Commentary: Patterns in mortality governed by the seasons

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It has long been recognized that seasonal patterns exist in mortality rates with, for example, northern hemisphere countries observing a marked excess of deaths during the colder winter months.1,2 Many causes for this winter excess
have been suggested, including temperature and weather fluctuations,\textsuperscript{3} variable light–dark cycles,\textsuperscript{4} and changing patterns in the frequency of seasonally-variable infectious agents.\textsuperscript{3,5} Mapping such patterns in cause-specific mortality has clear implications for many aspects of health care as these could potentially be used to guide targeted health-related interventions, such as the provision of the normal seasonal influenza vaccine during the winter months.\textsuperscript{6} However, while much is recorded for economically developed countries, the lack of long-term record keeping means that little accurate information on the seasonal pattern in mortality has been reported from resource-poor countries. This shortage of published information is most notable for adults and comes in spite of much evidence for the marked effects of seasonality on factors such as nutritional status, energy balance, and infection rates.\textsuperscript{7} An article in this issue of the International Journal of Epidemiology adds important data to this area, detailing the seasonal pattern of mortality in a large cohort of adults and children from Burkina Faso, West Africa.\textsuperscript{8} In their paper, Kynast-Wolf et al.\textsuperscript{9} use demographic data for over 35,000 individuals to highlight patterns in mortality according to season of death and season of birth. Using a number of detailed analytical methods, this paper highlights some interesting trends in the seasonal influences on mortality within this population setting.

The data come from a demographic surveillance site within the rural Nouna Health district in north-western Burkina Faso, collected during an 8 year period from 1993 to 2001. As is typical for this part of West Africa, the Nouna study site has a Sahelian climate with a rainy season from June to October and a long dry season from November to May.\textsuperscript{8} In the analysis by month of death, overall mortality was consistently higher during the dry season months of November to May for all age groups, with the exception of infants and young children where an additional peak was seen around the end of the rainy season. In sub-Saharan Africa there are a number of seasonally-dependent environmental factors (nutritional, infectious, toxic) that could potentially explain these observed trends, but in their interpretation of the data, the authors focus only on the seasonal rates of transmission of common infectious agents. The peak in infant and child deaths around the end of the rainy season is most probably explained by an increase in frequency of malaria infection, as is observed in two comparable studies from The Gambia where the seasonal trends are supported by data on cause of death.\textsuperscript{9,10} Although less published data is available for older children and adults, the authors suggest that the excess mortality seen during the early dry season is explained by an increase in frequency of specific infectious diseases such as meningitis and pneumonia. What these observations highlight is the importance of a good system for the recording of cause of mortality among adult populations. Although many deaths occur without previous contact with a health facility, and hence an acute diagnosis at the time of death cannot be given, the use of population-specific verbal autopsy questionnaires allow a greater understanding of possible cause.\textsuperscript{11} Indeed, it is of interest to note that the authors of this paper indicate that data on cause-specific mortality is indeed available for this population, although a delay in the processing of the verbal autopsy data prevented its inclusion within the current analysis. Adding this data to the analysis could potentially help establish seasonal priorities for the health sector and we wait with interest for this important additional information.

Our own work from rural Gambia, West Africa using demographic data collected since the late 1940s has previously documented the marked seasonal variations in mortality across the whole life course.\textsuperscript{12} But intriguingly we have also shown a profound bias in premature mortality in individuals born during, or shortly after the wet season months of July to December.\textsuperscript{13} Since the majority of these premature adult deaths were from infections or infection-related diseases, we hypothesized that an insult occurring in early life and linked to season of birth is disrupting immune development and resulting in impaired immune function, increased susceptibility to infections, and premature mortality later in life.\textsuperscript{14} Despite a number of attempts to reproduce this observation in other population groups with distinct seasonal patterns,\textsuperscript{15,16} this observation has yet to be fully replicated. Within the current analysis, Kynast-Wolf et al.\textsuperscript{9} have looked at survival by month of birth for individuals with an accurate date of birth recorded. For infants, mortality rates were highest for those born during the months of September, October, and December but for all other age groups no significant trends were observed in patterns of mortality rates by month of birth. The authors speculate that the effect observed in infancy is a consequence of infants born during these months entering the second half of infancy, when they are most susceptible to severe malaria, during the period of highest malaria transmission. What is not clear from the current analysis is how dates of birth were obtained for individuals born prior to the start of the demographic surveillance system in 1992.

An interest in understanding the impact of climatic variations on the epidemiology of disease patterns has been fuelled in recent years, largely as a consequence of our increasing abilities to detect and predict climate variations such as El Niño, coupled with mounting evidence for global warming and a growing concern regarding the consequences that this may have. Demographic data such as that used in the current analysis will be absolutely vital for studying the linkages between climate and disease and may help to provide insights into the factors that drive the emergence of seasonal or interannual variations in contemporary epidemic diseases and possibly into the potential future impacts of long-term climate change. The establishment of the INDEPTH network (International network of field sites with continuous demographic evaluation of their health in developing countries; http://www.indepth-network.org/) will allow a co-ordinated analysis of survival by season in other largely rural populations across the globe and comparison with climate data will enable a co-ordinated analysis of the climatic influences of mortality patterns. The potential future use of such analyses for targeting measures aimed at lessening the burden of seasonal disease epidemics support the importance of understanding the true relationship between seasonality and patterns in morbidity and mortality.

References

\textsuperscript{1} Guy WA. On the annual fluctuations in the number of deaths from various diseases, compared with like fluctuations in crime and in


