

## **Seasonality and early childhood mortality in the Netherlands, 1812-1912**

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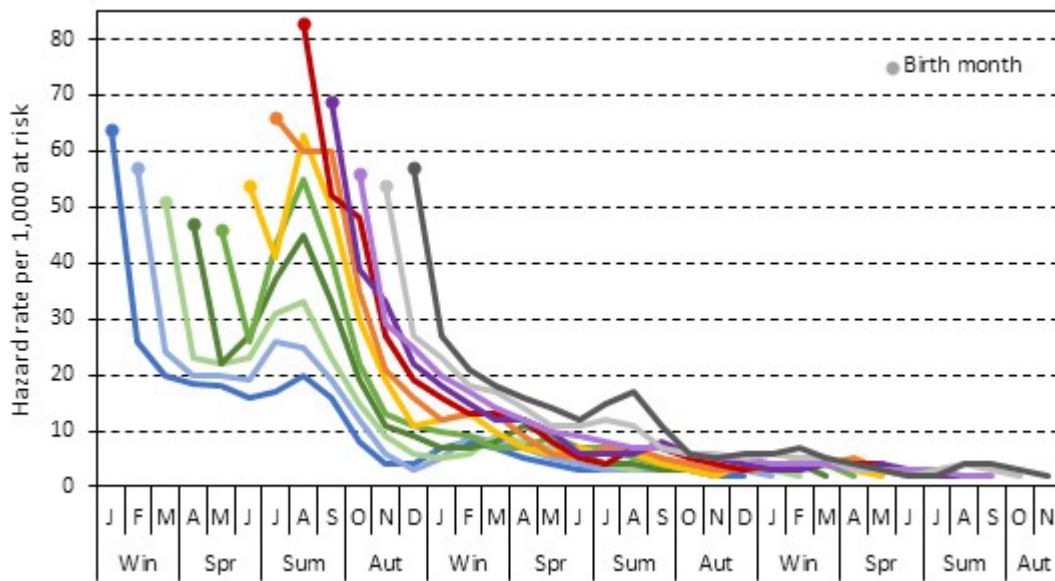
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It has long been known that mortality is affected by seasonality. Ancient Chinese, Greek, and Indian medical works already recognized the influence of seasonal changes on human health (Dong 2011). In particular in the 19<sup>th</sup> century, many medical doctors and statisticians across Europe stimulated their national statistical offices to collect data on seasonal patterns in mortality (Breschi & Livi-Bacci 1997). Historical demographers and social historians have widely used these data to study the influence of seasonality on infant and (early) childhood mortality. Now that more refined microdata have become available over long periods of time and for larger regions, there are new opportunities to study the long-term and area-specific relationship between seasonality and childhood mortality. This article presents some selected outcomes on temporal, regional and social variation in the seasonal patterns of infant and early childhood mortality in the Netherlands based on Van Poppel et al. (2018). The study used a large microdata set of three of the eleven Dutch provinces (~1.6 million live born children), containing information on the mortality and background characteristics of children born between 1812 and 1912.

### **Seasonal mortality patterns**

Results are shown for the province of Zeeland, a predominantly rural region located in the southwest of the Netherland. Zeeland was characterized by very high infant mortality, in many parts even higher than 300 deaths per 1,000 live births. Figure 1 shows early childhood mortality rates by consecutive month of birth from January to December during the first 24 months of life. Infant mortality in the first month of life (the dots in the graph) shows a seasonal pattern with the highest risks (hazard rates) for those born in summer and winter. Mortality risks for those born in the summer were higher than for those born in the winter. Although mortality risks were roughly declining as children grew older, cohort mortality rates did not show a continuous decline over time. In particular, in the first summer after birth, mortality rates increased again. Mortality rates in August were even higher for those born in May and June than in their month of birth. Although mortality rates in general declined again after the summer mortality peak, this again was not a continuous decline.

Figure 1. Monthly hazard rates by month of birth in Zeeland (The Netherlands) 1812-1912



Source: Van Poppel et al. (2018).

However, this cannot be easily read from Figure 1. Therefore, Figure 2 shows the same data by month of birth and calendar month in a two-dimensional heat map table. The heat map clearly shows the summer mortality peaks, but also reveals a cohort mortality increase that clusters in the diagonal of higher mortality twelve to thirteen months after birth. Children born in the summer showed no increased risk entering their second summer period.

Figure 2. Monthly hazard rates (per 1,000 at risk) by month of birth in Zeeland (The Netherlands), 1812-1912

Period Birth month	Winter			Spring			Summer				Autumn			Winter			Spring			Summer			Autumn																
	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N			
Winter	J	44	26	20	19	18	16	17	20	16	8	4	4	7	8	7	5	4	3	3	3	4	3	2	2														
	F		52	24	20	20	19	26	25	19	12	6	3	5	9	8	7	5	4	3	3	3	3	3	3	3													
Spring	M			51	23	22	23	31	33	23	15	9	6	5	6	9	8	7	5	4	3	4	3	3	3	3	2												
	A				47	22	27	37	45	33	19	11	9	7	7	8	11	9	6	4	4	3	3	3	3	4	4	2											
	M					46	26	43	55	41	22	13	11	10	9	7	7	9	7	7	5	4	3	3	3	4	4	4	2										
Summer	J						54	41	13	30	30	19	11	12	13	10	7	6	7	6	6	4	3	2	4	3	5	4	3	2									
	J							50	10	10	35	21	16	12	13	13	9	6	5	7	7	5	4	3	3	3	4	4	5	3									
	A								52	48	27	19	16	13	13	12	8	5	4	7	7	5	4	3	4	4	4	4	4	2	3								
Autumn	S									49	39	33	22	18	15	12	12	10	6	6	6	8	6	5	4	3	3	4	3	4	3	2	2						
	O										56	29	25	20	17	14	12	10	9	8	7	7	6	5	5	4	4	4	3	3	3	3	2	2					
Winter	N											54	27	23	18	17	14	11	11	12	11	7	6	6	5	6	5	5	3	3	2	3	4	3	2				
	D												57	27	21	18	16	14	12	15	17	11	6	5	6	6	7	5	4	3	2	2	4	4	3				

Source: Van Poppel et al. (2018).

Seasonal patterns were similar for separate social classes (not shown). Mortality differences in the first month of life were similar for children born to workers, farmers and the middle class. However, the mortality risks in the first summer after birth were much lower (around 40%) for

children from farmers and slightly lower (around 13%) for middle-class children than for working-class children.

### **What explains regional differences in seasonal mortality?**

Seasonal effects in early childhood mortality over the period 1812-1912 were quite strong in the province of Zeeland. Seasonal patterns in other provinces, in the northeast of the country, were much weaker. Similar regional differences were found for Italy by Breschi et al. (1997) and Germany by Knodel (1983). Such large differences in seasonal patterns, even in a relatively small country like the Netherlands, with only small differences in weather conditions, suggest that social, economic and ecological conditions and cultural practices might be more relevant than temperature. The high summer peak in mortality in the rural province of Zeeland might be explained by the relatively high participation of women in agricultural activities, which peak in the summer. These women were often away from home, causing early weaning or irregular breastfeeding of children and a lesser degree of care and protection. An additional factor was the difference in the sanitary situation across the country. Due to the gradual salinization of surface and ground water and the high groundwater level in Zeeland, the sanitary situation in Zeeland was generally worse than in many other regions in the Netherlands, providing an ideal environment for the malaria-carrying mosquito. Where breastfeeding was absent or irregular and artificial feeding was practiced, the salinization and the high level of environmental contamination of the water strongly increased the risk of diarrhoea, the main cause of death among infants. It thus was the interaction between low incidence of breastfeeding and the atrocious condition of the drinking water and sanitation that led to high summer mortality in Zeeland, not only for children born in summer but also for children born a few months before summer.

### **Extreme weather conditions and health vulnerability: An ongoing challenge**

While in general social, economic and ecological conditions and cultural practices might have been more relevant than temperature, more extreme climatic conditions, like heat waves and cold spells, did affect mortality. Ekamper et al. (2009, 2011) found that in the Netherlands in the 19<sup>th</sup> and early 20<sup>th</sup> century, young children were by far the most vulnerable group when temperatures reached extremely high or low values. In particular in the province of Zeeland infants and young children endured strongly increased mortality rates during extreme weather conditions. Here, again, the lowest social classes were the most vulnerable to heat waves and cold spells. Over time, however, infants and young children became less and less sensitive to temperature fluctuations. Nowadays, in Europe the elderly population has become the most vulnerable to extreme temperatures (Masselot et al. 2023). However, in other parts of the world, such as Africa, children still are among the most vulnerable (Chapman et al. 2022).

Further information:

- The associated image of this post can be found [here](#).
- This post is based on the research article by the author: Van Poppel, F., Ekamper, P. & Mandemakers, K. (2018), Season of birth and early childhood mortality: A review of the debate and a case study for the Netherlands, 1812-1912. In: P. Puschmann & T. Riswick (Eds.), *Building Bridges. Scholars, History and Historical Demography*. Nijmegen: Valkhof Pers, p. 590-625.

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