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Introduction

"Whoever wishes to investigate medicine properly,
should proceed thus: in the first place to consider
the seasons of the year, and what effects each of
them produces for they are not at all alike, but differ
much from themselves in regard to their changes."
— Hippocrates in "On Airs, Waters, and Places", ∼ 400BC

Seasonal mortality was a hot topic in the media in the summer of 2003 when more than 10,000 people died of the heatwave in France in August [55, 157]. Nevertheless, the real "grim reaper" [172] in most countries is winter. Periodically, winter excess mortality emerges in the popular media especially in countries such as the UK where cold related deaths are a serious public health issue. Headlines like "Cold killed 20,000 elderly people last winter, says charity" [362], "Cold kills 'thousands' in a week" [25] and "Britain is a rich nation; its old people should not be dying of the cold" [363] are reflected in official statistics. The national statistical office of the UK (ONS) estimates that during the last ten years between 23,000 (1997/98) and 48,000 (1999/2000) more people died annually during winter than would be expected from death rates at other times of the year [266].

Seasonality in morbidity and mortality has been of interest to scholars for a long time. At least since Hippocrates' seminal work "On Air, Waters and Places" written almost 2500 years ago, people are aware of the impact of the seasons throughout the year on diseases.[1] The first modern investigations into seasonal mortality have been conducted in the middle of the 19th century by British statisticians [eg. 368].

[1] Sometimes Wong Tai is credited to be the first to mention the variation of diseases with the seasons about 4700 years ago [237].

Nowadays, seasonal effects in demographic variables are rarely the center of attention in population studies[2] — although most basic indicators such as births, deaths, marriages,... are subject to annual fluctuations. The last monograph on seasonality in mortality has been published more than 25 years ago [324]. The multi-disciplinary approach taken in this dissertation is typical for demographic analyses. Demography is based on a solid foundation of methods derived from mathematics and statistics. It takes biological as well as social forces into account to arrive at conclusions which could be transmitted as policy recommendations into the political arena [cf. 202, 379]. This dissertation incorporates all of these aspects in its chapters. It focuses, nevertheless, on social strains of explanations using modern statistical methods.

The current state of knowledge of seasonal mortality will be presented after this introduction in Chapter 2 (starting at page 5). First, the biomedical causes of increased mortality risks during cold weather conditions are outlined. Such an approach would not be sufficient to take the differential in winter excess mortality between various countries into account. In a second step, social and cultural forces need to be included to obtain a more complete picture. This description of a causal chain of events is followed by a historical literature review which describes the seasonal mortality pattern from the past up until the present. Special attention is given to the influences of social and cultural factors in mediating the amplitude in seasonality of mortality.

To make any meaningful quantitative analysis of a phenomenon of interest, one has to be able to have a valid measurement of this phenomenon. The subsequent chapter (Chapter 3, starting at page 39) is therefore more methodological: On the one hand, various indices and tests for seasonality will be described, discussed and tested with hypothetical data as well as with real data. The chapter gives recommendations for which index one should use to describe seasonality, and which statistic should be employed to test for seasonality in data. On the other hand, several standard time-series methods will be evaluated whether they are suitable to analyze demographic data which often come as count data with variable trends, a changing seasonal figure and overdispersion.

The potential impact of social and cultural factors on seasonal fluctuations in deaths and mortality in current populations are analyzed in the two subsequent chapters. The study of seasonality in deaths in the United States in Chapter 4 (page 83) covers the years 1959–98. The wealth of data, large social differences, the wide variability in climatic conditions, and the lack of research for this country make the US an important case study. In addition, a new method for the time-series analysis of seasonal count data will be introduced, as previous methods did not yield satisfactory results. With the analysis of Denmark in Chapter 5 (page 125), a more homogenuous country is

[2] A recent exception is the second monograph in Springer's "Demographic Research Monographs" series "The late life legacy of very early life" by Gabriele Doblhammer-Reiter where month of birth is the key factor [70].

presented. The base of these data, the population registers, is the main reason for the demographers' widespread interest in Scandinavian data. These registers allow the availability of information for almost any given point in time, and are of unmatched quality.

Before the dissertation is concluded, a small chapter (Chapter 6, page 169) gives an outlook how much gain in life expectancy could theoretically be expected if people did not have to experience adverse environmental conditions during winter, yet rather faced summer mortality conditions throughout their lives.

Despite this wide scope it should be pointed out that this dissertation is specialized in two dimensions:

- The analysis does not cover the entire age range; it focuses on seasonal mortality among adults — especially at advanced ages. Due to its completely different causality, seasonality in infant and child mortality has been deliberately left out.
- Developing countries often display a seasonality pattern which is reminiscent of European countries of about 150 years ago. As this dissertation intends to focus on the latest developments in combatting seasonal mortality, it only takes developed countries into account.