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Reduction in the suicide rate during Advent—a time series analysis

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Abstract

Research has shown that there are different seasonal effects in suicide. The aim of this study is to demonstrate that the decrease in suicide rate at the end of the year is extended over the last weeks of the year and represents a specific type of seasonal effect. Suicide data were extracted from individual records of the Swiss mortality statistics, 1969–2003. The data were aggregated to daily frequencies of suicide across the year. Specifically, the period October–February was examined using time-series analysis, i.e., the Box–Jenkins approach with intervention models. The time series models require a step function to account for the gradual drop in suicide frequencies in December. The decrease in suicide frequencies includes the whole Advent and is accentuated at Christmas. After the New Year, there is a sharp recovery in men's suicide rate but not in women's. The reduction in the suicide rate during the last weeks of the year exceeds the well-recognised effect of reduced rates on major public holidays. It involves valuable challenges for suicide prevention such as timing of campaigns and enhancement of social networks.

Keywords: Seasonality; Prevention; Epidemiology; Switzerland

1. Introduction

Research and administrative statistics from the 19th century onwards have shown that suicide frequency peaks in the late spring and summer months and is least frequent during the winter (Kevan, 1980; Massing and Angermeyer, 1985). These well-known seasonal fluctuations are superimposed by additional temporal fluctuations such as the drop in suicides around major public holidays such as Christmas and New Year's eve (Phillips and Wills, 1987; Jessen and Jensen, 1999). Recent descriptive analyses have suggested that the decrease in suicide frequencies in December is not restricted to Christmas and New Year's Eve but extends across the whole Advent season and represents a specific type of seasonal effect (Ajdacic-Gross et al., 2003). This study aims to provide more detailed evidence on this phenomenon using intervention models within a Box–Jenkins modelling framework.

2. Methods

These analyses rely on suicide data extracted from computerised records of Swiss mortality statistics (Minder and Zingg, 1989). The individual records cover the period 1969–2003. Switzerland used the ICD8 coding

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system until 1994 and then switched to ICD10 coding in 1995. Suicide comprised the ICD8 codes 950–959 and the ICD10 codes X60–X84, respectively. Suicide is regularly registered as the main cause of death. The 35-year period included 49,763 suicides—35,079 (70.5%) men and 14,684 (29.5%) women.

The data were aggregated by day of death on the annual cycle, thus resulting in virtual time series. February 29th was excluded from the analyses. The range of the aggregated daily frequencies of suicide is between 183 (May 13th) and 80 (December 25th). To allow the modelling of time series across the turn of the year, the data were arranged by sequencing the year from July 1st to June 30th. The data used in these analyses were restricted to the period October 1st to February 28th. This 151-day time window comprised 19,963 suicides (14,037 men and 5926 women). Besides analysis of overall data, the analyses were differentiated by sub-periods (1969–1985 vs. 1986–2003), by sex and age (−29, 30–59 and 60+), and by religious affiliation (Catholics vs. Protestants). Below, we present results from sex-specific analyses.

The time series of aggregated daily frequencies of suicide in men and in women were analysed with the Box–Jenkins modelling approach, which is also known as Autoregressive Integrated Moving Average–ARIMA modelling (Box and Jenkins, 1970). A basic ARIMA(p, d,q) model may comprise an auto-regressive AR(p) process, a moving-average MA(q) process, and, for the purpose of transforming the series to a (mean-)stationary series, a differencing term d (see also Gottman, 1981, Diggle, 1990; Schmitz, 1989). However, ARIMA was interesting for our purposes mainly because it makes assessing temporary departures from the baseline possible. Two approaches are at our disposal:

- Firstly, ex-post-forecasting, which is based on modelling a preliminary part of the time series to determine a model forecast which can be compared with the actual rest of the time series (Helfenstein, 1991a);
- Secondly, intervention models to account for shifts (steps) and pulses in the series in a direct manner (for an example, see the work of Schimek, 1988). Even though an intervention model is related to a specific target date, the effects can be immediate or delayed; they can involve instantaneous or gradual change and can include eventual after-effects (Helfenstein, 1991b).

While the first approach gives evidence on a general level whether a shift and/or a pulse might be relevant, the second approach provides more detailed information about the specific dynamics of change. We chose the second approach to model the suicide time series at the turn of the year.

The concrete procedure was to examine firstly basic ARIMA models in time series in men and women (for steps in identification of a transfer function model, see Helfenstein, 1996). Preliminary analysis was performed with the October/November series before extending the analysis on the whole series October–February. We used maximum likelihood estimation as default. The adequacy of the models was assessed by the Ljung–Box Q-test. In addition, Akaike's Information Criterium (AIC) values were consulted to choose a model among two or more well-working alternatives (Schmitz, 1989).

Pulse and step functions in intervention analysis were represented as usual by dummy variables, and thus implemented in transfer function models. The transfer functions applied to men's and women's series included:

- A step function representing a linear decrease which breaks off on December 31st. The corresponding dummy variable was not set to 1 but was graduated from 0 to 1 in order to represent linear decrease. To derive a starting point of this step function, we calculated models with all starting points between November 11th and December 15th and compared the fit with respect to the AIC values. A detailed discussion of the identification of a change point was presented by Helfenstein (1991a,b).
- A pulse function to account for the effects of December 24th and December 25th.
- A pulse function with target date January 1st to fit the counter-movement of the series after New Year. The pulse function delay was derived in a manner similar to the starting point of the step function, i.e., by comparing the AIC values of models with subsequent delays.

Transfer functions, which did not turn out to be relevant, were excluded from finalizing the models. After introducing the transfer functions, we again took a look at the AR and MA parameters to perform final corrections, if necessary. Comparing the predicted values from models incorporating transfer functions and the baseline values without transfer functions led to calculating the numbers of saved suicides.

The analyses were conducted with SAS for Windows, Version 8.

3. Results

Aggregated daily frequencies of suicide between October and February are depicted in Fig. 1 (men) and