

**An Ecological Study of Community Level Correlates of Suicide Mortality Rates in the Flemish Region of Belgium, 1996-2005**

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**Abstract**

In this article, we conduct an ecological study of age-standardized suicide rates in Belgian communities during the 1996-2005 period using spatial regression techniques. The theoretical assumption that community characteristics are significantly related to suicide rates was supported by the data. A significant positive relation with the proportion of single households and the presence of an ageing population in the community was found, while average income level, immigration and a larger share of non-European foreigners had a negative impact on suicide rates. There was a nonlinear relation between population density and male suicide rates. Religious participation was not significantly related to suicide rates at all. A moderate spatial contagion effect of neighboring communities is present for male suicide rates. In the conclusion we present some hypotheses on why an ageing population could be associated with higher suicide rates in the community.

S U M M A R Y

## **1. Introduction**

In recent years, various studies on community level correlates of suicide rates have been published, without, however, leading to any final conclusions (Rehkoph & Buka, 2006; Knox, Conwell & Caine, 2004). Most of these studies are based on American data, and the number of studies on ecological correlates of suicidal behavior in a different cultural context remains rather limited (Neeleman, 1998; Agerbo, Sterne & Gunnell, 2007). The available evidence suggests that in developed countries, social integration indicators are strongly related to suicide rates (Fernquist & Cutright 1998; Helliwell, 2007). While the older literature tends to focus on traditional mechanisms of social integration, like organized religion, in the more recent literature attention is concentrated on social fragmentation and isolation, socio-economic deprivation and differences between rural and urban areas (Pescosolido & Georgianna, 1989; Congdon, 1996; Evans, Middleton & Gunnell, 2004; Whitley, Gunnell, Dorling, & Davey Smith, 1999).

In this article we investigate the association between community level indicators and suicide rates in Belgium. Belgium has one of the highest suicide rates in Western Europe, but there is a significant variation between communities. We focus on the level of the local community since it can be argued that this offers an effective small-scale interaction context for most residents, and numerous statistical indicators are also available on this level, allowing us to develop a comprehensive multivariate model. To avoid any misunderstandings, it has to be stressed here that the current data do not allow us any interference at all about individual suicidal behavior, since data on the background characteristics of those involved in suicidal behavior are not collected in a systematic manner in Belgium. Our analysis therefore remains limited to observing meaningful associations between community characteristics and suicide rates within these communities. This kind of ecological studies, however, clearly has an interest from an academic point of view, but also from a policy perspective. If we can identify meaningful differences in the suicide rates of communities, and we can identify the community characteristics that are associated with these differences, more targeted prevention policies can be developed.

We first review the literature on community level differences in suicide rates, before moving on to presenting our data and methods. Using a spatial regression model we try to assess the community level correlates of suicide, before drawing conclusions, both with regard to the scholarly interest in suicide and community characteristics, and the possible implications for preventive policies.

(...)

## **Data and Methods**

This article investigates standardized suicide mortality rates for 308 communities in Belgium, for the period 1996-2005. Our analysis is based on two distinct data sources. On the one hand we have access to the suicide rates that are registered in the region of Flanders in the Northern area of Belgium. The rates are based on official death certificates in the region, confirmed by a medical doctor, and they can be considered as highly reliable. In total they refer to ca. 12,000 registered cases of suicide over this ten year period. On the other hand we rely on community level social cohesion indicators for all local communities in the region. The Flanders region is divided in 308 municipalities with on average 20,000 inhabitants.

### *Dependent variable*

As dependent variable, we use a smoothed version of the standardized mortality rates (SMR) for every community. To reduce random variation and minimize measurement error we use average SMR's for a ten year observation period (1996-2005). The SMR is the index of actual suicides over expected suicides in the period under study. The expected suicide rate was calculated taking into account age and gender composition of the community, departing from the age specific average suicide rate in Flanders. To avoid outliers in the data caused by small municipality size, we used empirical Bayes prediction assuming a normal distribution (Clayton & Caldor, 1987) as is custom in epidemiological research.<sup>1</sup> This transformation increases the reliability of the SMR for small municipalities, by borrowing strength from the total population (Riggan, Manton, Creason, Woodbury & Stallard, 1991). The advantage of using standardized rates is that both age differences in the composition of the population of a community and the population size are already integrated in the dependent variable, so that any correlation we might observe with age or population size would indicate a concentration effect instead of a composition effect. A second advantage of using the transformed SMR is that we can use an ordinary least squares regression with coefficients that can be more easily interpreted, and in a second step estimate the spatial effects in a straightforward matter.

A suicide mortality index over 100 indicates a higher occurrence of suicide than is to be expected, and a score under 100 indicates a lower occurrence of suicide than is to be expected given the demographic composition in terms of age and gender of the community. We will

analyze suicide rates for men and women separately, and the total rate for both genders combined. Since male suicide rates are higher than female suicide rates, suicidal behavior among men will disproportionately determine this overall indicator.

Data were collected in Flanders, i.e., the northern autonomous region of Belgium (population: 6,162,000 in 2008). Data were collected by the Flemish Regional Agency for Health and Care, and they are only available at the regional level because the prevention of suicide is a regional authority in the Belgian federal system. This implies that figures for the entire country are not currently available, but it has to be remembered that the Flemish region includes almost 60 per cent of the Belgian population. Belgium offers an interesting case for the study of suicide rates because it is a country with one of the highest suicide rates in the European Union. Within the literature, however, there is no clear consensus on why exactly these high levels can be found in Belgium (Bossuyt & Van Calsteren, 2007).

### *Independent variables*

We included various variables at the community level, as indicators for social fragmentation, socio-economic deprivation and the rural/urban divide.

Looking at religious participation, we used a measure based on attendance figures of the Roman Catholic Church. This is the most prevalent religious affiliation in the strongly secularized region of Flanders. The actual indicator is a factor score based on the ratio of participation to rituals such as baptism, marriage and funeral and the attendance at the Christmas mass in the church averaged over two observations, in 2006 and 2007 (Botterman & Hooghe, 2008). While strictly speaking, the observation period of this independent variable is situated one year after the observation period of the dependent variable, it is safe to assume that the regional variation in religious behavior is quite stable. It can therefore be assumed that municipalities that were highly religious in 2006, also had this characteristic in the 1996-2005 observation period. It has to be pointed out that Catholicism is the only religion that can play a role on the community level, as the second most prevalent religion is Islam, with only about three per cent of the population adhering to Islam.

In order to operationalize a lack of marital or relational status integration, we included the rate of single households, i.e. the rate of all inhabitants registered as living alone (only one person living at that address). Furthermore, two different migration rates are used: the internal migration rate, which measures the migration within Belgium (from another community in Belgium) and the external migration rate (from outside of Belgium). The rates are the sum of

incoming and outgoing inhabitants in a community per 1000 inhabitants. We use both rates, since on the community level they have a strong negative correlation (-.46) and thus clearly convey different information: communities attracting people already living in Belgium are apparently different from the communities attracting people from outside Belgium. We also included information on the percentage of non-European inhabitants of the community. This was operationalized as the proportion of inhabitants not having the nationality of one of the 15 countries that belonged to the European Union in 1996, at the start of the observations.<sup>2</sup>

For deprivation, various variables are available but since most of them are strongly related, they cannot be used simultaneously in one analysis. In a preliminary analysis we used average income level, unemployment rate and average education level of the population one by one as unique community level correlate. This analysis showed that the average income (in euro/inhabitant) has the strongest relation with suicide rates, and therefore this variable was included as an indicator for the socio-economic status of the geographic area.

For the rural/urban divide we used population density (inhabitants/square kilometer) as an independent variable.<sup>3</sup> It can be argued that a high population density creates anxiety, stress and social disorganization (Levy & Herzog, 1974). Population density was transformed into its natural logarithm, in order to achieve a normal distribution. The squared and cubed value of population density were also included in order to detect any curvilinear effects.

As a control variable we include the proportion of elderly in the population, since we know this is a population at risk for suicidal behavior. To be able to separate the effect of having an older population from living in a single household, the residuals of the regression of the rate of inhabitants over 65 on the proportion of single households is used instead of the crude measures, so that we can prevent multicollinearity. This means that the common variance of these two indicators is assigned to the proportion of elderly and not the proportion of single member household, thus leading to a very conservative test of the effect of single households.

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The model is quite powerful, with an explained variance of 31 per cent for men, 20 per cent for women and 36 per cent for the total rate. The strongest community level determinant of suicide rates is the proportion of single households in a community. A community with a higher proportion of single households has significantly higher suicide rates than one would expect based on the age-specific suicide rates, and this goes both for women as for men. This

illustrates that a community with less dense networks of social support among its inhabitants has a significant chance to record higher suicide rates. A concentration of older inhabitants, too, has a positive effect on suicide rates. We point to out here that the dependent (*standardized* mortality rates) is already controlled for age specific suicide rates, so that the effect we observe here is not a compositional effect but a concentration effect. Municipalities with a higher proportion of older inhabitants have higher risks of suicide for all the age-groups who live there.

Furthermore, we can observe that population growth in the form of immigration towards the community has a strong negative impact on suicide rates. Both immigration from within the country as from outside the country are negatively related with suicide rates for men, for women only the foreign immigration has a significant negative effect. The proportion of inhabitants that do not have the nationality of one of the 15 original European Union member states, also has a significant negative impact on suicide rates. These findings seem to contradict the findings of earlier research, suggesting a positive relation between migration and suicide rates. A possible explanation for this positive correlation is that the people who migrate to other municipalities themselves as a group commit less suicide, either because of different psychological profile, in the case of the internal immigration, or because of a different cultural attitude towards suicide in the case of the external immigration and the non-European inhabitants. A higher mean income lowers suicide rates. This illustrates that controlling for social fragmentation, deprivation still plays a role, even in countries with a generous social security system such as Belgium. The relation with population density is nonlinear for men, since both the squared and cubic term are significant. The cubic relation means that in densely populated areas of the region, with more than 600 inhabitants/km<sup>2</sup>, suicide rates are significantly lower, while in sparsely populated areas, with less than 100 inhabitants/km<sup>2</sup> suicide rates are significantly higher, and in between they are relatively constant. Religious participation has no effect at all at the community level.

Comparing suicide rates for women and for men, we can observe that most community characteristics have a similar direction, but the effects are weaker for women than for men. Only population density seems to matter for male suicide rates, but not so for female suicide rates.

## **Discussion**

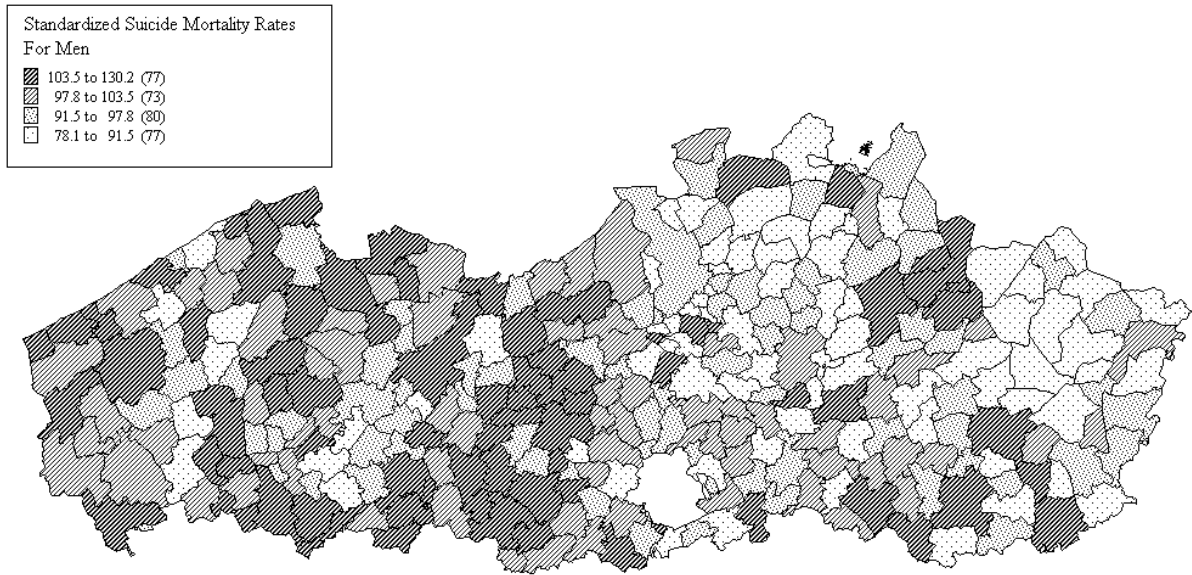
The current analysis investigates the occurrence of significant community level differences in suicide rates in Belgium. It has to be observed that the smoothed standardized suicide mortality rates differ from 77 to 134, suggesting a considerable amount of inter-community variance. With a squared correlation of 20 to 36 percent, our models are able to explain a substantial part of that variance. This by itself suggests that communities have an impact on suicidal behavior, an impact that is often overlooked in policy programs aimed at preventing suicide. Most importantly, suicide rates tend to be higher in communities with higher proportions of single households, an older population and a negative net migration. All these elements together seem to indicate a higher risk for social isolation, which is a fertile ground for suicidal behavior. It has to be noted that in the analysis we control for the variables that might be responsible for explaining a positive migration balance, like income levels. Two complementary explanations can be formulated, and merit further investigation. A first plausible explanation is that the higher suicide rates are due to compositional differences in the population. Because migrants, and households that are not single, have characteristics that lower their chances towards suicidal behavior, on an aggregate level cities where these groups are more prevalent have lower suicide rates. A second and partly documented effect is a concentration effect. Communities with a large proportion of elderly, have a higher suicide rate than we would expect on age specific suicide rates alone. This means that the presence of a high proportion of elderly increases the suicide rate in total. In other words, the composition of a community translates itself into a less tangible but pervasive climate that influences suicide rates indirectly.

Contrary to other research, the degree of religious involvement of a community had no effects. This means that in the highly secularized Flemish region, religious involvement does not seem to matter anymore for suicide rates, if adequate controls are used. The literature also suggested a relation between the urban character of a community and the suicide rate, although hypotheses about the positive or negative impact of urbanity differed. The current analysis on one of the most densely populated regions in Europe suggests that for women there is no significant impact. For men, on the other hand, we observed lower suicide rates in densely population communities. In this analysis, we did not rely on composite indicators, but rather on distinct variables. This allowed us to observe that the relation with migration and diversity is exactly the opposite of what is usually assumed in the literature. Diverse communities with high levels of immigration actually have lower suicide rates. The current analysis suggests that community characteristics should be included in policies aimed at reducing suicide rates. For example communities with older and isolated populations, should

be targeted in suicide prevention. It would be highly relevant to determine, whether these community levels effects hold, if we add information about the individual characteristics of people who lost their lives as a result of suicidal behavior. Only if we have access to these kind of data, we can determine in a convincing manner whether the relations we have found in this study are due to composition or concentration effects.

A last point is that, especially when looking at male suicide rates, a moderate contagion effect among neighboring communities is present. This means that the suicide rate of a community is not only determined by endogenous factors such as the various aspects of social fragmentation, deprivation or urbanity, but also by the suicide rates in nearby communities. Although it is not entirely clear what the mechanism of this spatial influence is, it underlines that context, here seen both as municipality of residence and the neighboring municipalities, all contribute to circumstances that can facilitate or prevent suicide.

**Figure 1: Standardized Suicide Mortality rates for men, 1996-2005**



Standardized Suicide Mortality Rates for men, 1996-2005. Source: Health Agency of the Flemish Region, Belgium.

**Table 2: Spatial lag regression on standardized suicide mortality rates (n=307)**

	Suicide Mortality Rate Men			Suicide Mortality Rate for Women			Suicide Mortality Rate Total		
	Coef.	Robust Std. Err.	p	Coef.	Robust Std. Err.	p	Coef.	Robust Std. Err.	p
Cte.	71.76	8.69	0.000	83.08	9.23	0.000	73.94	8.81	0.000
Religious participation	-1.17	0.65	0.071	-0.40	0.45	0.371	-1.30	0.69	0.060
Proportion of single households	103.79	17.90	0.000	82.62	15.13	0.000	129.35	18.64	0.000
Internal migration rate	-0.33	0.15	0.023	-0.24	0.15	0.102	-0.41	0.16	0.009
External migration rate	-0.83	0.22	0.000	-0.50	0.21	0.020	-1.05	0.22	0.000
Proportion non-EU inhabitants/1000	-0.15	0.05	0.003	-0.11	0.05	0.032	-0.19	0.05	0.001
Mean income level	-1.05	0.36	0.003	-0.92	0.31	0.003	-1.47	0.37	0.000
Population density (ln)	0.01	1.31	0.995	1.58	1.28	0.215	0.96	1.50	0.522
Population density (ln) squared	-1.87	0.62	0.003	-1.14	0.59	0.053	-2.32	0.68	0.001
Population density (ln) cubed	-1.10	0.41	0.007	-0.66	0.44	0.138	-1.42	0.46	0.002
Proportion 65 +	0.48	0.10	0.000	0.36	0.08	0.000	0.62	0.10	0.000
Spatial multiplier	0.25	0.07	0.000	0.15	0.07	0.039	0.23	0.06	0.000
Squared correlation	.314			.204			.366		
Log Likelihood	-1075.8414			-1050.3792			-1103.9094		

Entries are the result of a spatial lag regression, performed with tools for spatial data analysis in Stata written by Pisati (2001). The municipality of Voeren (6355 inhabitants) had to be excluded because it does not have a border with any other Flemish municipality.

## **Endnotes**

<sup>1</sup>. A nonparametric approach yielded similar results.

<sup>2</sup>. Various studies have already shown that non-nationals from neighboring European countries are not perceived as ‘foreigners’ by a large part of public opinion. Attitudes toward foreigners are mainly based on perceptions about non-Europeans or visible minorities residing in the community.

<sup>3</sup>. The number of inhabitants of the municipality is not a good indicator in the Belgian case, because some of the larger metropolitan areas are divided in smaller, distinct municipalities.