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# Infant mortality in Japan after Fukushima

English version

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## Summary

Following the nuclear disaster at Fukushima Dai-ichi, Japanese infant mortality monthly data exhibit distinct peaks in May 2011 and December 2011, 2 and 9 months after the melt-downs in March 2011. After Chernobyl, an analysis of data of early infant mortality in West Germany also found peaks in June 1986 and February 1987, i.e. 2 and 9 months after the Chernobyl disaster on 26 April 1986.
In December 2011, 9 months after Fukushima, there is a significant deficit in the number of live births in Japan. Similarly, a significant decline in birth numbers was found in February 1987 in southern Bavaria, the German region most affected by the Chernobyl fallout. In Japan as well as in Bavaria, the effect is limited to a single month.

## Background

The first health effects from the catastrophic accident at the nuclear power plant in Fukushima Dai-ichi on 11 March 2011 might be expected to be seen in infant mortality data. A German study [1], conducted after the Chernobyl accident on April 1986, showed noticeable increases in early infant mortality (i.e. deaths in the first week of life) in June 1986 and at the beginning and the end of 1987. The maximum in February 1987 was interpreted in [1] to be due to damage to the embryo at the critical stage of pregnancy. From the German experience, one would expect a similar increase in infant mortality in Japan after Fukushima.

## Data and Methods

Monthly data of infant mortality from Japan can be found on the website of the Japanese Ministry of Health and Labour, http://www.mhlw.go.jp/toukei/list/81-1a.html. However, as there is no English version, the required data, i.e. the numbers of live births and infant deaths, were provided by a Japanese friend, Masao Fukumoto. The German monthly data of early infant mortality data, 1980 to 1993, were obtained from Statistisches Bundesamt in Wiesbaden.

The monthly rates of infant mortality from January 2002 through March 2011 were analyzed with linear logistic regression, taking into account seasonal variations. The course of the data from April 2011 to May 2012 was compared with the extrapolated trend of the data before Fukushima. In addition, an analysis of the data for the entire study period was performed (January 2002 to May 2012); the possible increase in infant mortality after March 2011 was estimated by a dummy variable.

Results

(a) infant mortality

The regression model yields a good fit to the data from 2002 to March 2011 (deviance = 86.0, df = 98). Figure 1 shows infant mortality rates and the long-term trend. After Fukushima, pronounced peaks in infant mortality appear in May 2011 and December 2011.
Figure 2 shows the residuals, i.e. the differences between observed and expected rates, in units of standard deviations. The dashed lines indicate the range of 2 standard deviations in which 95% of the data points normally should lie.

The test for an increase in mortality in April 2011 through May 2012 compared to the extrapolated trend of the data prior to April 2011 yields an upward shift of 4.0% (P = 0.100).
The Japanese results were compared with the results of an analysis of monthly data of early infant mortality in West Germany, 1980 to 1993 (see Figure 3). Figure 4 shows the deviations of early infant mortality from the long-term trend. Significant increases are found in June 1986, February 1987, and November 1987.

The mortality peaks in the German data in February 1987 and November 1987 are associated with peaks of cesium burdens in pregnant women. In particular, the November 1987 peak follows an increase in cesium content in cows' milk during the winter 1986/87 when cows were fed with cesium-contaminated silage. The December 2011 peak in the Japanese data parallels the February 1987 peak in the German data, with similar time lags from the respective nuclear accidents.

As to the peak in the Japanese data in May 2011, two months after Fukushima, the author is not aware of a radiobiological explanation. But since a mortality peak is also found in the German data in June 1986, about two months after the Chernobyl disaster on 26 April 1986, a radiological cause seems likely.

(b) decline in live births

Interestingly, there is also a statistically significant reduction in the number of live births in December 2011 in Japan as a whole (minus 4.7%, P = 0.007, see Figure 5) and, more pronounced, in Fukushima prefecture (minus 15.4%, P = 0.0001). In the previous month (November 2011) and the following month (January 2012), the birth numbers are not decreased.

A similar effect is found after Chernobyl in Bavaria. In February 1987, 9 months after the nuclear disaster, the number of births fell by 8.7% relative to the expected value. As in Japan, the decrease is limited to a single month (February 1987), because no effect is seen in January 1987 and March 1987. In southern Bavaria, where the cesium soil contamination was significantly higher than in northern Bavaria, the decline in births is more pronounced (minus 11.5%, P = 0.001, see Figure 6) than in northern Bavaria (minus 5.0%, P = 0.162). The cause of the falling birth rate could be a radiation-induced loss of zygotes shortly after fertilization.

[1] Körblein A, Küchenhoff H. Perinatal mortality in Germany following the Chernobyl accident. Radiat Environ Biophys. 1997 Feb;36(1):3-7.

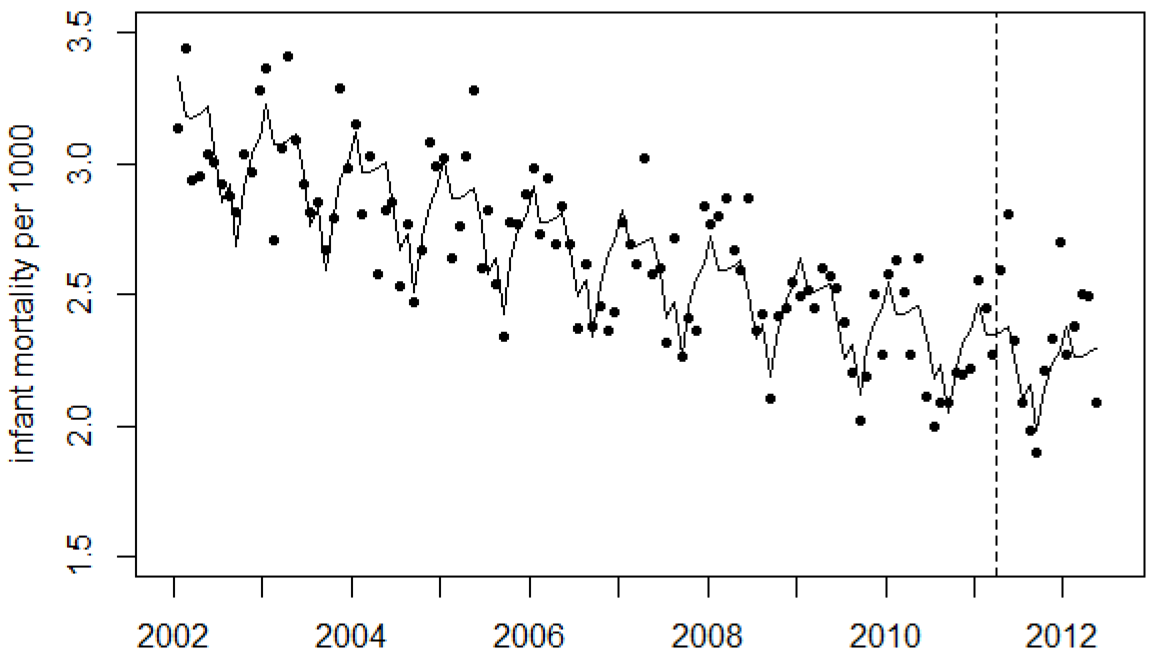


Fig.1: Monthly infant mortality rates in Japan and trend line. The vertical broken line indicates the end of March 2011.

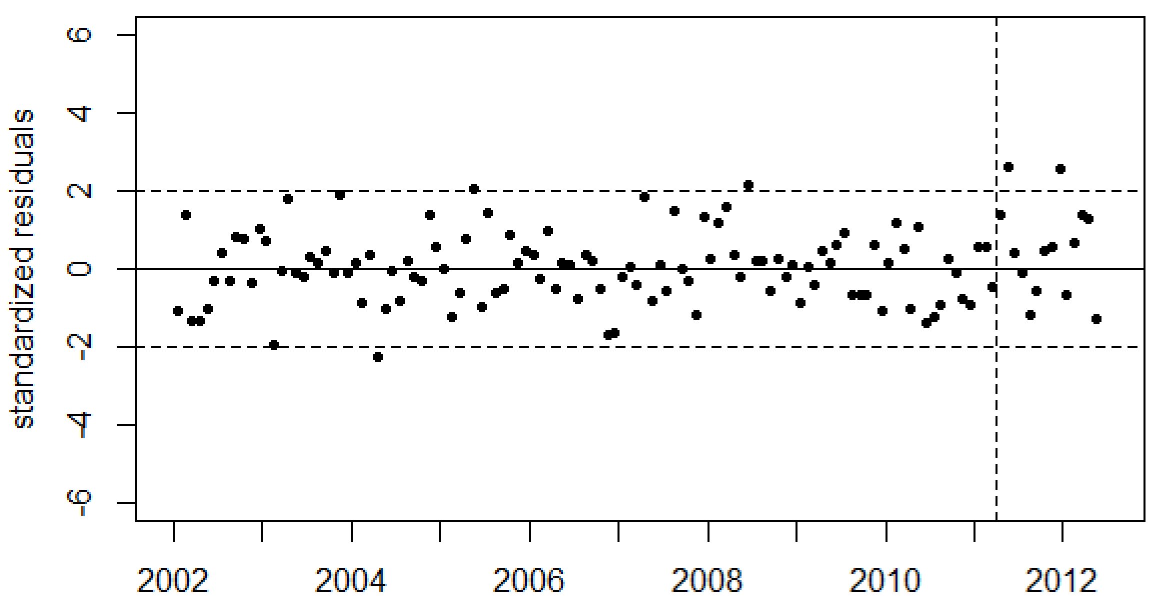


Fig.2: Deviations of infant mortality rates from the expected trend in units of standard deviations (standardized residuals). Die horizontal broken lines show the range of two standard deviations.

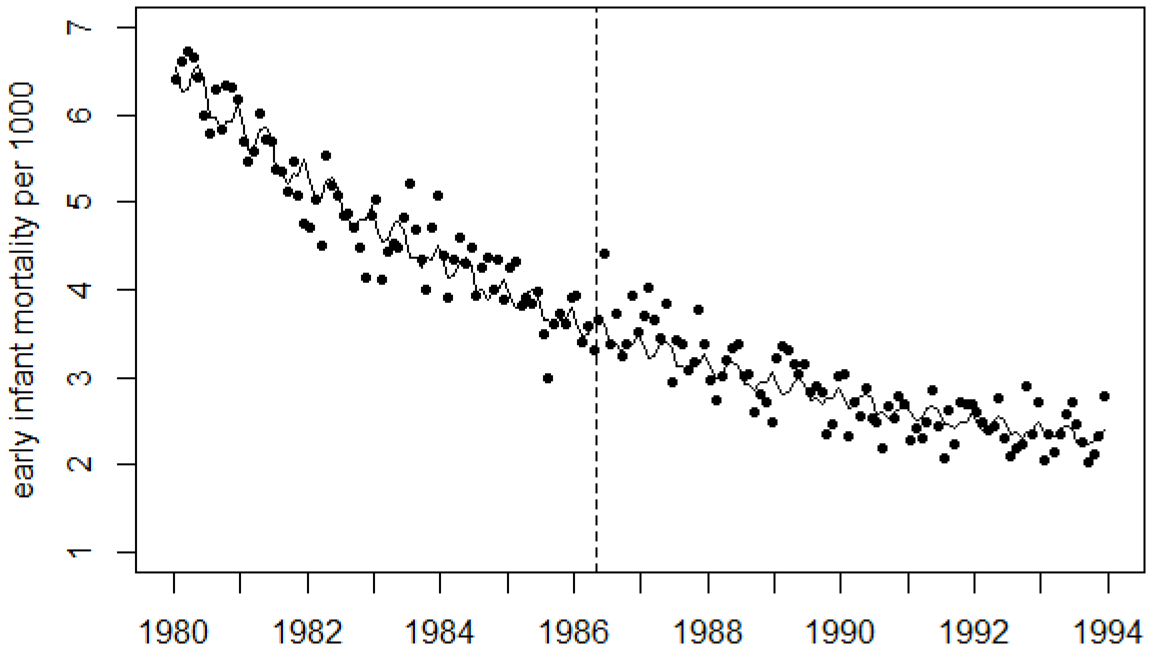


Fig.3: Early infant mortality rates (0-6 days) in West Germany and trend line. The vertical broken line indicates the end of April 1986.

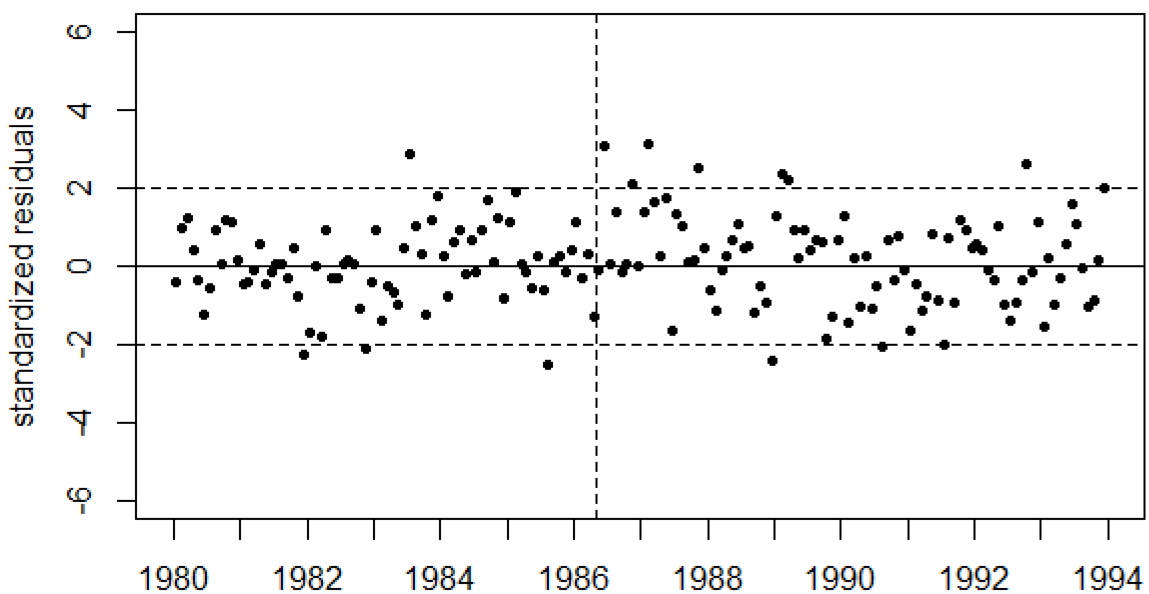


Fig.4: Deviations in the early infant mortality rates in West Germany from the expected trend in units of standard deviations (standardized residuals). The horizontal broken lines show the range of two standard deviations.

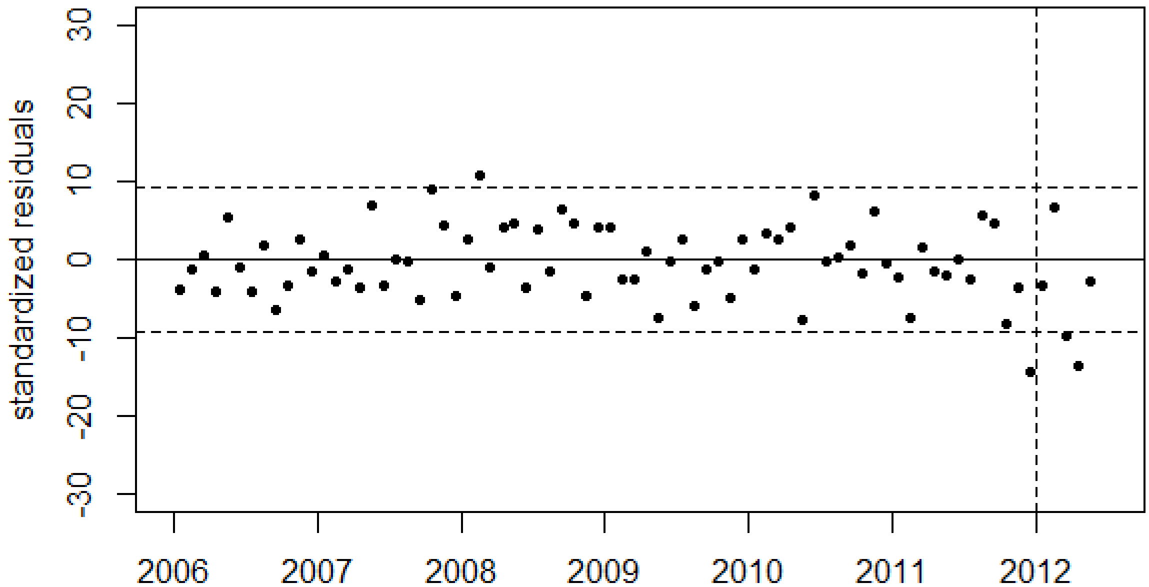


Fig.5: Deviations in the monthly numbers of live births in Japan from expected numbers (standardized residuals). The horizontal broken lines show the 95% prediction limits.

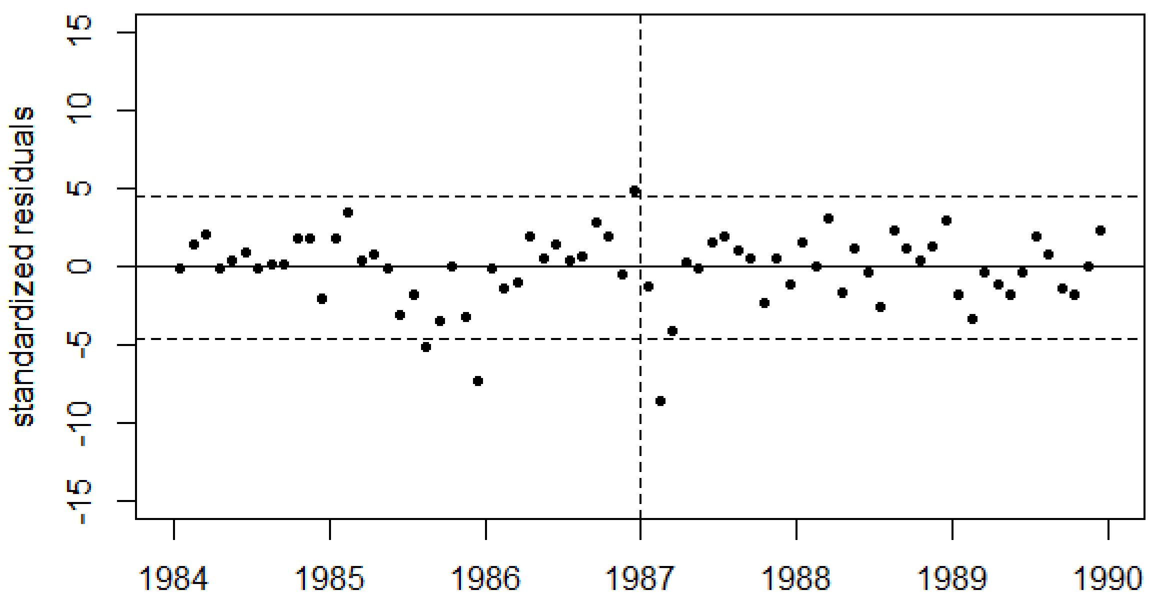


Fig.6: Deviations in the monthly numbers of live births in Southern Bavaria from expected numbers (standardized residuals). The drop in February 1987 is statistically significant.