Weather and climate versus mortality from the 19th century onwards in Lisbon (Portugal)

The relevance of Franzini's pioneer research.

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European Meteorological Society

13th EMS Annual Meeting & 11th European Conference on Applications of Meteorology (ECAM) 09 – 13 September 2013 | Reading, United Kingdom

1. Introduction

M.M. Franzini (1779-1861) was probably the first Portuguese scientist to work out the relationship between weather and mortality. He was an engineer and military man, who was also actively involved in Politics (liberal party). He took a keen interest in Nature and Sciences, particularly in the "influence" of weather and climate on health and agriculture.

Franzini started his meteorological observations in December 1815, by request of a physician; both scientists compiled existing mortality data from several Lisbon parishes between 1837 and 1849.

2. Main Objectives

2.1. To reconstruct mortality and climatic data from the early 19th century

2.2. To compare the seasonal rhythm of mortality and climatic variables over time and research the causal relationships between climate and mortality

3. Data

We have extracted meteorological and mortality data mostly from periodic newspapers (Fig.1) and official publications.

3.1. Mortality Data

Franzini used mortality data from the records of several parishes in Lisbon (1837-1841/1845). There is a gap in the data between 1845 and 1887.

Official records of demographic data in Portugal began in 1887. However, the mortality data between 1887 and 2012 do not always have the same spatial disaggregation, as shown in Table 1.

3.2. Meteorological Data

The temperature and precipitation data used for Lisbon were collected from different sources: Franzini’s papers and several newspapers (1815-1859, with some gaps, see Fig.2, Fig.3 and Table 2), as well as from the main meteorological station of Lisbon (Lisboa/Gefisco) between 1854 and 2012 (www.idl.ull.pt).

These data were compiled to construct the thermo-pluviometric diagram and an index of seasonality [100 - Index, see methodology].

4. Methodology

To assess mortality seasonality and its changes through time we calculated two different indexes: 100-index and Winter/Summer ratio (e.g. Rau, 2007).

The 100-index (I) assumes that the annual value is equivalent to 1200, i.e. in a non-seasonal series the monthly value is 100. The proportional relation between data of each month and the annual mean indicates if that specific month has recorded higher (I>100) or lower (I<100) values than would be expected in a non-seasonal series.

where:

\[
I = \frac{X}{X_{\text{annual}}} 	imes 100
\]

The Winter/Summer index (WS) allows the comparison (across time) between seasons. If the index value is higher than 1, winter season mortality (D\text{w}) is higher than summer season mortality (D\text{s}), and vice versa.

5. Results

5.1. Lisbon’s climate

Lisbon has a Mediterranean climate with a dry summer and rainfall mostly occurring in the cold season (Fig.4).

5.2. Variability of seasonal mortality over time

The peak of mortality occurred in the summer as opposed to what happened in the Northern European Countries. According to Franzini, in summer the underprivileged classes consumed damaged fruits, which induced serious gastric problems and fevers, also "due to exhaustion of harmful gases that the intense heat and the very dry air produce in the low and swampy lands ..." (Rev. Un. Lisb., 42, 1842, p.493). The only direct relationship that Franzini establishes is between the temperature and mortality.

He points out the heat and cold extremes associated with Easterly and North-easterly winds “which constantly develop explosive heat or cold in this country, according to the time of the year when they blow” (Rev. Un. Lisb., 46, 1843, p.576), hence showing his knowledge of Portugal’s climate and regional circulation.

6. Conclusions

We conclude that there was actually a change in the seasonal rhythms of mortality over the last century (Fig. 5 and Fig. 6). In the early 1830s the peak of mortality occurred in the summer. Towards the end of the 19th century the mortality values varied little throughout the year. During the 20th century the relative importance of mortality in the winter months increases. Notwithstanding this evolution, a second peak of mortality nearly always occurs during one of the summer months. Given the increased frequency of summer heat waves such peaks will tend to occur more frequently or become more significant. Furthermore, a recent research on mortality per civil parish in the Lisbon region during the 2003 heat wave has shown a great spatial variation and discusses the meteorological versus non-meteorological causes of the differences found, stressing the role of a deprivation index and a health indicator in increased mortality.

7. References


Franzini, M.M. (1837 and 1842) - Observações meteorológicas nos Anos de 1836 a 1842... Lisboa, Imprensa de Lisboa.

Franzini, M.M. (1839) - Observações Meteorológicas e Crônica de Os Dias de Lisboa. Tomo II. Lisboa, Imprensa da Câmara de Lisboa.

Franzini, M.M. (1839) - Observações Meteorológicas e Crônica de Os Dias de Lisboa. Tomo II. Lisboa, Imprensa da Câmara de Lisboa.

Main newspapers from which Franzini’s data (from 1842) were retrieved: Jornal das Ciências Médicas, Revista Universal Lisboetas, O Panorama.