lancet 1970; Feb 7: 291-6.
11. Bull GM. Meteorolgical correlates with myocardial and cerebral infaction and respiratory disease. Brit J Prev Soc Med 1973; 27: 108-13.
12. Dunnigan MG, Harland WA, Fyfe T. Seasonal incidence and mortality of ischaemic heart disease. Lancet 1970; Oct 17: 793-6.
13. Gill JS, Davies P, Gill SK, Beevers DG. Wind-chill and the seasonal variation of

cerebrovascular disease. J Clin Epidemiol 1988; 41(3): 225-230.

14. Douglas AS, Rawles JM, Alexander E, Allan TM. Winter pressure on hospital medical beds. BMJ 1991; 303: 508-9.

15. Rose G. Cold weather and ischaemic heart disease. Birth J Prev Soc Med 1966; 20: 97-100.

16. Rogot E, Padgett SJ. Associations of coronary and stroke mortality with temperature and snowfall in selected areas of the United States, 1962-66. Am J Epidemiol 1976; 103: 565-75.

17. Bean WB, Mills CA. Coronary occlusion, herat failure, and environmental temperatures Am Heart J 1938; 16: 701-13.

18. Bull GM, Morton J. Seasonal and short-term relationships of temperature with deaths from myocardial and cerebral infarction. Age and ageing 1975; 4: 19-31.

19. Bull GM, Morth J. Relationships of temperature with death rates from all causes and from certain respiratory and arteriosclerotic diseases in different age groups. Age and ageing 1975; 4: 232-46.

20. Bull GM, Morton J. Environment, temperature and death rates. Age and ageing 1978; 7: 210-24.

21. Tillett HE, Smith JWG, Gooch CD. Excess deaths attrib-utable to influenza in England and Wales: age at death and cerified cause. Int J Epidemiol 1983; 12(3): 344-52.

22. Bainton D, Jones GR, Hole D. Influenza and ischaemic heart disease - a possible trigger for acute myocardial infarction ? Int J Epidemiol 1978; 7(3): 231-9.

23. Marshall RJ, Scragg R, Bourke P . An analysis of the seasonal variation of coronary heart disease and respira-tory disease mortality in New Zealand. Int J Epidemiol 1988; 17(2): 325-31.

24. Spodick DH, Flessas AP, Johnson MM. Association of acute respiratory symptoms with onset of acute myocardial infarction: prospective investigation of 150 consecutive patients and matched control patients. Am J Cardiol 1984; 53: 481-2.

25. Syrjanen J, Valtonen VV, Iivanainen M, Kaste M. Preceeding infection as an important risk factor for ischaemic brain infarction in young and middle aged patients. BMJ 1988; 296: 1156-60.

26. Nicholls AC, Thomas M. Coxsackie virus infection in acute myocardial infarction. Lancet 1977; Apr 23: 883-4.

27. Nikoskelainen J, Kalliomaki JL, Lapinleimu K, Stenvik M, Halonen PE. Coxsackie B virus antibodies in myocardial infarction. Acta Med Scand 1983; 214: 29-32.

28. Saikku P, Leinonen M, Mattila K, et al. Serological evi-dence of an association of a novel chlamydia, TWAR, with chronic coronary heart disease and acute myocardial infarction. Lancet 1988; Oct 29: 983-5.

29. Mattila KJ, Nieminen MS, Valtonen VV, et al. Association between dental health and acute myocardial infarction. BMJ 1989; 298: 779-82.

30. Lawrence JC, Xabregas A, Gray L, Ham JM. Seasonal variation in the incidence of deep vein thrombosis. Br J Surg 1977; 64: 777-80.

31. Clark CV. Seasonal variation in incidence of brachial and femoral emboli. BMJ 1983; 287:1109.

32. Stout RW, Crawford V. Seasonal variations in fibrinogen concentrations among elderly people. Lancet 1991; 338: 9-13.

33. Meade TW, Mellows S, Brozovic M, et al. Haemostatic function and ischaemic heart disease: principal results of the Northwick Park Heat Study. Lancet 1986; Sep 6: 533-7.

34. Qizilbash N, Jones L, Warlow C, Mann J. Fibrinogen and lipid concentrations as risk factors for transient ischaemic attacks and minor ischaemic strokes. BMJ 1991; 303: 605-9.

35. Keatinge WR, Coleshaw SRK, Cotter F, Mattock M, Murphy M, Chelliah R. Increases in platelet and red cell counts, blood viscosity, and arterial pressure during mild surface cooling: factors in mortality from coronary and cerbral thrombosis in winter. BMJ 1984; 289: 1405-8.

36. Gordon DJ, Trost DC, Hyde J, et al. Seasonal cholesterol cycles: the Lipid Research Clinics Coronary Primary Pre-vention Trial placebo group. Circulation 1987; 76(6): 1224-31.

37. Brennan PJ, Greenberg G, Miall WE, Thompson SG. Seasonal variation in arterial blood pressure. BMJ 1982; 285: 919-23.

38. Scragg R. Seasonality of cardiovascular disease mortality and the possible protective effect of ultra-violet radiation. Int J Epidemiol 1981; 10(4): 337-41.

39. Scragg R, Jackson R, Holdaway IM, Lim T, Beaglehole R. Myocardial infarction is inversely associated with plasma 25-hydroxyvitamin D3 levels: a community-based study. Int Epidemiol 1990; 19(3): 559-63.

40. Keatinge WR. Seasonal mortality among elderly people with unrestricted home heating. BMJ 1986; 293: 732-3.

41. Alderson MR. Season and mortality. Health Trends 1985; 17: 87-96.

42. Lloyd EL. Hypothesis: temperature recommendations for elderly people: are we wrong? Age and ageing 1990; 19: 264-7.