

# Biometric analysis of infant mortality and temperature

Northern Sweden 1895–1950

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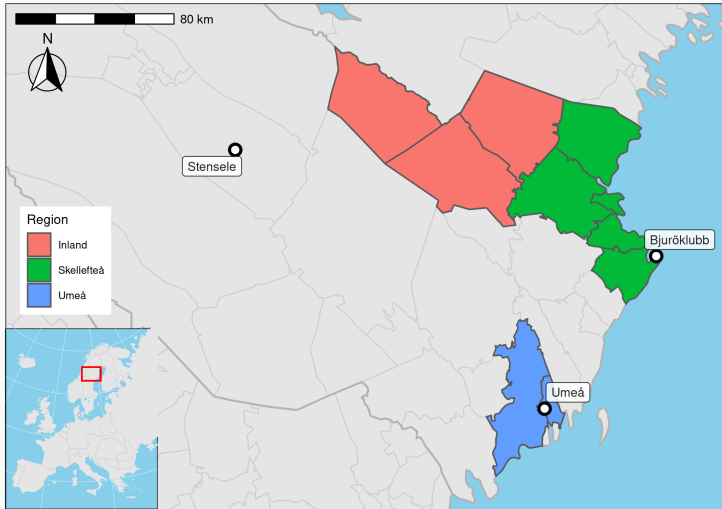
Web: [ehl.lu.se/kontakt/ekh-tbe](http://ehl.lu.se/kontakt/ekh-tbe)

- The impact of ambient temperature variations on infant mortality in Umeå-Skellefteå regions.
- Temperature with two components:
  - Expected temperature or climate (given time of the year).
  - Marginal temperature a given week a given year: *observed minus expected* temperature.
- Are the effects of expected and marginal different by
  - Social class?
  - Neonatal and postneonatal age periods?

## Earlier on weather and mortality

- **Neonatal mortality:** Junkka et al. (2021), Karlsson et al. (2021). Same area and time period.
- **Mortality general:** Rocklöv et al. (2014), Rogers (1928), Bengtsson (1993, 2004), Bengtsson and Broström (2010)

# Study area



## Temperature data 1–7 January 1923, Umeå

Date	Time	Temp	Quality
1923-01-01	07:00:00	0.4	G
1923-01-01	13:00:00	0.6	G
1923-01-01	20:00:00	0.0	G
1923-01-02	07:00:00	-1.4	G
1923-01-02	13:00:00	-1.4	G
1923-01-02	20:00:00	-1.2	G
1923-01-03	07:00:00	0.4	G
1923-01-03	13:00:00	0.8	G
1923-01-03	20:00:00	1.2	G
1923-01-04	07:00:00	1.4	G
1923-01-04	13:00:00	1.2	G
1923-01-04	20:00:00	1.0	G

Date	Time	Temp	Quality
1923-01-05	07:00:00	-1.4	G
1923-01-05	13:00:00	-3.2	G
1923-01-05	20:00:00	-3.4	G
1923-01-06	07:00:00	1.0	G
1923-01-06	13:00:00	0.4	G
1923-01-06	20:00:00	0.4	G
1923-01-07	07:00:00	0.6	G
1923-01-07	13:00:00	0.4	G
1923-01-07	20:00:00	0.4	G

52 weeks per year, 56 years = 2912 weekly means.

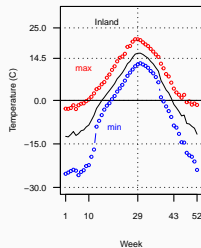
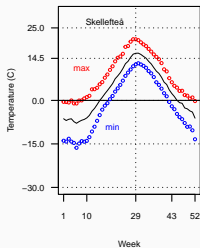
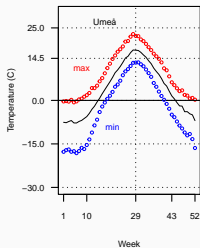
# Temperature variables

- **Temp**: Mean temperatures by week and year.
- **expTemp**: Mean of **Temp** for each week (over all years, *seasonality*).
- **margTemp**:  $\text{Temp} - \text{expTemp}$  (short term variation).

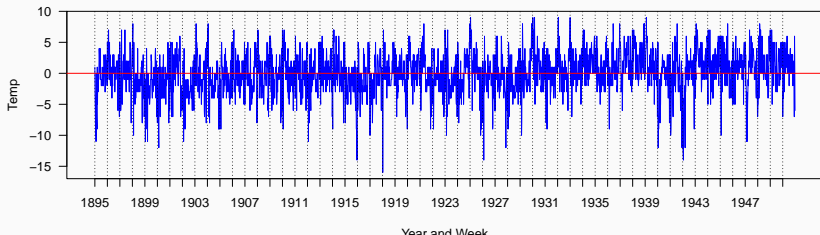
**expTemp** and **margTemp** are used in the analyses.

# Temperature variations

expTemp (one period):

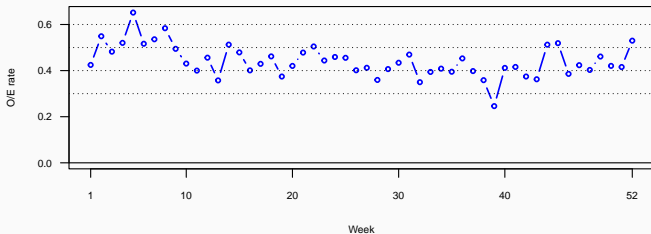


margTemp (Umeå):

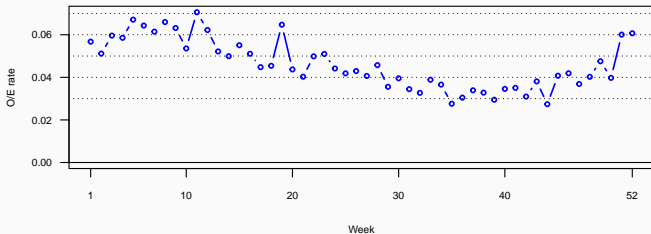


# Neonatal and postneonatal mortality by week

## Neonatal:



## Postneonatal:





# Infant mortality data

From [Centre for Ageing and Demographic Research](#), Umeå University.

## Merging of temperature and mortality data

Use the function `make.communal` in the **R** package `eha`.

Result for infant No. 1226 (selected variables):

id	enter	exit	event	socst	urban	year	week	expT	margT
1226	0	5	FALSE	farmer	FALSE	1901	7	-11	-5
1226	5	12	FALSE	farmer	FALSE	1901	8	-10	-4
1226	12	19	FALSE	farmer	FALSE	1901	9	-10	-6
1226	19	26	FALSE	farmer	FALSE	1901	10	-9	-11
1226	26	33	FALSE	farmer	FALSE	1901	11	-8	6
1226	33	40	FALSE	farmer	FALSE	1901	12	-7	5
1226	40	45	TRUE	farmer	FALSE	1901	13	-5	-1

**Weeks:** 1 = 1–7 Jan, . . . , week 52 = 24(23) - 31 Dec. **Every year!**

## Variables in regression analyses

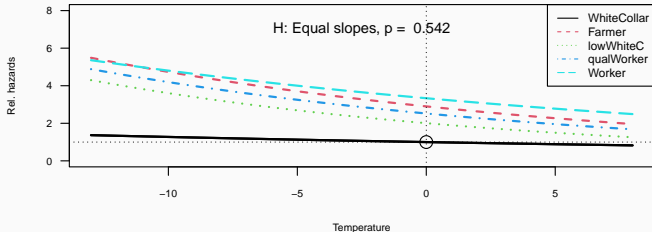
- **expTemp** (time varying) expected temperature given week number.
- **marginTemp** (time varying) Observed week temperature minus expTemp.
- **socst** Social status:
  - *highWhiteC* Upper white collar
  - *farmer*
  - *lowWhiteC* Lower white collar
  - *qualWorker* Qualified worker
  - *worker* Unqualified worker
  - *none* No notation (for instance unmarried mother)
- **sex** Boy or girl
- **urban** Small town (Umeå or Skellefteå) or not (logical)
- **parity** Birth order
- **year** (time varying)

## Postneonatal mortality, winter (weeks 40–52, 1–13)

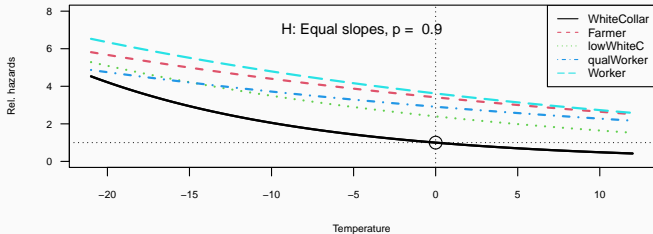
Covariate	Mean	Coef	H.R.	S.E.	L-R p
expTemp	−3.763	−0.046	0.955	0.005	0.000
marginTemp	0.018	−0.017	0.983	0.005	0.000
socst					0.000
highWhiteC	0.030	0	1	(reference)	
farmer	0.464	0.836	2.308	0.219	
lowWhiteC	0.078	0.785	2.192	0.230	
qualWorker	0.134	0.947	2.579	0.222	
worker	0.270	1.047	2.848	0.219	
none	0.025	1.003	2.727	0.253	
urban					0.642
FALSE	0.860	0	1	(reference)	
TRUE	0.140	0.035	1.036	0.076	
l(year - 1920)	3.267	−0.024	0.976	0.001	0.000
Events	2346	TTR	46214		
Max. logLik.	−25069				

# Interactions postneonatal, winter

Interactions between socst and expTemp:



Interactions between socst and marginTemp:

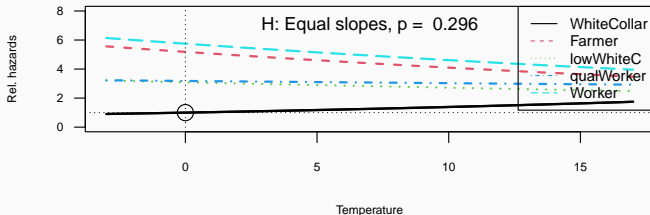


## Postneonatal mortality, summer

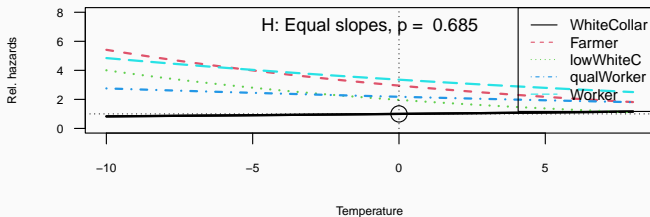
Covariate	Mean	Coef	H.R.	S.E.	L-R p
expTemp	9.578	-0.019	0.981	0.004	0.000
marginTemp	0.003	-0.011	0.989	0.010	0.259
socst					0.000
highWhiteC	0.030	0	1	(reference)	
farmer	0.464	0.744	2.105	0.231	
lowWhiteC	0.078	0.605	1.831	0.245	
qualWorker	0.133	0.678	1.971	0.236	
worker	0.270	0.988	2.686	0.230	
none	0.025	0.903	2.467	0.268	
urban					0.936
FALSE	0.860	0	1	(reference)	
TRUE	0.140	0.007	1.007	0.086	
l(year - 1920)	3.217	-0.023	0.977	0.002	0.000
Events	1914	TTR	45958		
Max. logLik.	-20498				

# Interactions postneonatal, summer

Interactions between socst and expTemp:



Interactions between socst and marginTemp:



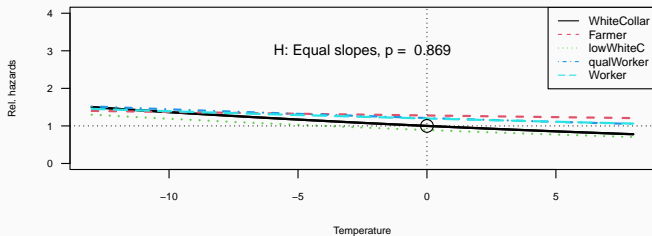
# Neonatal mortality, winter

Covariate	Mean	Coef	H.R.	S.E.	L-R p
expTemp	-3.771	-0.013	0.987	0.005	0.007
marginTemp	-0.026	-0.011	0.989	0.005	0.039
socst					0.384
highWhiteC	0.029	0	1	(reference)	
farmer	0.471	-0.076	0.927	0.158	
lowWhiteC	0.076	-0.170	0.844	0.177	
qualWorker	0.130	0.063	1.065	0.162	
worker	0.270	-0.037	0.964	0.159	
none	0.024	-0.010	0.990	0.210	
urban					0.571
FALSE	0.863	0	1	(reference)	
TRUE	0.137	-0.047	0.954	0.084	
I(year - 1920)	2.104	-0.015	0.986	0.002	0.000
Events	1806	TTR	3899		
Max. logLik.	-19493				

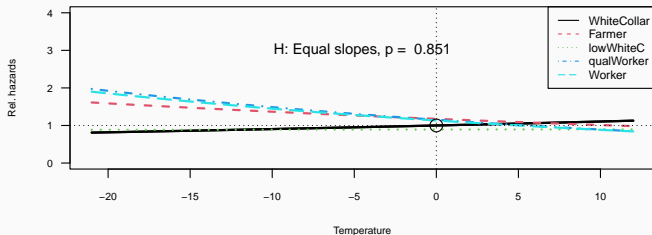


# Interactions neonatal, winter

Between socst and expTemp:



Between socst and marginTemp:

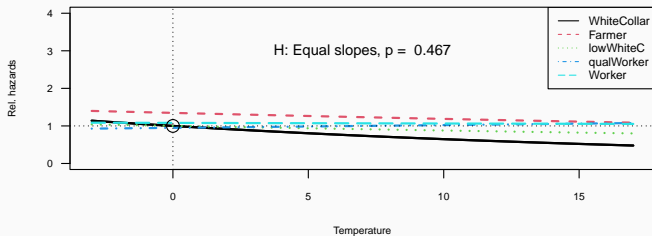


# Neonatal mortality, summer

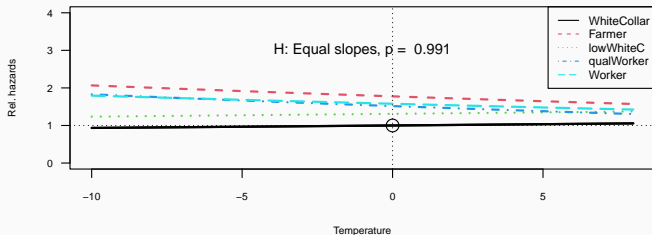
Covariate	Mean	Coef	H.R.	S.E.	L-R p
expTemp	9.416	−0.008	0.992	0.004	0.056
marginTemp	0.019	0.007	1.007	0.011	0.498
socst					0.098
<i>highWhiteC</i>	0.029	0	1	(reference)	
<i>farmer</i>	0.460	0.329	1.389	0.191	
<i>lowWhiteC</i>	0.078	0.209	1.232	0.207	
<i>qualWorker</i>	0.135	0.321	1.379	0.196	
<i>worker</i>	0.272	0.265	1.304	0.192	
<i>none</i>	0.026	0.588	1.800	0.227	
urban					0.030
<i>FALSE</i>	0.860	0	1	(reference)	
<i>TRUE</i>	0.140	−0.190	0.827	0.089	
I(year - 1920)	2.960	−0.012	0.988	0.002	0.000
Events	1689	TTR	4026		
Max. logLik.	−18304				

# Interactions, neonatal, summer

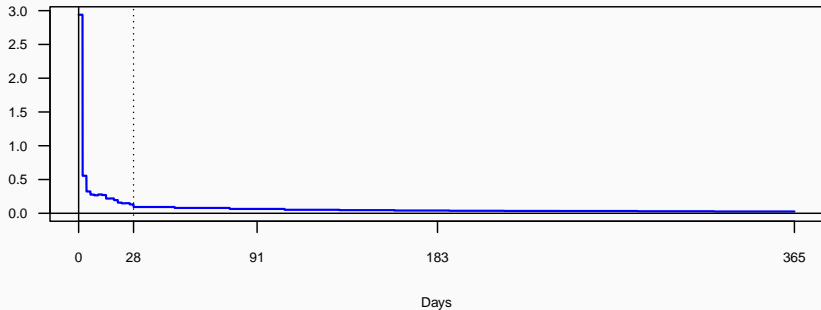
Between socst and expTemp:



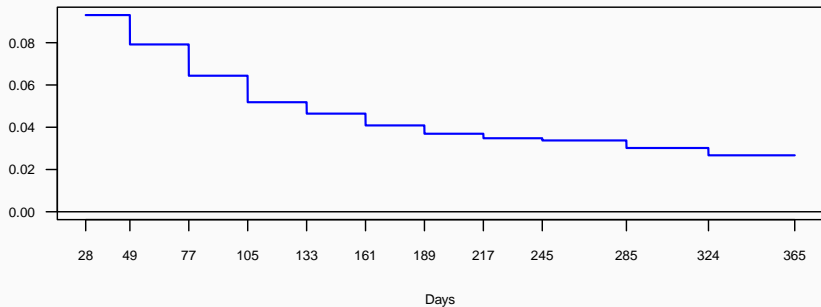
Between socst and marginTemp:



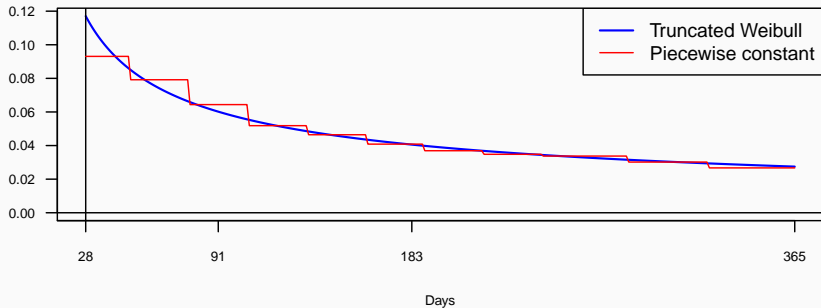
# Infant mortality hazard function



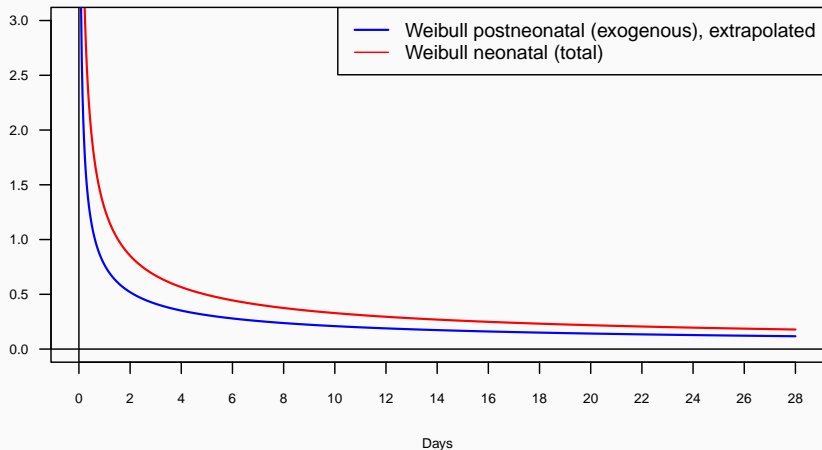
# Postneonatal hazard function



# A Weibull approximation



# Endogenous and exogenous neonatal mortality



Jean Bourgeois-Pichat (1951, 1952) would be pleased!

(The “biometric” model)

# Conclusions

- **Season** (“expected” temperature, *climate*) more **important** than deviations from it.
- **Sensitivity** to temperature levels and variations **do not vary** much by social class but is **stronger during winter** than during summer.
- The **most privileged** are
  - **well prepared** for variation in **climate**, but
  - more **like the others** when it comes to **unexpected cold** weather during winter.