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"Some Infectious and Parasitic Diseases" Mortality Peridicities, Seasonality and Trend, by Sex, in Portugal (1980-2012)

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Introduction

The awareness of the influence of season on human health has been discussed since Hippocrates. Typically in the northern hemisphere countries mortality peaks can be found during winter, i.e., between January and March.

Studies have related a multitude of causes of death to seasonal incidence namely on cardio-respiratory diseases and infectious disease. In developed countries, a shift from a summer peak in mortality towards a winter peak has been observed. Also, in tropical countries this has been an important subject for studies. For instance, in Bangladesh a study revealed a relation between sex and seasonal variations in mortality by all causes and in specific causes. According to the authors, the association may find an explanation in the high prevalence of infectious and diarrhoeal diseases.

Apart from climate, cultural and behavioural aspects apparently play a major role in shaping the seasonal distribution of mortality. Several demographic studies claim that mortality measures the ecological and social conditions of the environment and accordingly, men and women show a different susceptibility to seasonal environmental risk, that could be reflected age of death related to each disease throughout life. A mortality study conducted between 1997 and 2007 in the United States population revealed that females appear more susceptible to seasonality then males. However, there are studies on seasonality that included the gender effect in which no significant difference was found regarding "all causes" mortality by.

Throughout this document the reader will find a description of the results obtained after the systematic application of a spectral decomposition method to "Some infectious and parasitic diseases (ICD-9: 001-139, ICD-10: A00-B99)" by sex, in three different periods of time, (from now on referred as): overall time period: 1980-2012; past time period 1980-1996; recent time period 1997-2012. This study aims to explore differences between the seasonal fluctuations and trend in mortality between sexes during the three time periods defined in Portugal.

Keywords: Seasonality; Periodicities; Spectral decomposition; Fourier series; Mortality

Methodology

The daily mortality data (1980-2012) by "Some infectious and parasitic diseases (ICD-9: 001-139, ICD-10: A00-B99)" were kindly provided by the National Statistics Institute. This group of cause of death were coded as in the Volume I of the International Classification of Diseases, 9th and 10th Revisions: ICD-9 (from AAAA to AAAA) and ICD-10 (since AAAA) respectively (WHO, 1975 and 2010), and stratified by sex.

This study had a retrospective character in relation to the phenomena under study were kindly provided by the National Statistics Institute of Portugal. The statistical methods used to identify seasonality and periodicities were suggested by Brockwell and Davis [1]. They suggested the application of a test that allows analyzing the null hypothesis that the analysed series is white noise, needed to represent the empirical distribution function and use of the Kolmogorov-Smirnov test to examine the compatibility of this function with the uniform distribution function. A Fourier series was then used to represent functions with periodicities. It was, also, constructed the periodgram to identify periodicities in the data series, and used the Priestley test to determine statistical significance of those periodicities. After periodicities detection, and respective statistical significance estimation, we defined a procedure to allow a better viewing of the mortality fluctuation associated with these periodicities by season and month [2,3]. In summary, we summed the positive and negative contributions from all the mortality time series in the different seasonal time periods, based in the defined frequencies [4].

The seasonal time period was defined as follow: WINTER: 21 of December to 19 of March, SPRING: 20 of March to 20 of June, SUMMER: 21 of June to 21 of September, AUTUMN: 22 of September to 20 of December (Figures 1,3 and 4). The remaining periods defined as usual: monthly by year months (Figures 2,5 and 6). Finally, for trend detection it was used the hypothesis test p=0 with Student's t distribution.

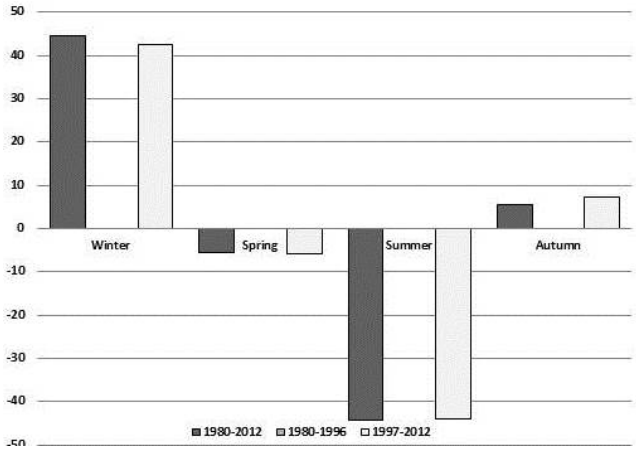

Figure 1: Graphical representation of the male mortality seasonal fluctuation (Seasons) associated to the annual (365 days) periodicity disclosed in Table 1.

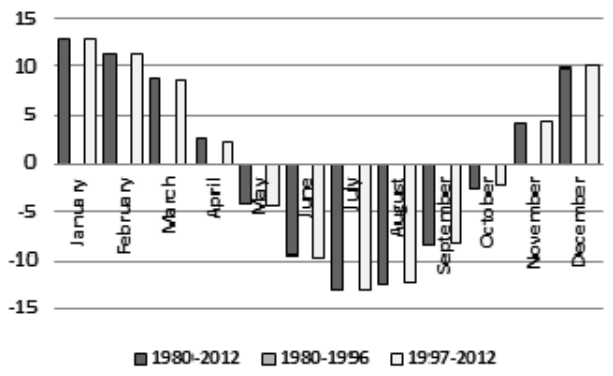

Figure 2: Graphical representation of the male mortality seasonal fluctuation (Monthly) associated to the annual (365 days) periodicity disclosed in Table 1.

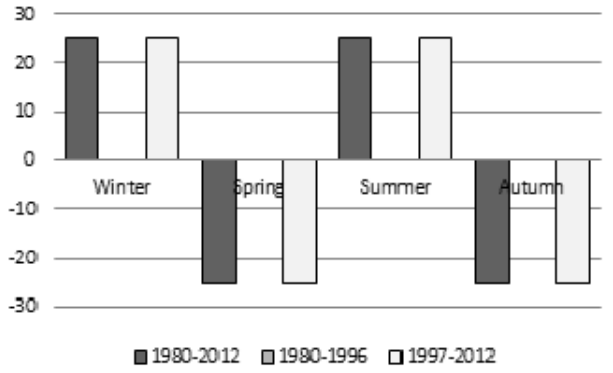

Figure 3: Graphical representation of the female mortality seasonal fluctuation (Seasons) associated to the biannual (182).

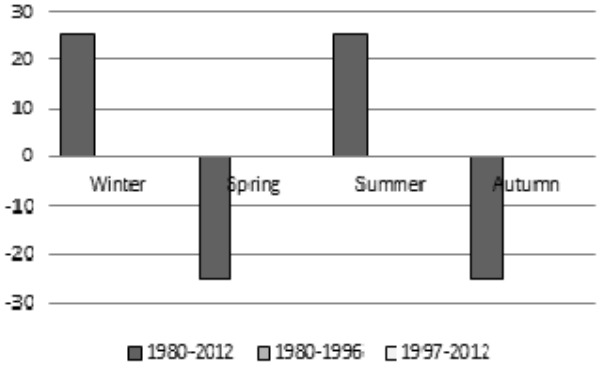

Figure 4: Graphical representation of the male mortality seasonal fluctuation (Seasons) associated to the biannual (182).

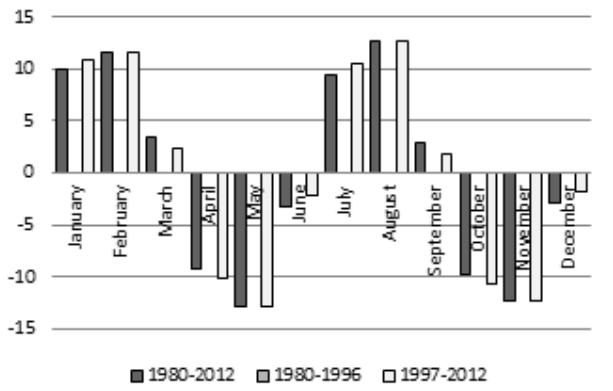

Figure 5: Graphical representation of the female mortality seasonal fluctuation (Monthly) associated to the biannual (182 days) periodicity disclosed in Table 1.

Figure 6: Graphical representation of the male mortality seasonal fluctuation (Monthly) associated to the biannual (182 days) periodicity disclosed in Table 1.

Results

Mortality by infectious and parasitic diseases revealed, in the overall period, a biannual periodicity in both men and women. This periodicity was, also, found in the most recent time period but only in females [5-7]. It was also disclosed an annual periodicity in males in overall and recent time periods. Results indicated an increasing trend for both sexes in all time periods, except in the most recent time period in males, where there was evidence of a decreasing trend. In the three time periods, males showed a higher number of deaths compared to females (Table 1). Graphical representations, for the annual pattern, showed, for male during the overall and most recent time periods, positive contributions during winter and autumn, and negative contributions during spring and summer. Monthly variation showed during overall and the most recent time periods positive contributions from January to April, November and December and negative contributions from the rest of the months of the year (Figures 1 and 2).

Time periods	1980-2012				1980-1996				1997-2012			
Sex	F		M		F		M		F		M	
K.S*	(0.091)0.012		(0.134)0.012		(0.061)0.017		(0.165)0.017		(0.057)0.018		(0.046)0.018	
Trend	↑		↑		↑		↑		↑		↓	
n	20106		38020		6366		14288		13740		23732	
Periodicity P**	12,054.00	0	12,054.00	0	6,210.00	0	6,210.00	0	2,922.00	0	365.25	0.037
	6,027.00	0	6,027.00	0			3,105.00	0.001	182.63	0	3,105.00	0.001
	3,013.50	0	4,018.00	0								
	182.64	0	365.27	0								
			2,410.80	0.002								
			3,013.50	0.005								
			182.64	0.047								

*(p): Refers to KS test, for testing the null hypothesis of the data be white noise; **p: Refers the Priestley test for testing the null hypothesis of the data do not contain periodic components.

Table 1: Results by sex for the trend and periodicities for "Some infectious and parasitic diseases (ICD-9: 001-139, ICD-10, A00-B99)" in each of the three time periods studied.

Graphical representations, for the biannual pattern, showed positive contributions during the winter and summer and negative contributions in spring and autumn during the overall time period in both sexes and most recent time period only in females (Figures 3 and 4). Monthly fluctuation reveal positive contributions during January to March and July to September during overall and most recent time periods and negative contributions from April to June and October to December during overall and the most recent time periods in females [8-10]. Males revealed positive contributions during January to March, July August and December and negative contributions from the others months of the year during the overall time period (Figures 5 and 6).

Discussion

In the most recent time period mortality by "Some infectious and parasitic diseases" revealed apparent "new" annual and biannual periodicities in females and males, respectively. It is interesting to see that in the overall time period the biannual periodicity is also present in male sex. When focusing in the biannual monthly fluctuation of the overall time period, it is possible to see some differences between the two sexes: males have contributions from 8 in 12 months (January, February, April, May, July, August, October and November) while in female all the months of the year contribute to this pattern [11].

Regarding trend, mortality by "Some infectious and parasitic diseases" revealed in both sexes and in the three time periods increased mortality rates, except in males during the most recent time period that revealed a decrease over time (Table 1). It is possible; also, to see in Figure 7 that the number of deaths trend by sex, appear to have many modifications along the years. There was a decrease in the 80's and then an increase in the 90's in both sexes (more pronounced in males) [12-14]. After that, the number of deaths by these causes stabilized and showed a decreasing trend in males and had an intense increase since 2001 in females. These figures also reveal that since 2011 the numbers of deaths by these causes for both sexes are almost the same. To understand this pattern a more in-depth look is needed in the mortality by specific causes that contribute to the infectious and parasitic group of diseases.

The three major causes of death that contribute to the "Some infectious and parasitic diseases group are Tuberculosis (ICD: 010-018, ICD-10, A15-A19, B90), other bacterial diseases (ICD: 030–041, ICD-10, A30-A49) and Human immunodeficiency virus (HIV) infection (ICD: 042–044, ICD-10, B20-B24). When we look at these three causes of death, the differences between the mortality of both sexes seem to be explained by variations in mortality mainly by Tuberculosis (Figure 8) and HIV (Figure 10). For this two causes, mortality rates in women varied little but the values for men had a pronounced decline indicating global increases mortality in women. To this increase (which actually could be a proportional increase) we could add the increased mortality from “Other bacterial diseases” (Figure 9) which is more evident in women (probably associated with a higher life expectancy and changes in behaviour).

This change of behaviour (economical and social) in Portugal had two significant moments; in the 80's just after the revolution and in the 90's after joining to the European Union. The former one brought female freedom in social, cultural and labour market, while the second brought a substantial improvement of salaries and the possibility of travelling and discover social realities. Nevertheless, it is important to study more profoundly this differences in the seasonality and trend between men and women and its potential causes [15-17]. Finally, the knowledge that there are differences between the two sexes in mortality by "Some infectious and parasitic diseases" seasonality may be useful both for improving the timing of health education actions to the population, as well as for a better management of health units not only of health care but also of health resources[18-20]. On the other hand the differences between the sexes in trend of this type of pathologies over time should be useful for health policy makers to a

better prepare of the future in terms of social actions that can prevent this type of pathologies.

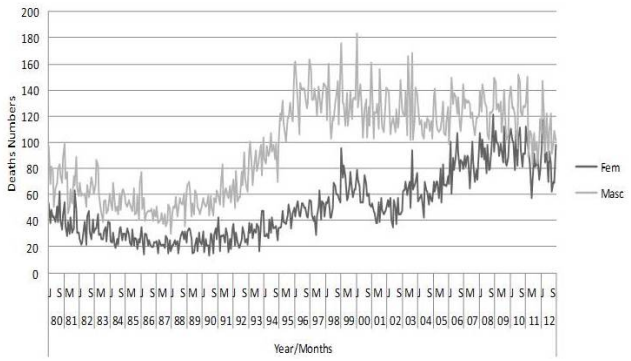

Figure 7: Graphical representation of the monthly deaths number by "Some infectious and parasitic diseases (ICD-9: 001-139, ICD-10, A00-B99)" for each year of the time series database.

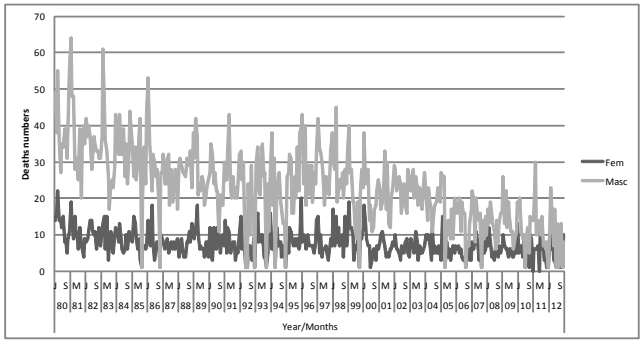

Figure 8: Graphical representation of the monthly deaths number by Tuberculosis (ICD: 010–018, ICD-10, A15-A19, B90) for each year of the time series database.

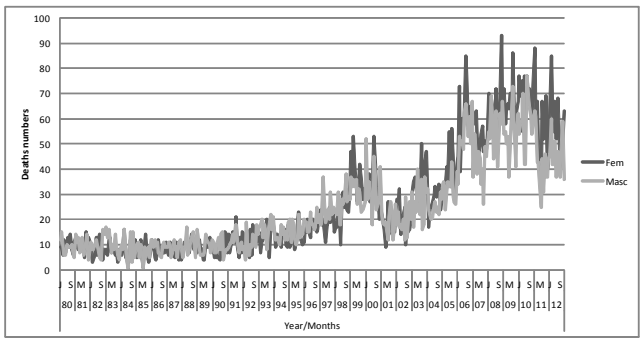

Figure 9: Graphical representation of the monthly deaths number by other bacterial diseases (ICD: 030–041, ICD-10: A30-A49) for each year of the time series database.

References

1. Davis (1987) Time series: Theory and methods. Springer-verlag.
2. Hare EH, Moran PA, Macfarlane A (1981) The changing seasonality of infant deaths in England and Wales 1912- -1978 and its relation to seasonal temperature. J Epidemiol Community Health 35: 77-82.
3. Murteira BJF, Muller DA, Turkman KF (1993) Análise de sucessões cronológicas. Lisboa: McGraw-Hill.
4. Nogueira P, Paixão E, Rodrigues E (2005) Periodicidades na mortalidade Todas as causas entre 1980 e 2000: relatório interno. Lisboa: Observatório Nacional de Saúde. Instituto Nacional de Saúde Dr. Ricardo Jorge.
5. Nunes M (1995) Detecção de periodicidades escondidas e regressão harmónica. Lisboa: FCUL. Universidade de Lisboa.
6. Pell JP, Cobbe SM (1999) Seasonal variations in coronary heart disease. QJM 12: 689-696.
7. Rau R (2004) Seasonality in human mortality.Max Planck Institute for Demographic research, editor Rostock.
8. Snedecor G, Cochran W (1989) Statistical methods. 8th ed. Ames, Iowa: Iowa State University Press.
9. Weiss KB (1990) Seasonal trends in US asthma hospitalizations and mortality. JAMA 263: 2323-2328.
10. Grech V, Aquilina O, Pace J (2001) Gender differences in seasonality of acute myocardial infarction admissions and mortality in a population-based study. J Epidemiol Community Health 55: 147-148.
11. Robine JM (2001) A new biodemographic model to explain the trajectory of mortality. Exp Gerontol 36: 899–914.
12. Eurowinter Group (1997) Cold exposure and winter mortality from ischaemic heart disease, cerebrovascular disease, respiratory disease, and all causes in warm and cold regions of Europe. Lancet 349: 1341–1346.
13. Gemmell IP, Mcloone F, Boddy GJ, Dickinson, Watt G (2000) Seasonal variation in mortality in Scotland. Int J Epidemiol 29: 274–279.
14. Nakai S, Itoh T, Morimoto T (1999) Deaths from heat-stroke in Japan: 1968–1994. Int J Biometeorol 43: 124–127.
15. Yan YY (2000) Th influence of weather on human mortality in Hong Kong. Soc Sci Med 50: 419–427.
16. Burkart K, Khan MH,Krämer A, Breitner S,SchneiderA,et al. (2011) Seasonal variations of all-cause and cause-specific mortality by age, gender, and socioeconomic condition in urban and rural areas of Bangladesh. Int J Equity Health 10: 32.
17. Nogueira P, Paixão E, Rodrigues E (2007) Sazonalidade e periodicidade da mortalidade portuguesa: 1980-2001. Fundação Merck Sharp and Dohme 268.
18. Epstein SE, Zhou YF, Zhu J (1999) Infection and atherosclerosis: emerging mechanistic paradigms. Circulation 100: e20–e28.
19. Sytkowski PA, D'Agostino RB, Belanger A, Kannel WB (1996) Sex and time trends in cardiovascular disease incidence and mortality: the Framingham Heart Study, 1950–1989. Am J Epidemiol 143: 338–350.
20. Hirai AH, Sappenfield WM, Kogan MD, Barfield WD, Goodman DA, et al. (2012) Contributors to Excess Infant Mortality in the U.S. South. Am J Prev Med 46: 219-227.