Research Trends

Socioeconomic Change and Suicide

A Time-Series Study from the Republic of Ireland

Siobhán Lucey[1], Paul Corcoran[2], Helen S Keeley[3], Justin Brophy[4], Ella Arensman[2], and Ivan J Perry[5]

[1]Department of Economics, University College, Cork, [2]National Suicide Research Foundation, Cork, [3]Child and Adolescent Mental Health Services, Mid-Western Health Board, Limerick, [4]Newcastle Hospital, Greystones, Wicklow, [5]Department of Epidemiology and Public Health, University College, Cork, all Ireland

Abstract. This ecological study examined the association between seven socioeconomic indicators (GDP, unemployment rate, female labor force participation rate, alcohol expenditure, marriage rate, percentage of births outside of marriage, and indictable crime rate) and total, male, and female rates of suicide and suicide plus undetermined death in Ireland during the period 1968–2000. Analysis of the data expressed as absolute values showed highly significant associations between the socioeconomic indicators and the total, male, and female suicide rates. However, these associations were explained by the strongly trended data. The trended nature of the data was removed by using year-to-year differences. Analysis of the first-differenced data showed that none of the socioeconomic indicators was associated with the total, male, or female suicide rates with the exception of indictable crime, which had a significant independent effect on the female suicide rate (coefficient = 2.0, $p < .01$) but not on suicide plus undetermined death. This study highlights the need to use econometric methods in time-trend analyses, the lack of age-sex specific exposure data in this area, and the challenge of understanding trends in suicide in their socioeconomic context.

Keywords: suicide, trends, socioeconomic change, time series, Ireland

Age-standardized suicide mortality rates have fallen in the majority of Western European countries over the past two decades, whereas in Ireland suicide mortality in men has increased steadily (Chishti, Stone, Corcoran, Williamson, & Petridou, 2003). Ireland has experienced profound social and economic change. There has been a relatively rapid transition from a predominately rural society dominated by religious values to one that is increasingly urbanized and secular. Based on the official data from the Central Statistics Office (CSO), low suicide rates were observed until the mid-1970s. However, there are indications that the true suicide rate was higher due to underreporting, albeit still relatively low (Cantor, Leenaars, & Lester, 1997; Connolly, 1997; Kelleher, Corcoran, & Keeley, 1997). We assessed the association between change in a range of socioeconomic indicators and changing total, male, and female rates of suicide during the period 1968–2000. Suicide plus undetermined death was also examined in recognition of the underreporting of suicide in the past.

The first theory developed to explain the societal factors associated with changing national suicide rates is generally credited to Durkheim and his development of the concept of 'social deregulation' or anomie (Durkheim, 1952). The various theories and findings of empirical studies, in particular those investigating the association between economic factors and suicide rates, are well described by Lester and Yang (1997), Stack (2000a, b), and Neumayer (2003). The choice of which socioeconomic variables to examine for an association with suicide has varied. In relation to the economy, unemployment has been most often considered (Webb, Glass, Metha, & Cobb, 2002), however, significant findings have also been reported for gross national product and female participation in the labor force (Yang, Lester, & Yang, 1992). The importance of alcohol in suicide is becoming increasingly recognized (Neeleman & Farrell, 1997; Foster, 2001) and this is reflected in the positive associations that have been found between national alcohol consumption levels and suicide rates (Wasserman, Varnik, & Eklund, 1998; Ramstedt, 2001). From the perspective of social deregulation, crime would seem to be relevant but its ecological association with suicide has rarely been examined. On the other hand, divorce has

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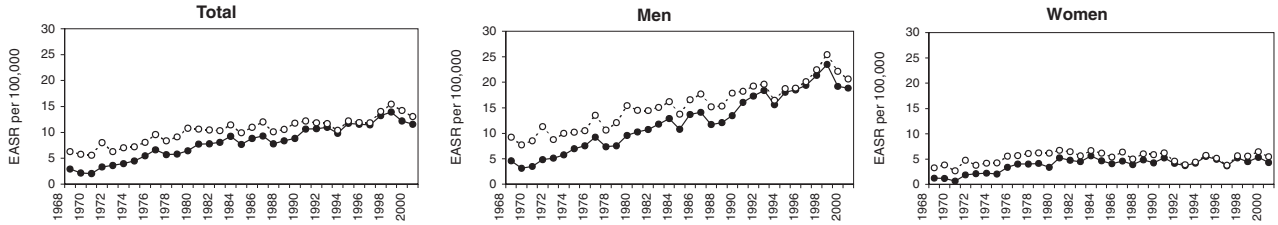

Figure 1. Irish rates of suicide and suicide plus undetermined death, 1968–2000. Note: EASR = European age-standardized rate. Empty circles = Suicide + UD, filled circles = Suicide.

been included in many empirical studies and in the vast majority of these it has been positively associated with suicide, while data relating to birth rates have generally been ignored (Stack, 2000b). The socioeconomic indicators included in this study were: Unemployment rate, gross domestic product (GDP), female labor force participation rate, alcohol consumption levels, indictable crime rate, marriage rate (as divorce has only recently been legalized in Ireland), and the rate of births outside of marriage (a potential indicator of departure from the traditional family structure).

Method

Annual mortality data for both genders in 5-year age groups were obtained for the period 1968–2000 from the Irish CSO for suicide and undetermined deaths (ICD-9 codes E950–959 and E980–989, respectively). The CSO also provided annual population data based on the national censuses or official CSO estimates as appropriate.

The following variables comprised the set of economic and social indicators: Per capita gross domestic product based on 1995 prices; the unemployment rate; the female labor force participation rate, which was only available for 1971–2000; per capita expenditure on alcoholic beverages based on 1995 prices; the marriage rate; the percentage of births outside of marriage; and the indictable crime rate. The data were derived from the relevant CSO publications (Central Statistics Office, 1968–2000a, 1968–2000b, 1968–2000c) except in the case of indictable crime where data were derived from the Annual Garda (Police) Reports (An Garda Siochana, 1968–2000).

Rates of suicide and undetermined death were age-standardized to the European Standard Population (Waterhouse, Muir, Correa, & Powell, 1976). All variables, except those measured as proportions (unemployment rate, female labor force participation rate, and percentage of births outside of marriage), were expressed in natural logarithms. These data were initially analyzed using standard correlation and linear regression analyses. The standard unit root tests (the Augmented Dickey Fuller tests, used to test the stationarity of the variables) indicated that the socio-economic and suicide data series were strongly trended. Time series data are often strongly trended or nonstationary with the consequence that the regression of two strongly trended data series are virtually certain to produce significant associations even if the two series are, in fact, independent. The significance arises as a consequence of the underlying trend in the data. We, therefore, used standard econometric methods for the analysis of time-series data (Enders, 1995). On examining the time-series properties of the variables, we found that first differences (i.e., the absolute difference between 2 consecutive years) produced stationary or nontrended data series. Correlation and regression analysis of these differenced data was then used to assess the association between the socioeconomic indicators and the suicide rates over the period, independent of any underlying trends. All analyses involving suicide were replicated using suicide plus undetermined death in order to account for possible distortion of suicide trends due to misclassification of suicides as undetermined deaths.

Results

Irish mortality rates by suicide and suicide plus undetermined death are illustrated in Figure 1 for the period 1968–2000. For the first half of this period the total, male, and female suicide rates increased steadily from a low base rate. During this time, the addition of undetermined deaths markedly increased the rates and also somewhat diminished the gradient of the increasing trend. This suggests a degree of underreporting of suicide that decreased over time. In the latter half of the study period the female rate remained stable while the total and male suicide rates continued to rise. For the past decade, the undetermined death rate was very low and its addition to the suicide rate had little or no effect.

Each of the indicators of social and economic change were significantly associated with the total, male, and female rates of suicide. The correlation coefficients were highly significant ($p < .001$) and ranged in magnitude from 0.596 to 0.903, except for weaker correlations be-

Table 1. Results of multiple linear regression of Irish age-standardized suicide rates on seven socioeconomic variables, 1968–2000,[1,2] based on (a) the full model[3] and (b) the model arrived at by stepwise backward selection of variables.

	(a) Full regression model coefficients			(b) Stepwise regression model coefficients		
	Total suicide	Male suicide	Female suicide[4]	Total suicide	Male suicide	Female suicide
Gross domestic product	0.946	0.703	1.237			
Unemployment rate	0.006	0.014	–0.003			
Female labor force participation rate	0.028	0.028	0.028			
Alcohol expenditure	0.902	0.943	0.863	1.032***	1.080***	0.639**
Marriage rate	–0.828	–0.893	0.153	–0.625*	–1.134**	0.663*
Births outside marriage	–0.034	0.020	–0.055			
Indictable crime rate	0.536*	0.393	1.081*	0.753***	0.571**	1.139***

*$p < .05$; **$p < .01$; ***$p < .001$

[1]All variables, except those measured as proportions (unemployment rate, female labor force participation rate, and percentage of births outside of marriage), were expressed in natural logarithms; [2] Female labor force participation data were only available for the period 1971–2000; [3] The coefficient estimates reported for Female labor force participation rate were obtained from the full multiple linear regression that included all seven socioeconomic variables for the period 1971–2000. Results for the other six variables were based on a model that excluded Female labor force participation and, hence, used data from the full study period 1968–2000; [4] A dummy variable was included in this regression to account for nonnormality attributable to an outlier in 1969.

Table 2. Results of multiple linear regression of change in Irish age-standardized suicide rates on the change in seven socioeconomic variables, 1968–2000,[1,2] based on (a) the full model[3] and (b) the model arrived at by stepwise backward selection of variables.

	(a) Full regression model coefficients			(b) Stepwise regression model coefficients		
	Total suicide	Male suicide	Female suicide	Total suicide	Male suicide	Female suicide
Gross domestic product	–0.609	–0.946	0.422			
Unemployment rate	–0.020	–0.012	–0.055			
Female labor force participation rate	0.008	0.038	–0.091			
Alcohol expenditure	0.137	0.466	–0.818	0.271	0.492	0.456
Marriage rate	–0.229	–0.400	–0.255	–0.204	–0.465	1.934
Births outside marriage	–0.039	–0.034	–0.065			
Indictable crime rate	0.187	–0.077	0.969	0.359	0.167	1.966**

*$p < .05$; **$p < .01$; ***$p < .001$

[1]Variables measured as proportions (unemployment rate, female labor force participation rate and percentage of births outside of marriage) were expressed as the differences of the values in successive years (i.e., $X_n - X_{n-1}$). All other variables were expressed as the differences of the natural logarithm of the values in successive years (i.e., $\ln(X_n) - \ln(X_{n-1})$); [2]Female labor force participation data were only available for the period 1971–2000; [3]The coefficient estimates reported for Female labor force participation rate were obtained from the full multiple linear regression that included all seven socioeconomic variables for the period 1972–2000 (loss of one observation due to first differencing). Results for the other six variables were based on a model that excluded Female labor force participation and, hence, used data for the study period 1969–2000 (loss of one observation due to first differencing).

tween the female suicide rate and both the female labor force participation rate ($r = .445$, $p < .05$) and the birth rate outside of marriage ($r = .494$, $p < .01$). All socioeconomic indicators, except the marriage rate, correlated positively with the suicide rate measures.

The results of multiple linear regression of the total, male, and female suicide rates on the seven socioeconomic indicators based on the data in absolute values are given in Table 1. For the model including all seven variables, the only independent significant associations indicated were between the indictable crime rate and both the total and female suicide rates. Stepwise deletion of variables from the regression models based on the significance of their coefficients indicated that alcohol expenditure, marriage rate, and indictable crime rate were independently significantly associated with the total, male, and female Irish suicide rates.

The matrix of correlations between the three suicide measures and the seven socioeconomic variables showed no significant correlations when based on year to year changes in the data. The correlation coefficients ranged in magnitude from 0.009 to 0.272. The results of multiple linear regression of changes in the suicide rates on changes in the seven socioeconomic indicators showed no significant associations when all seven indicators were included in the model (Table 2). Regression of changes in suicide on changes in the three indicators that emerged in analyses of the data expressed in absolute values (alcohol expenditure, marriage rate, and indictable crime rate) showed no significant associations

for the total and male suicide measures. In women, changes in the indictable crime rate had a significant independent effect on changes in the rate of suicide (coefficient = 2.0, $p < .01$). The regression coefficient indicated that, on average, a 1% increase in the year to year change in indictable crime (growth rate) led to a 2% increase in the growth rate of Irish female suicide. However, there was no such significant effect on suicide plus undetermined death in women.

Discussion

Ireland has seen a steady increase in suicide over the period 1968–2000 that occurred in parallel with rapid social change. In terms of the seven indicators included in this study, Ireland's economic output increased, particularly in the last decade when the trend of rising unemployment was reversed. Alcohol expenditure more than doubled. Female labor force participation increased gradually. The rate of marriages fell steadily while births outside of marriage became common. Using time-series analysis, we have found no evidence that these socioeconomic trends were the driving force behind the trends in Irish suicide. There was a significant positive association between changes in the indictable crime rate and changes in the female suicide rate but the association was no longer significant when the female rate of suicide plus undetermined death was considered. The problem of multiple comparisons must also be considered in our interpretation of this finding.

While we considered seven social and economic indicators, it is possible that other factors have contributed significantly to changes in Irish suicide rates. Because this was an ecological study, the results do not preclude significant associations between the socioeconomic factors considered in this study and suicide at the individual level.

A number of studies have found the effect of factors associated with suicidal behavior at the individual level to be modified by their ecological context. For example, the relative risk of deliberate self-harm among ethnic minorities in London was found to vary according to the ethnic mix of their areas of residence (Neeleman, Wilson-Jones, & Wessely, 2001). Future studies of individual risk and protective factors should appropriately consider the ecological context of the individual (Braucht, 1979).

Ireland's increase in suicide was experienced by both genders until 1980 as their rate of undetermined death fell steadily, suggesting that improved recording procedures may have contributed to the increasing suicide rate (Cantor et al., 1997). The low rate of undetermined death for Irish men and women in recent years indicates that underreporting of suicide caused by misclassification as undetermined death is not a significant problem (Kelleher et al., 1997). After 1980, the female suicide rate in Ireland remained relatively constant at 4–5 per 100,000 whereas the male suicide rate continued to increase reaching 19 per 100,000 in 2000. Comparing these Irish suicide rates to those of other European Union countries, the Irish male suicide rate is similar to the European average, while the Irish female rate is below average. However, it has been shown that this rise in Irish male suicide rates was in sharp contrast with decreasing male suicide rates in most other European Union countries (Chishti et al., 2003). Young men in Ireland have been most affected by rising suicide rates. Between 1980 and 2000, suicide mortality in men aged 15–34 years increased four-fold from 6.4 to 25.3 per 100,000.

While the details of the analysis are not presented in this paper, we found no significant association between changes in the young Irish male suicide rate and changes in the seven socioeconomic indicators used in this study. Given that the socioeconomic data related to the total Irish population, the value of assessing their association with an age-sex specific suicide rate is questionable. Unfortunately, the relevant age-sex specific socioeconomic data were not available. This may have been particularly relevant to alcohol as a stronger association has been found between alcohol and suicide in men than in women (Wasserman et al., 1998). This issue was also addressed recently in a time-series analysis of suicide trends in England and Wales as it relates to a wide range of variables from the social, economic, and health domains, including prescribing of antidepressants (Gunnell, Middleton, Whitley, Dorling, & Frankel, 2003). Gunnell and colleagues found that social, economic, and health-related factors associated with suicide rates varied by age and gender. It is, therefore, important that in future ecological studies addressing this issue in Ireland we examine age and sex specific suicide and socioeconomic exposure data.

In summary, we have found no significant associations between major socioeconomic indicators and suicide mortality in Ireland with the exception of an association with indictable crime that may be only chance. These findings highlight the importance of using rigorous econometric methods in time-trend analyses. The work also highlights the need for age and sex specific data on socioeconomic indicators such as alcohol consumption and the challenge of understanding trends in suicide in its socioeconomic context.

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About the authors

Siobhán Lucey is a Lecturer of Economics at University College, Cork, Ireland, where she completed her PhD. Her teaching and research interests focus on quantitative techniques and forecasting.

Paul Corcoran is Senior Statistician/Deputy Director of the National Suicide Research Foundation, Cork, Ireland, where he has worked since it was established 10 years ago. He is also a lecturer in Biostatistics with the Department of Epidemiology and Public Health at University College, Cork, where he is completing a PhD. He is a member of the National Suicide Review Group and an Officer of Statistics to the Irish Central Statistics Office with responsibility for the analysis of the data recorded on every inquested death in the country.

Helen S. Keeley is a Consultant Child and Adolescent Psychiatrist with the Mid-Western Health Board, Ireland. She was previously Research Registrar and Deputy Director with the National Suicide Research Foundation, Cork, Ireland, before completing higher training in Child and Adolescent Psychiatry at the Tavistock and Portman NHS Trust in London. She maintains an active involvement in suicide research with a particular interest in biological systemic approaches, especially in the young.

Justin Brophy is a Consultant General Adult Psychiatrist at Newcastle Hospital, County Wicklow, Ireland. He is Chairman of the Irish Psychiatrists Association and former Chairman of the Irish Psychiatric Tutors Association. He has a research interest in suicide and is currently investigating suicide notes from Ireland as well as further investigating the correlation between suicide rates and alcohol consumption in Ireland.

Ella Arensman is Director of Research at the National Suicide Research Foundation, Cork, Ireland. Her specific research areas of interest are the prediction of suicidal behaviour, cross-cultural differences in suicidal behaviour, and the treatment of people who have engaged in deliberate self-harm as well as prevention of repeated suicidal behaviour. She is also involved in training people in different work-settings to increase awareness of suicidal behaviour and to improve early intervention.

Ivan J. Perry is Professor of Public Health, Head, Department of Epidemiology and Public Health, University College, Cork, and Director of the National Parasuicide Registry, which is based at the National Suicide Research Foundation, Cork, Ireland. His current major interests are chronic disease epidemiology with a focus on the role of diet and lifestyle in the etiology of cardiovascular disease and Type 2 diabetes, suicide epidemiology, and health services research.

Address for correspondence

Professor Ivan J. Perry
Department of Epidemiology and Public Health
Distillery House
University College
Cork
Ireland
Tel. +353 21 490-4235
Fax +353 21 490-4236
E-mail i.perry@ucc.ie