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Research report

Investigation of the marked and long-standing spatial inhomogeneity of the Hungarian suicide rate: A spatial regression approach

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ABSTRACT

Background: In the last century Hungary had astonishingly high suicide rates characterized by marked regional within-country inequalities, a spatial pattern which has been quite stable over time.
Aims: To explain the above phenomenon at the level of micro-regions ($n=175$) in the period between 2005 and 2011.
Methods: Our dependent variable was the age and gender standardized mortality ratio (SMR) for suicide while explanatory variables were factors which are supposed to influence suicide risk, such as measures of religious and political integration, travel time accessibility of psychiatric services, alcohol consumption, unemployment and disability pensionery. When applying the ordinary least squared regression model, the residuals were found to be spatially autocorrelated, which indicates the violation of the assumption on the independence of error terms and – accordingly – the necessity of application of a spatial autoregressive (SAR) model to handle this problem. According to our calculations the SAR_{lag} model was a better way (versus the SAR_{err} model) of addressing the problem of spatial autocorrelation, furthermore its substantive meaning is more convenient.
Results: SMR was significantly associated with the "political integration" variable in a negative and with "lack of religious integration" and "disability pensionery" variables in a positive manner. Associations were not significant for the remaining explanatory variables.
Limitations: Several important psychiatric variables were not available at the level of micro-regions. We conducted our analysis on aggregate data.
Conclusion: Our results may draw attention to the relevance and abiding validity of the classic Durkheimian suicide risk factors – such as lack of social integration – apropos of the spatial pattern of Hungarian suicides.

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1. Introduction

It is well known that suicide is a multicausal event thus the probability of its occurrence is determined by several factors. Accordingly, various medical conditions (mainly psychiatric (especially bipolar and major depressive disorders) and severe somatic illnesses), environmental factors and/or stressful life events (e.g. physical and/or sexual abuse; bullying; loss of a near family member; divorce; loss of personal financial balance etc.), peculiar personality characteristics (hostility, aggressive/impulsive traits) and sexual orientations (homosexualism and bisexualism) and several other factors (spring-summer time; first days of the week; low body-mass index; poor respiratory functions; insomnia) were found to be associated with increased risk of suicidal behavior (i.e. completed suicides and suicide attempts) (Rihmer, 2007; Wasserman et al., 2012; Haas et al., 2011; Hawton and van Heeringen, 2009; Antonsen et al., 2012; Fitzgerald et al., 2011; Goodwin and Marusic, 2008; Zhang et al., 2013; Giltay et al., 2010; Lamis and Malone, 2012). Besides risk factors some protective factors against suicidal behavior (e.g. having a high number of children, family support or good coping abilities) are also known (Wasserman et al., 2012). One of the most important known protective factors is religious affiliation (Gearing and Lizardi, 2009).

Apropos of the current global economic crisis the possible association between suicidal behavior and unemployment has received a lot of attention (Reeves et al., 2012; Barr et al., 2012; Catalano et al., 2011; Wanberg, 2012). The quest of this question and also the issue of the relationship between religiosity and

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suicide has a long history since Emile Durkheim in his seminal work 'Le Suicide' (1897) investigated the supposed effects of economical changes and religious affiliation, as well, on suicide (Edles and Appelrouth, 2010; Zivin et al., 2011; Panczak et al., 2013). In addition, Durkheim supposed that other forms of "social integration" (a phrase which was never explicitly defined – and used very rarely, as well – by Durkheim in his aforementioned book; an exception can be found at the beginning of the fourth chapter which dealt with "anomic" suicide) than the religious one may also affect suicidality and he argued that integration of the subject into domestic (familiar) and political societies is also of great importance (Wray et al., 2011; Ross, 2003). According to his statement "suicide rates vary inversely with the degree of integration of the social groups to which the individual belongs" (suicide cases related to decreased levels of social integration were labeled "egoistic") (Durkheim, 1897 cited in Wray et al., 2011). This hypothesis has been widely tested until recent times (e.g. Hooghe and Vanhoutte, 2011; Bando et al., 2012). On the other hand, Durkheim argued that excess levels of social integration may also lead to suicide cases (so called "altruistic suicides") but he emphasized that this type of suicide is mainly characteristic to traditional ("primitive") societies. For the sake of completeness we mention that in Durkheim's typology there are other two types of suicide namely "anomic" (as a consequence of decreased levels of regulation in "modern" societies) and "fatalistic" (as a consequence of higher levels of regulation in "primitive" societies) (Durkheim, 1897; Wray et al., 2011; Edles and Appelrouth, 2010; Garrison, 1991). From the two Durkheimian suicidogenic processes of modern societies (i.e. decreased "social integration" and decreased regulation) we investigated in the current paper whether supposed proxies for decreased "social integration" are associated with the suicide ratio. It should be also mentioned that the validity of Durkheimian axes (i.e. "integration" and "regulation") are matters of intense debate. For example, Pope stated that "the theory of social regulation does not differ from that of social integration in basic sociological content" (Pope, 1976).

Hungary had "traditionally" high annual suicide rates in the last century. Although suicide rate figures for Hungary have declined by almost 50% since 1986 the Hungarian suicide rate is still in the world's "top ten" (Dome et al., 2011). Similarly to some other countries marked regional differences in suicide rates are observed within Hungary; namely suicide rates are about two times higher for the south-eastern than for the north-western parts of the country (Rihmer et al., 1990; Zonda et al., 2010; Neeleman, 1998). This spatial pattern has been quite stable over time (the first mention of this phenomenon was in the year 1867) whereas its determinants were only investigated by a few studies (Konek, 1867; Rihmer et al., 1990; Rihmer et al., 1993; Zonda et al., 2010).

The primary aim of the present study is to test whether variables which are supposed to affect suicide risk and represent different fields (domains) of risk factors are able to explain the spatial inhomogeneity of suicide cases in Hungary. Accordingly, our explanatory variables came from the following three domains: (1) religious and political "***integration***" (measured by religious affiliation and election participation rates, respectively); (2) "***psychiatry***" (the travel time accessibility of psychiatric services (based on the temporal distances from the nearest outpatient and/or inpatient psychiatric departments) and on mortality related to alcoholic hepatopathy as a proxy for alcohol consumption) (3) "***employment***" (measured by the rates of unemployed persons and disability pensioners as well. Disability pensionery is extremely widespread in Hungary and it is highly conceivable that for a considerable proportion of this group becoming a disability pensioner was an alternative solution to avoid becoming unemployed with the concomitant loss of regular personal financial incomes) (Komiljovics, 2011; Ministry for National Economy, 2011). This supposition is bolstered up by the results of a Hungarian study conducted in the early 2000s which showed that the chance to become a disability pensioner was higher among those who feared to lose their job and/or were dissatisfied with their job (Monostori, 2008).

In order to handle spatial autocorrelation in our ecological dataset appropriately we used along with the traditional ordinary least squares (OLS) regression model the spatial lag model as well (Kissling and Carl, 2008; Yu et al., 2010; Duncan et al., 2013; Ng et al., 2012; Loomis et al., 2013).

2. Data and methods

2.1. Data

According to the demographic database (Demo) of the Hungarian Central Statistical Office (HCSO) during the period investigated (2005–2011) 17,384 completed suicide cases were documented in Hungary (male: 13,373; female: 4,011). From these 17,384 cases 12,620 were occured among economically active persons (aged 15–64 yrs) (male: 10,110; female: 2,510). In the database an individual whose International Classification of Diseases-10 (ICD-10) code in the paragraph "cause of death" was one of the following was considered as a suicide completer: X60 to X84 and Y87. This definition of suicide is in accordance with the international literature (see, for example, Pirkola et al., 2009).

For the dependent variable, we used the age and gender standardized (with the indirect method using 5-year age-groups) mortality ratios for suicide (the abbreviation of this variable is SMR) for every Hungarian micro-regions ($n=175$; the number of inhabitants was 7 thousand in the micro-region with the smallest number of dwellers). Suicide cases were grouped according to the place of residence of victims. SMRs were calculated from the number of suicide cases that occurred in the population aged 15–64 yrs from 2005 to 2011 (Fig. 1).

The same database (Demo) was the source of the data on age and gender standardized mortality rates due to *alcoholic liver disease* (ICD-10 codes: K70.0; K70.1; K70.2; K70.3; K70.4 and K70.9) calculated for the period investigated (2005–2011) for each micro-region (the abbreviation of this variable is ALC).

The measure of the *lack of religious integration* of a given micro-region was assessed by the proportion (in percent) of those persons who have avowed themselves as "Does not belong to any church/denomination" at the Census in the year 2001 (the abbreviation of this variable is MATER) (⟨http://www.nepszamlalas2001.hu/eng/volumes/26/tables/load1_3.html⟩) (We have aggregated the original data available at the level of settlements to the level of micro-regions).

The measure of the *political integration* of a given micro-region was estimated by the participation rate (in percent) in round I of the Parliamentary Election 2006. We have aggregated the original data available at the level of the electoral districts (⟨http://www.valasztas.hu/parval2006/main_en.html⟩) to the level of micro-regions (abbreviation of this variable is *PI*).

The T-STAR database of the HCSO provided data on rates of *unemployed persons and disability pensioners* for the period investigated (in the calculations we used the average values of these rates for the period 2005-11 for each micro-regions) (abbreviation of these variables are *UE* and *DP, respectively*).

To quantify the *travel time accessibility of psychiatric services* we used the matrix of vehicular distances (converted to time (minutes)) between all possible pairs of Hungarian settlements (supposing that distance to be zero within the same settlement the main diagonal of the matrix contains zero values). Based on the data of the matrix with the use of a loop written in R

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