

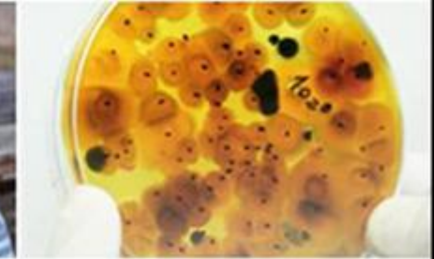

Which meteorological index is the best descriptor for winter mortality in elderly population in Lisbon district?

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Outline

- Introduction
- Main objectives
- Material and Methods
    - Data
    - Methodology
- Results
- Conclusions

Introduction

- Health is highly sensible to climate change (WHO)
- Some studies reported the cold effects on mortality, hospital admissions and on the use of emergency services
- Mortality in Portugal is higher in winter months
- It's important to know the population vulnerability to adverse meteorological conditions
    - Some European countries already do this monitoring
- Several meteorological indices were created aiming a direct measure of health risk
    - UTCI ”Universal Thermal Climate Index”
    - WSI - ”Weather Stress Index”
    - NET - ”Net Effective Temperature”
    - Windchill

Main objetives

- To select the meteorological index that is the best descriptor for winter mortality in elderly population living in Lisbon district
  - Mean temperature
  - Mean temperature and wind speed
  - Mean temperature and humidity
  - *Windchill*

Material and Methods - Data

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- Population aged 65 and over in the district of Lisbon
  - Daily mortality (from 2002 to 2012)
    - All cause (AC) - CID10 A00-Y98
    - Circulatory and Respiratory System Diseases (C&R) - CID10 I00-I99 and J00-J99
  - Average annual resident population

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- Influenza-like-illness rates (ILI) (/ 100,000 inhabitants) – Portuguese general practitioners sentinel network

IPMA
Instituto Português do Mar e da Atmosfera

- Lisbon Weather Station - Gago Coutinho
  - Minimum and maximum temperatures (ºC)
  - Temperature recorded at 09:00 hours (ºC)
  - Humidity recorded at 09:00 hours (%)
  - Wind speed recorded at 09:00 hours (m / s)

  - **Mean temperature**
  - **Windchill Temperature**

Material and Methods - Methodology

- **Descriptive analysis**

- **Distributed lag linear and non-linear models (DLNM)**

exposure-lag-response associations

Associations in which the dependence between exposure (meteorological index) and response (mortality) is time-shifted

The exposure at day *t* determines the risk at day *t+l*

Relative Risk (RR)

Risk of an event occurring - **death** - relative to exposure to risk factor - **temperature** –

Risk of death for a temperature T relative to the risk of reference temperature of confort (T0)

Material e Methods - Methodology

$$\text{Ln}[E(Y_t)] = \boldsymbol{\alpha} + \sum_{k=1}^{K} \boldsymbol{\beta}_{k,t} Temp(l)_{k,t} + \boldsymbol{\gamma} Gripe(l)_t + \boldsymbol{\delta} ns(t_t, 4) + \boldsymbol{\varepsilon} ns(doy_t, 6) + \boldsymbol{\epsilon} dow_t + \text{Ln}(pop_t)$$

- Y_t – number of deaths on day *t* (t=1,2,3…1830)
- α – intercept
- $Temp(l)_{k,t}$ – crossbasis relative to k^{th} meteorological variable considered from the current day (lag = 0) to lag corresponding to l days
- $Gripe(l)_t$ – crossbasis relative to the Influenza-like-illness rates from the current day (lag = 0) to lag corresponding to l days
- $ns(t_t,4)$ - corresponds to a natural cubic spline that is applied with 4 degrees of freedom (df) at the observation day (t) to control the trend
- $ns(doy_t,6)$ - corresponds to a natural cubic spline that is applied with 6 degrees of freedom (df), one for each month, applied to the day of the year (doy) to describe the seasonality in each season
- *dow* - categorical variable corresponding to the day of the week
- pop - resident annual average population that enters as offset.

Material e Methods - Methodology

<table>
<tr><th></th><th></th><th>Modelo:</th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td rowspan="2">Mean Temperature</td><td rowspan="2">Tmédia</td><td>argvar</td><td colspan="3">lin (cen=Q_3)
thr (D_4,D_6)
poly (2) (cen=Q_3)
ns(2:5) (cen=Q_3)</td><td>—</td></tr>
<tr><td>arglag</td><td colspan="3">integer
lin
ns(3:6)
poly(2:4)</td><td>—</td></tr>
<tr><td rowspan="2">Wind speed</td><td rowspan="2">Vento</td><td>argvar</td><td>—</td><td>lin (cen=0)</td><td>—</td><td>—</td></tr>
<tr><td>arglag</td><td>—</td><td>integer
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ns(3:6)
poly(2:4)</td><td>—</td><td>—</td></tr>
<tr><td rowspan="2">Humidity</td><td rowspan="2">Humidade</td><td>argvar</td><td>—</td><td>—</td><td>thr (40,60)</td><td>—</td></tr>
<tr><td>arglag</td><td>—</td><td>—</td><td>integer
lin</td><td>—</td></tr>
<tr><td rowspan="2">Windchill Temperature</td><td rowspan="2">WindChill</td><td>argvar</td><td>—</td><td>—</td><td>—</td><td>lin (cen=Q_3)
poly (2) (cen=Q_3)
ns(2:5) (cen=Q_3)</td></tr>
<tr><td>arglag</td><td>—</td><td>—</td><td>—</td><td>integer
lin
ns(3:6)
poly(2:4)</td></tr>
<tr><td rowspan="2">Influenza-like-illness rates (ILI)</td><td rowspan="2">Gripe</td><td>argvar</td><td colspan="4">lin (cen=50)
thr (50) (side=h)
ns(2:5) cen=50)</td></tr>
<tr><td>arglag</td><td colspan="4">integer
lin
ns(3:6)
poly(2:4)</td></tr>
<tr><td></td><td colspan="2">Modelos testados:</td><td>3402</td><td>30618</td><td>6804</td><td>2916</td></tr>
</table>

http://hdl.handle.net/10400.18/3767

Material e Methods - Methodology

Comparison and evaluation 4 of the models

Akaike's quasi-likelihood information criterion (QAIC)

$$QAIC = -2\mathcal{L}(\hat{\theta})+2\hat{\phi}k$$

Bayesian information criterion on quasi-likelihood (QBIC)

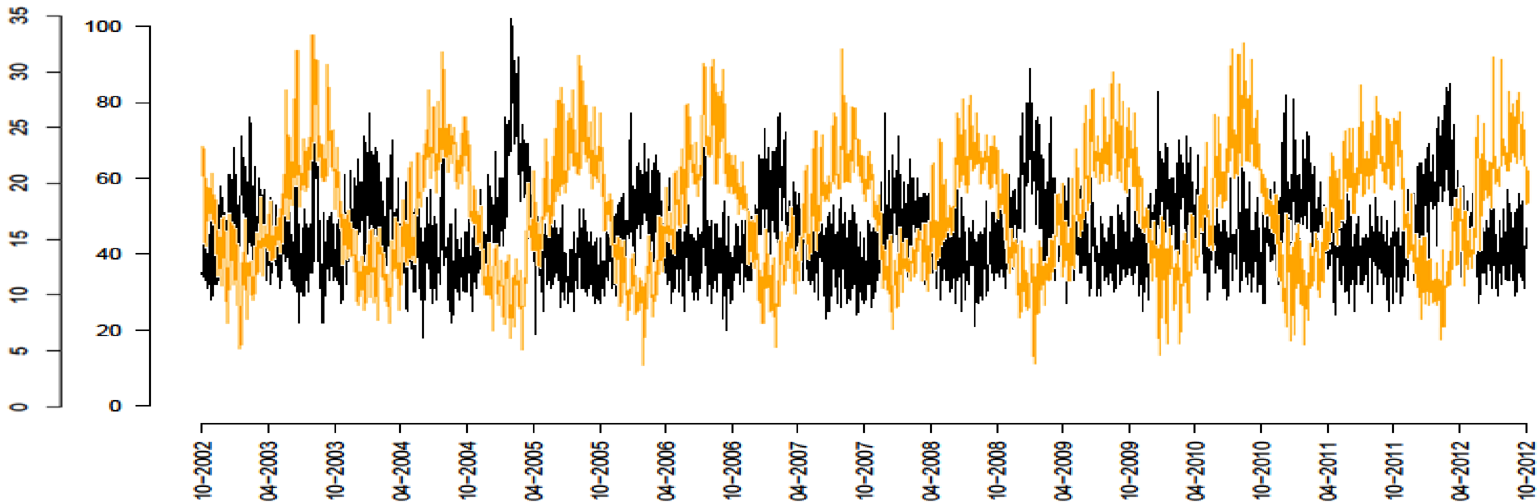
$$QBIC = -2\mathcal{L}(\hat{\theta})+\mathrm{Ln}(\mathrm{n})\hat{\phi}\mathrm{k}$$

- $\mathcal{L}$ *- Logarithm of the likelihood function associated to the model adjusted with parameters θ*
- ϕ *- overdispersion parameter*
- *k – number of parameters*
- *n – number of observations*

Lower values of these measures indicate better models

Principle of parsimony: Option for simpler models when the quality of the adjustment is similar

Results – Descriptive analysis

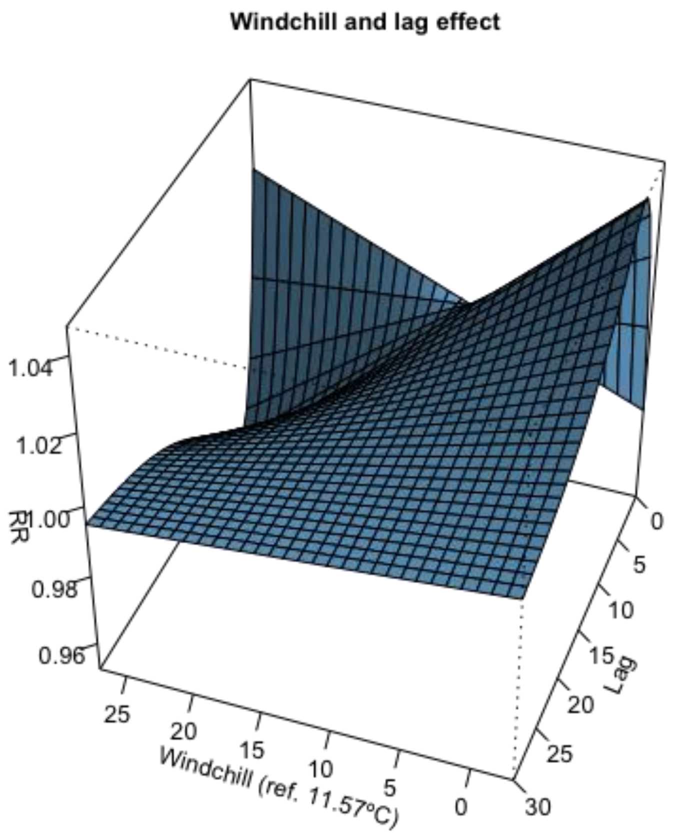


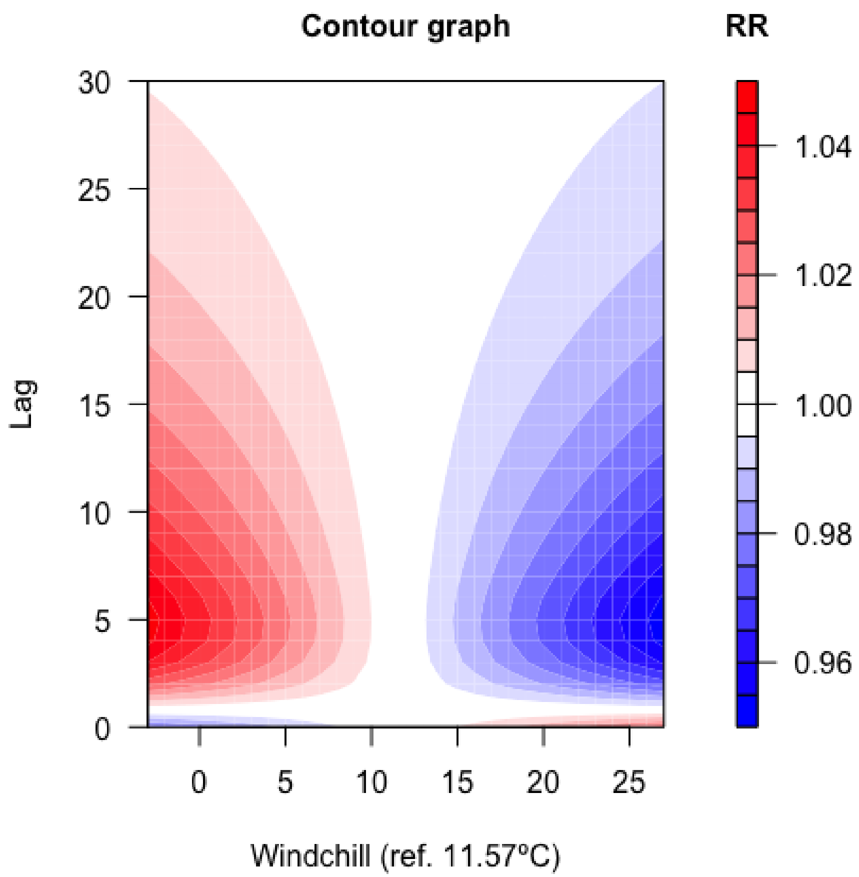
Variable	***Obs***	***Mean***	***Median***	***s.d.***	***min.***	***max.***
All Cause mortality	1830	49.98	49	10.94	25	102
Circulatory and Respiratory mortality	1830	27.34	26	7.91	8	67
Mean Temperature (ºC)	1830	13.77	13.35	3.63	3.75	26.45
Wind speed (m/s)	1830	3.14	2.9	1.81	0	11
Humidity (%)	1830	79.08	81	14.36	23	100
Windchill (ºC)	1830	11.44	11.57	4.82	-3.96	27.29

Results – All Cause Models

	Mean T.	Mean T. + Wind	Mean T. + Humidity	Windchill
Mean T. [lag]	lin [ns(4)]	lin [ns(4)]	lin [ns(4)]	-
Wind [lag]	-	lin [lin]	-	-
Humidity [lag]	-	-	double thr [lin]	-
Windchill	-	-	-	lin [ns(4)]
ILI [lag]	thr [ns(3)]	thr [lin]	thr [ns(3)]	thr [ns(3)]
QAIC	10582.30	10573.14	**10559.04**	10571.61
QBIC	10731.81	10728.13	10730.57	**10720.14**
No. of parameters	24	25	28	**24**

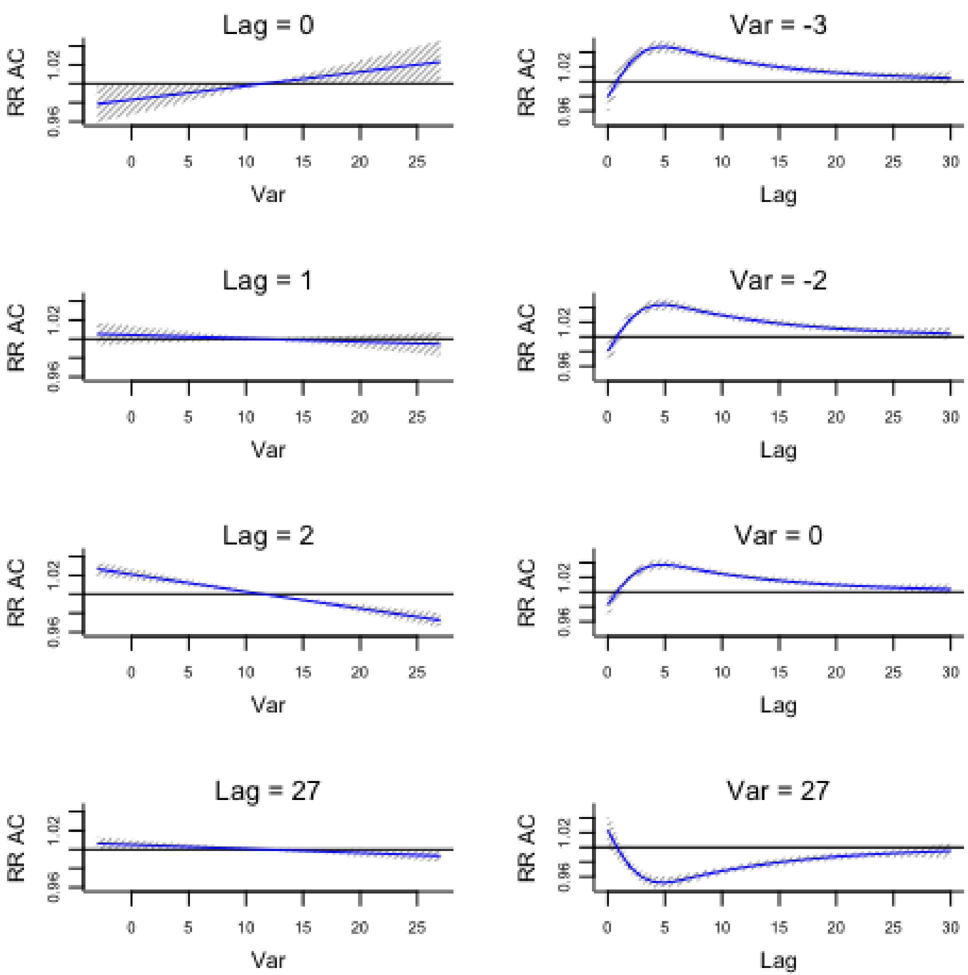
Results – AC *windchill*

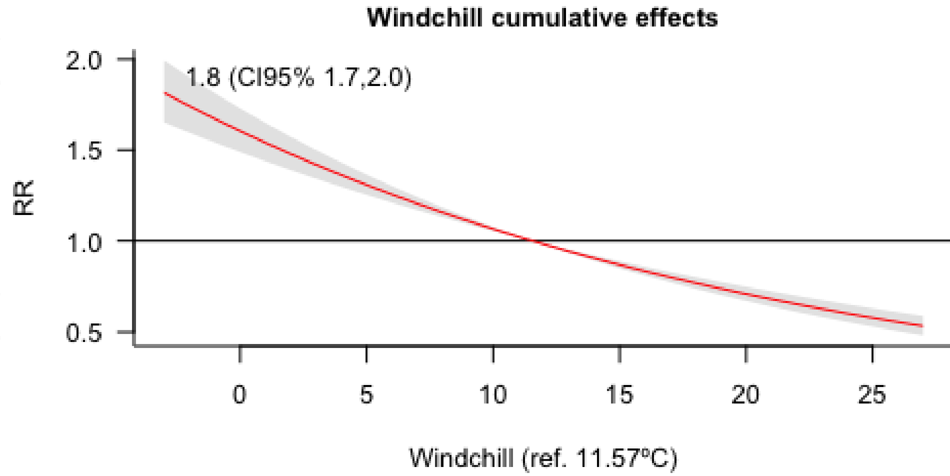


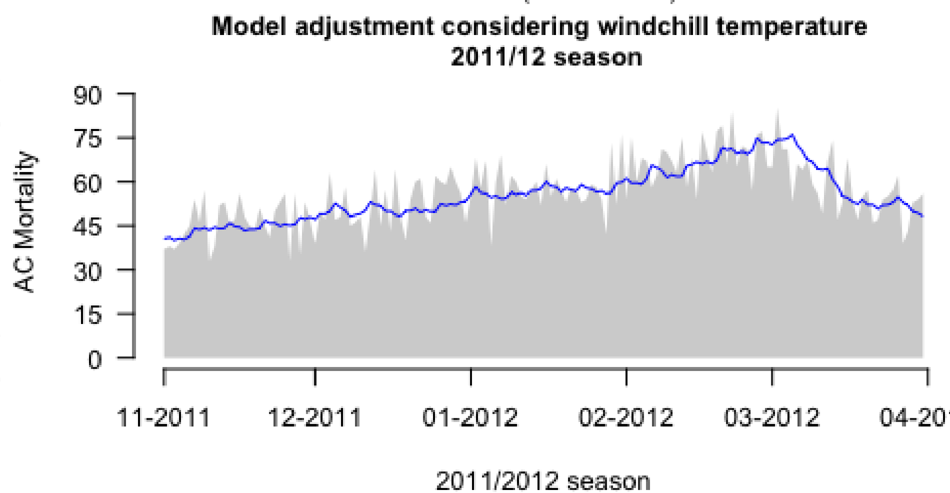


RR 1.047
lag 5
WC -3

Results – AC *windchill* (continued)



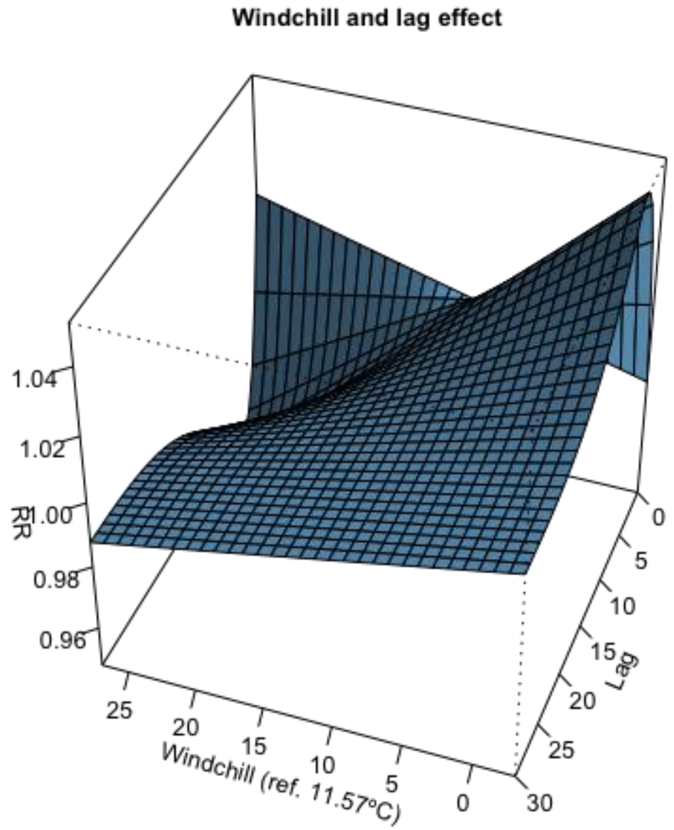


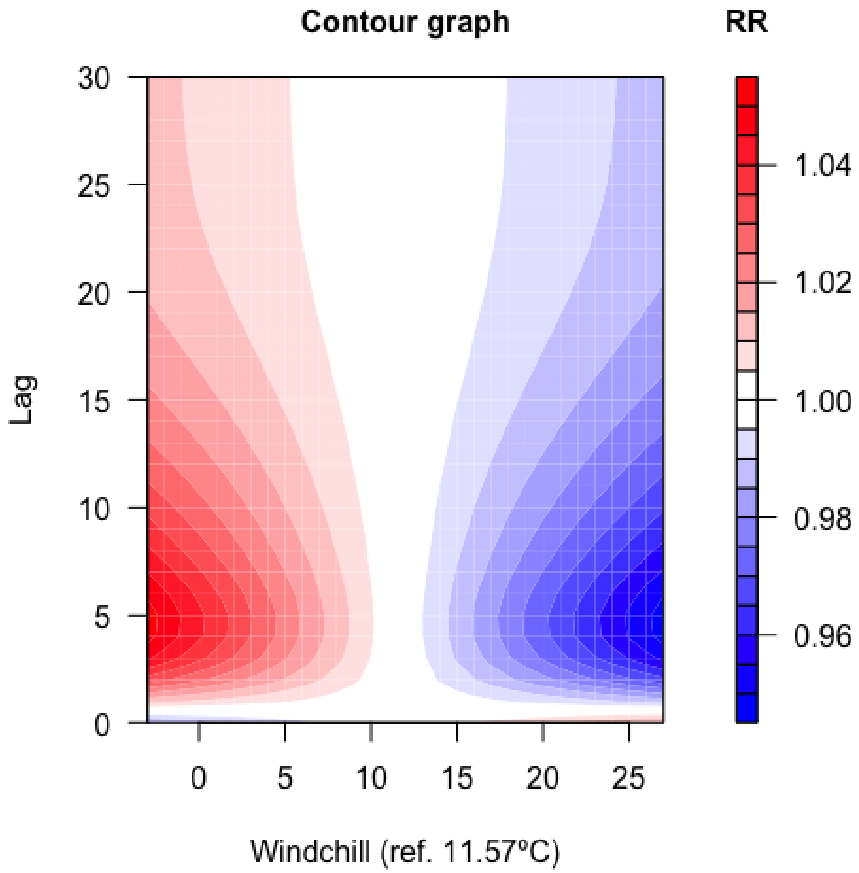


Results – Circulatory and Respiratory Models

	Mean T.	Mean T. + Wind	Mean T. + Humidity	Windchill
Mean T. [lag]	lin [ns(4)]	lin [ns(4)]	lin [ns(4)]	-
Wind [lag]	-	lin [lin]	-	-
Humidity [lag]	-	-	double thr [lin]	-
Windchill	-	-	-	lin [ns(4)]
ILI [lag]	thr [ns(3)]	thr [ns(3)]	thr [ns(3)]	thr [ns(3)]
QAIC	9660.08	9647.90	**9638.82**	9640.06
QBIC	9809.55	9808.72	9810.43	**9787.78**
No. of parameters	24	26	28	**24**

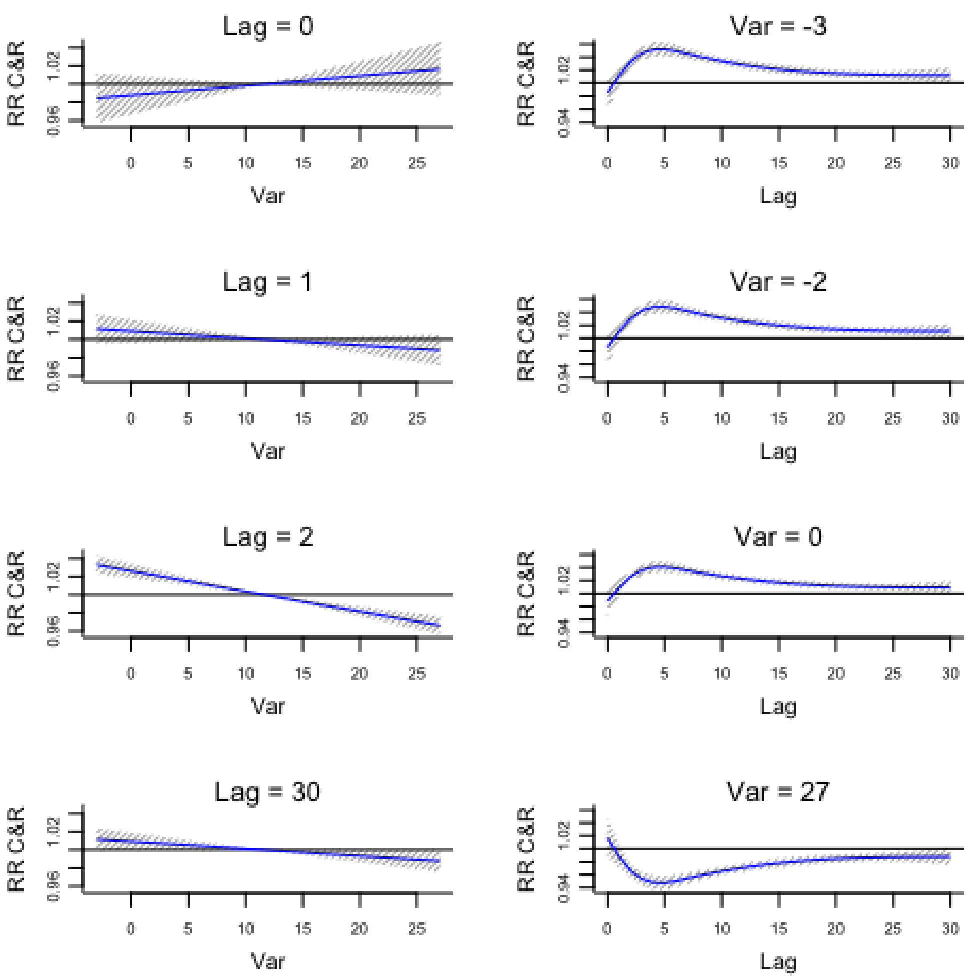
Results – C&R *windchill*

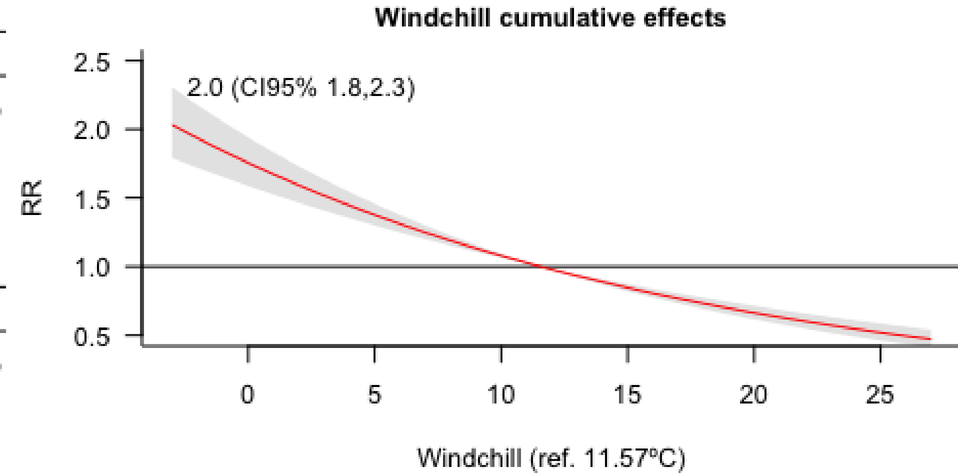


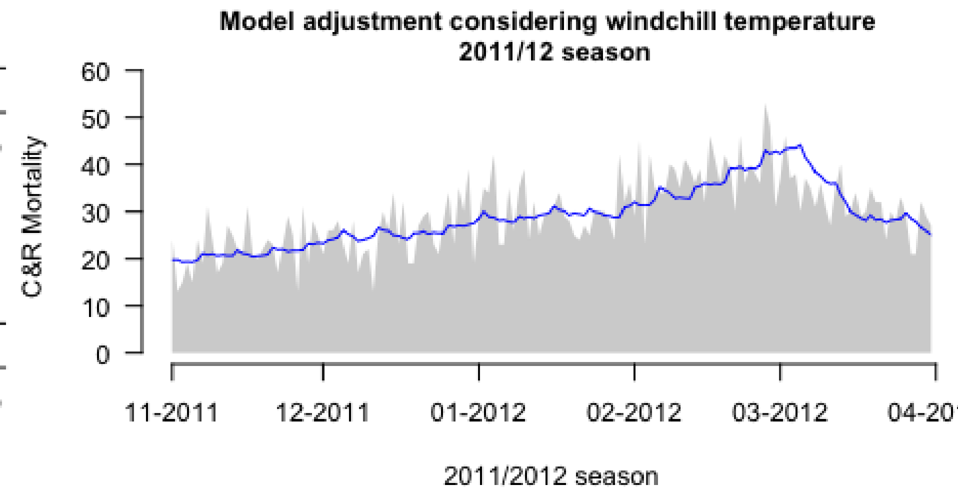


RR 1.052
lag 5
WC -3

Results – C&R *windchill* (continued)







Conclusions

- The method used was validated and allows flexible modeling of
  - the relationship between temperature and mortality whose effect is time-shifted
  - the relationship between the competitive factors such as the increase of the respiratory infections and the mortality
  - Allows the risk study using meteorological and biometeorological indices

- Low temperatures represent a good predictor of mortality in Lisbon
  - His effects was higher in mortality due to circulatory and respiratory diseases (Carmona et al, 2015)
  - Windchill temperature was a better descriptor than average temperature (Carder et al, 2005 and Kunst et al, 1994)

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Complete Report
in Portuguese

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