

Suicide in Europe Countries: A Multivariate Approach Analysis

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Abstract

Suicide is one of the most important causes of death in the European Union Countries (EU) and is considered as a phenomenon which can be explained from a psychological, biological and social point of view. Objectives: This research will analyze the phenomenon of suicide in the European Union from a sociological point of view, with the aim of creating a multivariate model which explains such phenomenon. Method: Taking into account those data offered by the European Statistics Office (EUROSTAT), this study will try to explain, through the multiple linear regression model, suicide rates in European countries from demographic variables (number of inhabitants, divorce rate, ratio of women), economic variables (Gross Domestic Product (GDP), general government gross debt), social variables (government expenditure on social protection, population at risk of poverty) or educational variables (public expenditure on education and population with secondary education). Conclusions: A model to explain suicide rates in different countries was developed. This model was made up of two variables (percentage of people with secondary education and ratio of women), which account for 50% of the suicide rate.

Keywords: suicide, sociology, linear regression model, EUROSTAT

1. Introduction

Presently, suicide is regarded as a public health problem since, according to the World Health Organization (WHO) and the Pan-American Health Organization (PAHO) (2014), it is one of the first three causes of death in people 15 to 44 years old. According to the figures made available by the World Health Organization (2012), the morbidity due to suicide has increased by 60% in the last few years.

There are many explanations related to suicide, which range from psychological, sociological and epidemiological explanations to biological, genetic and philosophical ones. This paper focuses on the sociological and epidemiological dimension since its objective is to identify the socioeconomic factors which contribute to the significant increase or decrease of suicide rates in the European Union countries.

To establish a clear definition of suicide is one of the major problems we face when we speak about this topic because of the multiple conceptions of this term. In this research we will try to use the WHO definition (1969), which defines the act of suicide as the act in which one individual injures himself, regardless of his/her intentions and knowledge about his/her motives. This phenomenon will be measured by means of the suicide rate of each country. It is the result of the ratio between the total number of suicides and the overall population in each country. This result is, moreover, multiplied by 100,000 (EUROSTAT, 2012; WHO and PAHO, 2014).

From a psychological perspective, one of the explanations of suicide has been given by the Psychoanalytic Theory (Freud, 1910; Garma, 1960; Menninger, 1972; Sarnet and Bemporad, 1981), which has analyzed those personalities which are likely to commit suicide. Other branch of Psychology which has studied this phenomenon is Cognitive Psychology. This perspective claims that factors such as despair, guilt and helplessness promote suicidal behaviours in people (Beck, 1983; Martínez, De la Rosa Hormiga, Hernández, Pulido and De la Merced Díaz-González, 2014). Moreover, according to the stress-diathesis model (Mann, Wateraux, Haas and Malone, 1999), which combines social and psychological causes, some explanations about suicidal behaviours have been found.

Apart from the approach of the previously mentioned trends, the act of suicide has also been analyzed as a

consequence of biological and genetic factors. Some researches about the genetic influence on the occurrence of suicide have proved the strong association between biological factors and depression (Beskow, 1979; Miles, 1977; Murphy & Wetzel, 1982; Tsuang, 1983; Qin, Agerbo, & Mortensen, 2003; Roy 2004). In addition to this explanation, the relation of the suicidal behaviour and those biological factors related to physical weaknesses or impairments have also been proved (Campanilla, 1985; Couzin & Frankel, 2010).

Despite all the approaches and perspectives which have tried to explain the phenomenon of suicide, this research will focus on a sociological-epidemiological perspective. Durkheim's investigation (1987) shows the interest of Human Sciences in suicide. This author has been considered as one of the founding fathers of the sociological discipline. His approach is based on statistics and figures of epidemiology, obtained from the 18th century with results which have been conventional sociological studies. These studies gave equal importance to individual factors (depressive tendencies, etc.) and those factors associated to the social structure or to the functioning of society.

Durkheim's theory (1897) found its continuation with Halbwachs (1930), one of his most prominent followers, who examined the relation between urban and rural suicide rate, the tendencies of such rates in different countries depending on the marital status, religious affiliation, homicide rate, economic and political crisis, alcoholism and psychopathic behaviours. Nevertheless, different authors have supported the existence of patterns of suicide depending on different social conditions (Gibbs & Martin, 1958; Gibbs & Porterfield, 1960; Sainsbury, 1961; Maris, 1969; Lester, 1995; Bille-Brahe, 2010; Clinard & Meier, 2010).

Presently, important studies about demographic and social variables are being performed in order to explain/predict suicide in different countries. Some of these studies are being carried out in Northern Ireland (O'Neill, Corry, McFeeters, Murphy, & Bunting, 2016), Italy (Pompili, Innamorati, Vichi, Masocco, Vanacore et al. 2011) or those investigations developed by Lester (2005) related to a set of countries. We can state that, in the light of the studies which have been reviewed, the search for models to explain suicide in different countries is an increasing tendency according to the current sociological trends.

2. Method

Data have been taken from the EUROSTAT database. In relation to the objectives which were defined for this research, homogeneous variables were selected among all the European Union countries, in 2012, with the exception of the expenditure on education as regards 2011, since no data were available for consideration later that year. Data were selected for all the EU countries. Figure 1 shows the set of variables under consideration.

Type of variable	Variable
Demographic	Death due to suicide
Demographic	Ratio of Women
Educational	Population with secondary education or lower level
Demographic	Crude divorce rate
Economic	General government gross debt
Social	Expenditure on social protection
Educational	Expenditure on education
Social	Population at risk of poverty
Economic	Gross Domestic Product, Current Prices, per capita
Demographic	Population, 1st January
Economic	Unemployment rate

Source: Eurostat, 2012.

Figure 1. Variables according to type and definition

Taking into account such variables, the suicide rate was considered as the dependent variable, whereas the other variables were regarded as independent.

As regard the procedure, the analyses were performed by means of the statistical package SPSS V.21. Firstly, the suicide rate of each country was analyzed. Then, we tried to calculate if there was a relation between the suicide rate and the other independent variables, through Pearson's correlation coefficient, after testing variables for

normality.

Once the independent variables, which were significantly related to the suicide rate, were obtained, a multiple linear regression model to explain suicide was developed. This model is commonly used in this field of study (Lester, 2005). In such model, all significant variables were included, starting from those variables which showed more correlation in a bivariate level with the suicide rate and finishing with the independent variable which was less related to the suicide rate (according to those coefficients showed in table 1, including firstly ratio of women, since it has a correlation coefficient of 0.590, $p < 0.01$; and finishing with the incorporation of Public Expenditure on Social Protection, with a correlation coefficient of -0.337, $p < 0.1$).

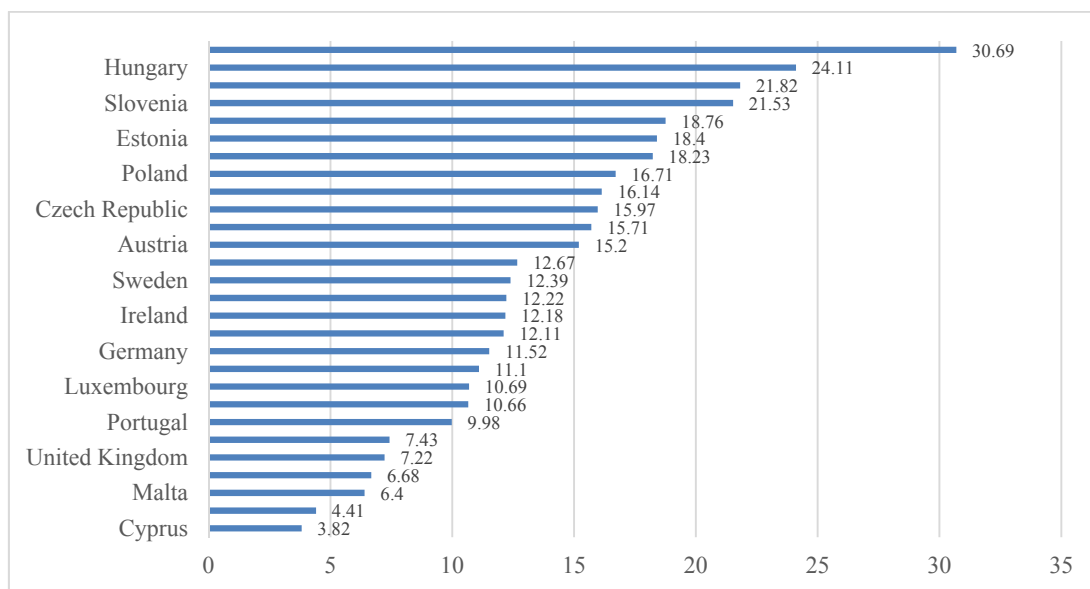
3. Results

The average of suicide rate in the European Union is 13.74 suicides per 100,000 inhabitants and it has varied greatly in the different countries concerned (Graph 1). The highest rates have been found in the Mediterranean area.

The country with the highest suicide rate has been Lithuania, which reached a rate of 30 suicides per 100,000 inhabitants. A lower rate, although similarly high, was found in Hungary, reaching 24/100,000. Latvia and Slovenia obtained a similar suicide rate (21/100,000). On the other hand, we could observe that a diverse group of countries showed a rate of 16/100,000 and 18/100,000 (Belgium, Estonia and Croatia, along with Poland and Finland).

Czech Republic, France and Austria obtained a rate of 15/100,000 suicides, whereas Romania, Sweden, Denmark, Ireland and Bulgaria obtained a rate of 12/100,000 suicides.

Below the average, between 9.9/100,000 and 11/100,000 suicides, we found countries such as Germany, Slovakia, Luxemburg, the Netherlands and Portugal, and far below average we found countries such as Spain (7.43/100,000), United Kingdom (7.22/100,000), Italy (6.68/100,000) and Malta (6.4/100,000). Finally, Greece (4.41/100,000) and Cyprus (3.82/100,000) were the countries with the lowest suicide rate.



Source: EUROSTAT, 2012.

Graph 1. Death due to suicide per 100,000 by countries. 2012. European Union. (Mean=13,74)

After analyzing the average of each EU country as regards suicide rates, it was convenient to observe if the variables considered as independent in this research were significantly related to the suicide rate (Table 1). The ratio of women obtained a correlation coefficient of 0.590, $p < 0.01$ when it was related to the suicide rate. Therefore, since observations have shown that there is a moderate-intensity relation among variables, we can state that the higher the ratio of women in a EU country, the higher the suicide rate. In addition, the percentage of the population which studied secondary education was also related to the suicide rate, with a coefficient of -0.565, $p < 0.01$. This fact suggests that the higher the proportion of population with low education background, the lower the suicide rate in the country.

The divorce rate was also significantly related to the suicide, showing a correlation coefficient of 0.437, $p < 0.05$. This relation implies that the higher the divorce rate, the higher the suicide rate. On the other hand, the public debt was negatively related to the suicide rate. This fact suggests that the higher the public debt in a EU country, the lower the suicide rate in such country. Finally, we could observe that the social expenditure was also significantly related to the suicide rate: a high expenditure on social protection implied a decrease in the suicide rate.

Table 1. Pearson's Correlation Coefficient between Death due to suicide per 100,000 and other independent variables

	Pearson's Correlation Coefficient
Ratio of women	0.590***
Population with secondary education level or lower level	-0.565***
Crude divorce rate (per 1.000) 2012	0.437**
General government gross debt (% of GDP)	-0.400**
Public expenditure on social protection (% of GDP)	-0.337*
Population 1st January 2012	-0.267
Gross Domestic Product (GDP) at market prices per capita	-0.261
Unemployment rate (%)	-0.130
Public expenditure on education (% of GDP)	-0.127
People at risk of poverty or social exclusion (% of total population)	0.77

***. $p < 0.01$, ** $p < 0.05$, * $p < 0.1$;

Source: EUROSTAT, 2012.

It must be taken into account that the basic assumptions to properly apply the multiple linear regression analysis (homocedasticity, error independence, linear correlation among variables, error normality and absence of multicollinearity) have been demonstrated according to authors such as Montgomery, Peck and Vining, (2001) and Pardo and Ruiz, (2002).

Table 2 shows the regression models for the variable Death due to suicide per 100,000 and the other independent variables (Ratio of women, Population with secondary education or lower level, Crude divorce rate, General Government gross debt and % GDP expenditure on social protection). The first variable which was included in the model was Ratio of women, which accounted for 32% of the dependent variable. The data obtained for this model suggest that the suicide rate increased to 0.78% when the ratio of women increased its percentage. It was, certainly, a really significant variable for the model.

Table 2. Regression Models for the dependent variable (Death due to suicide per 100,000) and other independent variables^a

	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5
Ratio of Women	.789***	.636***	.612***	.634***	.670***
Secondary education or lower level	----	-.189***	-.185***	-.163**	-.192***
Crude divorce rate	----	----	.358	----	----
General government gross debt	----	----	----	-.019	----
% GDP expenditure on social protection 2012	----	----	----	----	.053
Constant	-69.671	-49.094	-47.338	-48.193	-53.877
R ²	.348	.530	.531	.538	.532
Adjusted R ²	.323	.492	.472	.480	.473
N	28	28	28	28	28

*** $p < 0.01$, ** $p < 0.05$.

^a: Estimated coefficients through MCO.

When we added the following variable which is the most correlated to the suicide rate (the percentage of people with secondary education or lower education level), we could observe that it could be included in the model, along with the ratio of women. Thus, a second model was obtained, as it is shown in table 2. Both variables explained 49% of the suicide rate, being the contribution of the educational indicator 16%. In this new model, for each percentage point increase in the ratio of women, the suicide rate increased 0.63. Although this is an important variable for the model, we must consider that the educational level is also relevant. For each percentage point increase in people with basic education, the suicide rate decreased 0.18. Therefore, we can state that the more people with basic or low educational level, the lower the suicide rate.

Undoubtedly, model 2 has become the most efficient and adequate, taking into account the rest of variables included in other regression models. Therefore, model 3, which also included the variable of divorce rate, did not prove appropriate because its goodness of fit was worse and, moreover, it contained a non-significant variable. Similarly, model 4 was even worse than model 2 because of two reasons. On the one hand, it explained a lower percentage of the dependent variable (lower adjusted R²). On the other hand, the public debt was not significant in explaining the suicide rate. Finally, model 5, in which the percentage of social expenditure was included, did not prove appropriate since the goodness of fit was worse than that of model 2 and such variable was not considered as a significant variable for the model.

Thus, the final model which was developed to explain the suicide rate in the EU countries was model 2 (See table 2) with the following formula:

$$\begin{aligned} \text{Death due to suicide} \\ &= -49.09 + 0.636 * (\text{Ratio of women}) - 0.189 \\ & * (\% \text{ secondary education level or lower level}) + E \end{aligned}$$

5. Discussion and Conclusions

This paper has analyzed the variables which could influence the suicide rate in the European Union countries, apart from developing a model which has been able to explain most of this social fact. Those theories and researches we have consulted about this topic stated that the female suicide rate was always lower than the male suicide rate (Murphy, 1998; Canneto & Sakinofsky, 1998; Giner, Medina, & Giner, 2014; Vega, Kishikawa, Ricanati, & Friedland, 2002; Martínez, 2015). This fact was regarded as the gender paradox in suicide (Canneto & Sakinofsky, 1998). Nevertheless, in the results obtained in this study, one of the variables which has most influenced this phenomenon was the number of women who live in the country. More suicides were committed in those EU countries in which there were more women. This fact does not imply that the male suicide rate is lower than the female one. Therefore, our contribution to the theories about suicide is not related to the gender paradox in suicidal behavior. In contrast, our contribution is related to the demographic aspect of this phenomenon. In this sense and according to Murphy (1998), Canneto and Sakinofsky (1998); Vega, Kishikawa, Ricanati and Friedland (2002); Giner, Medina and Giner (2014) and Martínez (2015), we can state that in those countries where there is a higher percentage of women, there is a higher percentage of suicides. However, this fact does not imply that the female suicide rate is higher. Another studies say that gender was found to predict lethality in suicide attempts (Choo et al. 2017a). The findings of this study suggest that European women might make suicide attempts with higher risk of lethality. European women were at higher risk of suicide because the prevalence of depression in women is two times higher than men (Puri et al., 2014) and depression is a major cause of suicide.

Therefore, it is evident that the percentage of women who are resident in a country has accounted for a large proportion of the suicide rate in that country, as it is observed in the second regression model in the result section. Nevertheless, it does not occur with other socioeconomic variables which are directly related to economic periods of financial crisis.

Social and economic crises have had immediate effects on different social phenomena. The current situation is related to the interdependence of many risk factors which affect suicide: macroeconomic, political, socioeconomic, cultural, psychosocial, psychological, biological or medical factors (Martínez, 2015). All these factors can certainly affect suicide. Nevertheless, this research only focuses on socioeconomic factors. These are macroeconomic indicators (GDP, public debt) and other indicators of the weakness of the social structure such as the percentage of people at risk of poverty and the unemployment rate in each country. These indicators were chosen since they are homogeneous to all European countries (and almost to all countries in the world), when we compare the social situation of people from different countries. For example, Hungarians have the highest number of suicide but people from Cyprus have the lowest risk of suicide. There is a study that says that this difference between these countries is because Ethnic differences were found in risk and protective factors associated with suicide, and perceived lethality of suicide attempts (Choo et al., 2017b).

Bernal, Gasparrini, Artundo and McKee (2013) studied the impact of economic crisis in Spain as regards the

mental health of the population. They considered the assumption that macroeconomic conditions intensify mental disorders and came to the conclusion that the suicide rate in Spain has increased 8% since the beginning of the financial crisis. Nevertheless, when we study the suicide rate in all the EU countries, we can observe that the GDP (measured in euros per inhabitant) is not related to the suicide rate. According to the results obtained in this study, the economic capacity and the level of wealth of a country are not decisive to justify the increase of suicide rates. This result seems to go in opposite direction to those results obtained by Moyano and Barría (2006). Another explanation may be these differences. Depressive disorder is the main psychiatric disorder which precipitates suicide attempts. Quality of Life (QOL) was reported to be lower for patients with depression than the general population (Tan et al., 2015). The mean annual total costs for managing a patient suffering from major depressive disorder could be up to US\$7638 and indirect costs (e.g. loss of productivity (81%) dominated the total costs (Ho et al., 2013). Those European countries which spent more budgets on social protection will help to improve quality of life and compensate for loss of productivity associated with depressive disorder. As a result, the enhanced social protection would prevent suicide in patients with depressive disorder.

Nevertheless, other macroeconomic indicators affect suicide rates. In this sense, the public debt was inversely correlated with the suicide rate. The higher the public debt in a EU country, the lower the suicide rates in such country. A possible explanation for this fact may be that those countries which spend more money on their citizens have a lower number of suicides per 100,000 inhabitants. However, this a priori conclusion which will require further research, since those countries with the highest public debt such as Portugal, Greece, Ireland (EUROSTAT, 2012) are the countries which are experiencing social cuts. The present crisis is mainly affecting their population.

Data performance as regards the function of the percentage of population in risk of poverty and the percentage of social protection expenditure was also analyzed. The risk of poverty was not correlated with the suicide rate. This fact proved that the number of people who commit suicide does not depend on the situation of poverty they experience. Thus, we cannot state that poverty and suicide are two related phenomena, although some researchers such as Benach, Moreno, Muntaner, Moncada, Llorens et al. (2012) have indicated otherwise.

As regards the percentage of the budget for social protection and its relation to the suicide rate, the results showed interesting data. When we analyze those governments which are increasingly aware of social protection (those countries which spend more on this field), we can observe that such countries have registered a lower number of suicides per 100,000 inhabitants. Nevertheless, although both variables were correlated, this relation was not found in a multivariate model, causing their exclusion from the regression model which explains suicide in the EU.

With respect to unemployment and suicide, there are researches which have concluded that being unemployed or out of school are risk factors (Shaffer, Scott, Wilcox, Maslow, Hicks et al., 2004; Shibata, 2010). Other investigations (Bobes-García, Giner-Ubago, & Sáiz-Ruiz, 2011; Arnau, 1995) have identified as risk factors, related to suicidal behaviours, unemployment, unstable employment situation and retirement. In this sense, some authors have stated that job loss is not as important as the consequences resulting from it (psychological factors derived from this situation, financial precariousness, the impact on the family) when committing suicide (Bobes-García, Giner-Ubago, & Sáiz-Ruiz, 2011). Some studies, such as that of Lundin and Hemmingsson (2009), have emphasized the relation between suicide and unemployment. This study showed that in those countries with an increased spending on policies for the promotion of employment (and not necessarily in those countries with the highest unemployment rate), the incidence of suicide was lower. Thus, Lundin and Hemmingsson (2009) came to the same conclusion as Stuckler, Basu, Suhrcke, Coutts and McKee (2009) as regards the relation between unemployment and suicide.

As regards this study, an absence of correlations between unemployment rate and suicide rate in different EU countries has been found. However, it is important not to exclude completely precarious employment conditions as a risk factor to commit suicide, since some type of relation in the tendency of such variables, after analyzing time series, is likely to be found.

Usage of alcohol was associated with the risk of suicide (Choo et al., 2014) but this study did not explore the relationship between substance abuse and suicide in Europeans. Ethnicity was found to influence the method of suicide (Ho et al., 2016) but this study could not obtain information on the method of suicide in different countries. Similarly, past psychiatric history is an important predisposing factor for suicide (Ho et al., 2014) but such information is lacking. In Asia, religion (Mak et al., 2015) and resolution of conflict (Choo et al., 2017c) are protective factors against suicide but this study did not include protective factors for Europeans.

The variable educational level was also included in the model, but taking into account the percentage of people who only have compulsory education. We can observe that, apart from being correlated with the suicide rate, such variable was included in the regression model (model 2). It must be taken into account that, although this percentage of people with poor education correlated with the suicide rate, this was not the case for the percentage

of GDP devoted to education spending, since there was no statistically significant relation.

Most studies about suicide and education (Vega, Kishikawa, Ricanati, & Friedland, 2002; Nogales, 2011) have established that suicide is inversely proportional to the educational level (the higher the level of studies reached, the lower the probability to commit suicide). Nevertheless, our model has enabled us to establish, at a macro level, that the higher the percentage of population with low education background in a country, the lower the suicide rate. Therefore, it is understood that a country with 100% of its population with poor education would have a much lower suicide rate. The differences among previous researches and the results obtained in this study are based on the fact that we compare suicide rates as regards population at a national level (we work with the total population, not only with the suicidal population), in contrast to authors such as Vega, Kishikawa, Ricanati and Friedland (2002) and Nogales (2011). This suggests that we analyze the way socioeconomic factors affect suicide. If we only analyze the population which commits suicide, our conclusions would be biased since we would only know the impact of such socioeconomic indicators on suicidal population and we would not be relating suicide to the socioeconomic variables in each country.

Other variable which, although was not included in the final model, correlated with the suicide rate, was the divorce rate in the EU countries. In this sense, we could observe that the higher the divorce rate, the higher the suicide rate. In the light of our results, we come to the same conclusion as other researches which support the idea that marriage is a protective factor against suicide (Vega, Kishikawa, Ricanati, & Friedland, 2002; Buendía, Vidal, Riquelme, & Ruiz, 2004; Duberstein, Conwell, & Cox, 1998; Erlangsen, 2004). Nevertheless, there are some countries outside the European Union, such as Pakistan, India or Hong Kong in which marriage is a risk factor for female suicide due to the social, legal and economic discrimination that women suffer (Ruiz-Pérez and Olry, 2006). Therefore, in conditions of social and legal equality (as in the EU), we can observe that marriage directly affects suicide rates.

In conclusion, although there were different variables which correlated with the suicides rates (divorce rate, public debt, public expenditure on social protection), only the ratio of women and the percentage of people with basic education were present in the regression model which has been proposed (model 2) in order to predict the suicide rates in the EU countries. This bivariate model has been able to account for 49% of the suicide rate. In this sense, the higher women ratio in a country and the lower the number of individuals with basic studies, the higher the suicide rate in the country concerned. Thus, for each percentage point increase in the ratio of women, the suicide rate will increase 0.63 points. This fact means that the higher the number of women in a EU country, the higher the suicide rate in such country. As regards the percentage of people with a low educational level, the suicide rate decreased 0.18 for each percentage point increase in the rate of people with basic studies. Therefore, we can state that the more people with basic education level, the lower the suicide rate. Based on our research findings, brief suicide risk assessment that include gender and education level will achieve stronger predictive ability and reliability in suicide prediction among Europeans (Harris et al., 2015).

Competing Interests Statement

The authors declare that there are no competing or potential conflicts of interest.

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