

# The effect of the late 2000s financial crisis on suicides in Spain: an interrupted time-series analysis

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**Background:** The current financial crisis is having a major impact on European economies, especially that of Spain. Past evidence suggests that adverse macro-economic conditions exacerbate mental illness, but evidence from the current crisis is limited. This study analyses the association between the financial crisis and suicide rates in Spain. **Methods:** An interrupted time-series analysis of national suicides data between 2005 and 2010 was used to establish whether there has been any deviation in the underlying trend in suicide rates associated with the financial crisis. Segmented regression with a seasonally adjusted quasi-Poisson model was used for the analysis. Stratified analyses were performed to establish whether the effect of the crisis on suicides varied by region, sex and age group. **Results:** The mean monthly suicide rate in Spain during the study period was 0.61 per 100 000 with an underlying trend of a 0.3% decrease per month. We found an 8.0% increase in the suicide rate above this underlying trend since the financial crisis (95% CI: 1.009–1.156;  $P=0.03$ ); this was robust to sensitivity analysis. A control analysis showed no change in deaths from accidental falls associated with the crisis. Stratified analyses suggested that the association between the crisis and suicide rates is greatest in the Mediterranean and Northern areas, in males and amongst those of working age. **Conclusions:** The financial crisis in Spain has been associated with a relative increase in suicides. Males and those of working age may be at particular risk of suicide associated with the crisis and may benefit from targeted interventions.

## Introduction

In his seminal 1897 work, *Le Suicide*, Durkheim proposed that macroeconomic changes may increase suicides.<sup>1</sup> Since then associations have been found between economic instability and both mental ill health and suicide,<sup>2–8</sup> with past economic crises, such as the collapse of the Soviet Union and the Southeast Asian economic crisis in the late 1990s, associated with increases in suicides.<sup>9,10</sup> The current global financial crisis is widely regarded as the worst since the Great Depression of the 1930s and has had a severe deleterious effect on the Spanish economy, culminating in a request for Eurozone support for its banking sector.<sup>11</sup> Following a decade of expansion, economic growth began to slow in 2007 and gross domestic product (GDP) began to contract from the second quarter of 2008, ushering in a recession lasting seven successive quarters (Supplementary Appendix 1).<sup>12</sup> Between 2007 and 2012, unemployment trebled from 8% to 24% (Supplementary Appendix 2), reaching the highest rate in the European Union, with the greatest increases seen in young males (age 20–34): from 11% to 50%.<sup>13</sup> Since the onset of the financial crisis, there have been major cuts to social spending. Savings have included redundancies and salary reductions for health care personnel, changes to drug-prescribing policies, closure of facilities, reductions in opening times and delays in payments to suppliers.<sup>14–16</sup>

Evidence on the influence of the current financial crisis on mental health, either in Spain or elsewhere, is limited, largely because delays in data availability mean that the full impact cannot yet be assessed. The lack of any sign that the crisis is ending makes it important that its effects be understood so that mitigating interventions can be implemented. One previous study has formally examined the effect of the financial crisis on suicides, finding that observed suicide

counts in England were above those that would have been expected based on underlying trends, particularly amongst men.<sup>17</sup> There have also been reported increases in suicides in Greece, Italy and the European Union in general and possible increases in mental illness in Spain and Greece, although underlying trends were not accounted for.<sup>18–24</sup> A further study used joinpoint regression as part of their analysis of several mental health indicators in South Australia but found no change in trends of any psychological distress measures associated with the crisis.<sup>25</sup>

In this study, we investigate the relationship between the current financial crisis and suicides in Spain using an interrupted time-series analysis. We also evaluate how this relationship varies by geographical area, sex and age.

## Methods

An interrupted time-series analysis was used to compare suicide rates before the financial crisis with those subsequently. A financial crisis may impact on health through a variety of mechanisms, including job loss (or anticipation thereof), reduced working hours and debt. Consequently, it is appropriate to look at the financial crisis as a discrete, if multifaceted, event rather than using one or more intermediary variables. Suicide data were obtained from the 'Instituto Nacional de Estadística' (INE), Spain's national statistics institute.<sup>13,17</sup> Suicides are deaths coded as X60–X84 (ICD-10).<sup>26</sup> In Spain, suicides are determined following judicial review of any deaths that may have a possible accidental or violent cause. Monthly suicide data were used to maximize the data points available since the financial crisis.<sup>27</sup> Full monthly suicide data, disaggregated by region and age-group, were only available from 2005; in addition, the data are published with a 2-year delay, so only data for 72 months were available (January

2005 to December 2010). Population denominators were obtained from the INE official population figures.

The 'intervention' of interest in this study was the financial crisis. For unplanned events, the timing of the intervention must be established from data that are independent of the time-series data being analysed.<sup>28</sup> We based the timing on observed changes in GDP, the measure most commonly used in defining a recession.<sup>10,29</sup> In Spain, GDP began to contract from the second quarter of 2008 (Supplementary Appendix 1),<sup>12</sup> so the period up to and including March 2008 was considered pre-financial crisis and April 2008 onwards, post financial crisis.

### Statistical analysis

Segmented regression was used to estimate the effect of the financial crisis on suicides.<sup>27</sup> A Poisson distribution of monthly suicide counts was assumed offset by population data to model rates. Adjustments were made for the length of the month and for any seasonal effect, the latter by using a harmonic term based on the month of the year that included two sine/cosine pairs.<sup>30</sup> Initial analyses suggested a moderate degree of overdispersion (dispersion parameter = 1.46), so a more flexible quasi-Poisson model was used for all analyses.<sup>31</sup> Residual autocorrelation was also tested for using the Durbin-Watson test. Further models were tested in a sensitivity analysis, including a model allowing for both a step change and a change in the trend; a two-step model whereby a recession period was modelled as the duration that GDP contracted—second quarter of 2008 until the last quarter of 2009, then returning to growth until the end of the dataset (December 2010) (Supplementary Appendix 1); and a model with the crisis period starting from July 2007, the point where unemployment began to rise (Supplementary Appendix 2), rather than April 2008.

A control analysis was also undertaken using mortality from accidental falls as the outcome to distinguish any association with the financial crisis from other concurrent events.<sup>27</sup> This outcome was chosen as being unlikely to be affected by the financial crisis but has similarities to suicides in that both require judicial review and have short lag times compared with other causes of death such as chronic diseases.

Further stratified analysis was conducted to investigate whether changes in suicides varied by region, sex and age group. The individual autonomous regions of Spain could not be examined separately, as the number of suicides per month was too low (<30 for most regions), which would have led to too much random variability. The regions were therefore grouped into three areas based on geographical location and economic similarities: Northern Spain (comprising Galicia, Asturias, Cantabria, the Basque Country, Navarra, La Rioja and Aragon), central Spain (comprising Castilla and Leon, Castilla La Mancha, Extremadura and Madrid), the Mediterranean area and Canary Islands (comprising Catalonia, Valencia, Murcia, Andalucia, the Balearic Islands and the Canary Islands). Broadly speaking, regions in the Northern area have large manufacturing sectors; the Central area have a relatively large agricultural sector, although Madrid, which relies more on its financial and service sectors, is an anomaly here; and the Mediterranean area has a large service sector, in particular tourism, and a relatively large real estate sector. All regions also have large construction and public service sectors.<sup>13</sup> Age was grouped into younger economically active ages (age 15–39), older economically active ages (age 40–64) and post state retirement age (age 65 plus).

All analyses were conducted using the statistical packages R 2.15.0 and STATA version 11.

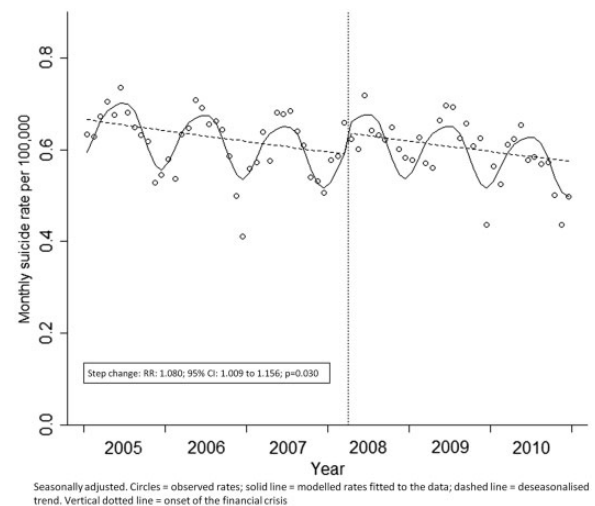
## Results

Table 1 shows summary data of the average monthly suicide counts and rates over the 72 months of the time series for the different groups studied. The highest monthly suicide rates for the

**Table 1** Mean monthly suicide data for the duration of the time series

Population	Monthly suicide count	Population (millions)	Monthly suicide rate (per 100 000)
All Spain	277 (31)	45.7 (1.1)	0.61 (0.07)
Area			
Northern Spain	66 (10)	8.8 (0.1)	0.75 (0.11)
Central Spain	51 (10)	11.8 (0.3)	0.43 (0.08)
Mediterranean	159 (19)	24.8 (0.7)	0.64 (0.08)
Sex			
Males	213 (26)	22.6 (0.5)	0.95 (0.12)
Females	64 (9)	23.1 (0.5)	0.28 (0.04)
Age group			
15–39	75 (13)	16.8 (0.1)	0.44 (0.08)
40–64	111 (15)	14.6 (0.6)	0.76 (0.09)
65+	91 (16)	7.6 (0.2)	1.20 (0.21)

Mean (SD). Note: Total for all Spain is not equal to the sum of the area totals, as Ceuta and Melilla (two autonomous Spanish cities in North Africa) are not included in the latter.



**Figure 1** Trend in monthly suicide rates for all of Spain before and since the financial crisis

categories of area sex and age group were in Northern Spain, males and those aged  $\geq 65$  years, respectively.

The principal model for all of Spain (figure 1) suggested that, over the period studied, the underlying trend was of a 0.3% decrease in the suicide rate per month (95% CI: 0.995–0.998;  $P < 0.001$ ). There was an 8.0% step increase in the suicide rate associated with the financial crisis (95% CI: 1.009–1.156;  $P = 0.030$ ). The Durbin-Watson statistic showed no evidence of autocorrelation (DW 2.10,  $P = 0.421$ ). The control analysis showed no evidence of a change in mortality from accidental falls associated with the financial crisis (step change: RR 1.031; 95% CI: 0.939–1.132;  $P = 0.525$ ) (Supplementary Appendix 3).

Results of the stratified analyses are presented in table 2 with the plots in Web Supplementary Appendices 4–6. All results are concordant in suggesting an increase in suicide rates. Although the stratified analyses suggest a greater increase in the Mediterranean and Northern areas, in males and in younger age groups, the low statistical power when testing for interaction and the associated  $P$ -values (test for interaction: area  $P = 0.868$ , sex  $P = 0.263$ , age  $P = 0.923$ ) prevent any firm conclusions being made on a differential effect by sub-groups.

All models tested in the sensitivity analysis also showed a relative increase in the suicide rate during the financial crisis period (Supplementary Appendix 7). Furthermore, removing three outlying observations (December 2006, December 2009 and November 2010) had little impact on the results.

**Table 2** Suicide rates during the financial crisis period compared with before the financial crisis

Population	Step change (RR) 95% CI	P-value
All Spain	1.080 (1.009–1.156)	0.030
Area		
Northern Spain	1.090 (0.967–1.226)	0.160
Central Spain	1.043 (0.911–1.195)	0.538
Mediterranean	1.086 (1.005–1.172)	0.037
Sex		
Males	1.100 (1.026–1.179)	0.007
Females	1.013 (0.894–1.149)	0.834
Age group		
15–39	1.104 (0.980–1.245)	0.110
40–64	1.082 (0.980–1.195)	0.119
65+	1.067 (0.957–1.191)	0.243

RR: rate ratio; 95% CI: 95% confidence interval.

P-values are two-sided. All results based on a step change model, adjusted for seasonality, with the pre-crisis period from January 2005 to March 2008 and the financial crisis period from April 2008 to December 2010.

## Discussion

### Principal findings

These results suggest that the onset of the financial crisis has been associated with a relative increase in the suicide rate in Spain above the expected underlying trend. If this association was causal, the financial crisis may account for around 21 suicides per month in Spain or around 680 suicides since the crisis so far (up to the end of 2010). Although we were underpowered to test for interaction, the relative increase in the suicide rate appears to have been greatest in the Mediterranean and Northern areas of Spain, amongst males and amongst those of working age.

### Comparison with previous studies

The underlying downward trend in suicides seen during the study period is consistent with the long-term trend in most European countries. Numerous explanations have been offered for this downward trend including improved mental health provision, greater use of antidepressants and policies such as changes to paracetamol pack sizes and withdrawal from certain drugs from over the counter sales.<sup>32</sup> Only one previous study has examined the effect of the current financial crisis on suicides while taking into account such underlying trends; this found around 1000 more suicides in England during the recession than would be expected based on historical trends. Similar to our results this increase was found to be greater amongst males.<sup>17</sup> The reported increases in suicides in Greece, Italy and the European Union as a whole also provide some support to our results, although these reports did not account for underlying trends in suicides.<sup>19,21,22</sup> Again, consistent with our results for suicides, the one previous study of the mental health effects of the financial crisis in Spain found increases in primary care attendance for various mental illnesses in 2010–11 compared with 2006–07, including mood, anxiety, somatoform and alcohol-related disorders.<sup>23</sup> Only one study so far, in South Australia, has shown no evidence of an increase in mental health indicators related to suicide since the financial crisis, in this case depression, suicidal ideation and other psychological distress measures.<sup>25</sup> This may perhaps be explained by a low proportion of unemployed people in their sample compared with the population as a whole but also the limited effect that the global financial crisis has so far had on Australia compared with Spain and other countries in Europe.<sup>25</sup> The increase in suicide rates is also supported by evidence of increases during past economic crises in Asia and Russia.<sup>9,10</sup> In addition, other studies find that associations between adverse macro-economic conditions and suicide are

strongest amongst males and younger age groups, consistent with our findings.<sup>3–6</sup> No other studies were found that have investigated the differential effect of the current financial crisis on suicide or other mental health indicators between age groups in Spain or abroad; nor were there any studies investigating regional differences in the effect within Spain; therefore, our findings cannot directly be compared with other results.

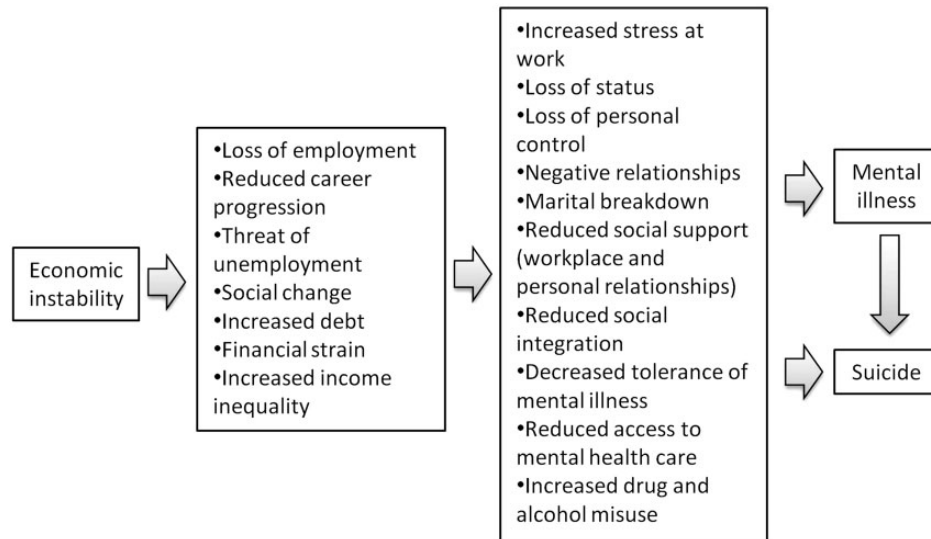
### Strengths and limitations

Our study has a number of strengths. Interrupted time-series is regarded as a powerful quasi-experimental design for assessing the longitudinal impact of an intervention, as it enables both random month on month fluctuations and the underlying trend to be accounted for in the analysis.<sup>27</sup> In addition, it does not suffer from some of the biases and confounders of other observational studies. Other variables associated with suicides that may have changed over the same time period, including seasonal fluctuations, were adjusted for during the analysis. Any residual confounders would have to be events that occurred at the same time as the financial crisis but were not a manifestation of the crisis. While the lack of any association between the financial crisis and deaths from accidental falls cannot exclude all such events, it does help to exclude many, such as unrecognized changes to systems of death registration or classification, or any other events that would have impacted on both causes of death. The results of this study were also robust to sensitivity analysis for the timing of the financial crisis period, with all models that were tested showing a relative increase in suicides above the underlying trend during the financial crisis period. In addition, there was no evidence of autocorrelation in our model. Finally, whilst the use of suicides as an outcome measure may provide a very incomplete picture of the impact of the financial crisis on mental health, it is an objective measure that is less subject to responder bias, observer bias and validity issues compared with other outcomes such as self-reported mental health indicators or suicidal ideation.

There are also potential limitations to this study. Firstly, the number of suicides per month in the stratified analysis was relatively low, leading to relatively wide confidence intervals and requiring the amalgamation of autonomous regions into three larger areas. Secondly, there is no established definition for the timing of the financial crisis in Spain. As recommended for imperfectly identifiable events, an independent indicator was used to determine the onset of the crisis, in this case GDP.<sup>28</sup> Nonetheless, it is clear that some manifestations of the financial crisis in Spain began before this point including the increase in unemployment rates. However, various other definitions of the financial crisis period were modelled in the sensitivity analysis, and all of these also showed evidence of an increase in the suicide rate above the underlying trend during the crisis, so it is unlikely that any incorrect timing of the 'intervention' impacted on the results. Thirdly, no lag period was included in the model, consistent with evidence from elsewhere that there is no significant lag effect.<sup>17,22</sup> However, if a lag did exist, the modelled effect would have been attenuated so the effect of the financial crisis on the suicide would, if anything, have been underestimated. Finally, studies have suggested that deaths from events with undetermined intent (ICD-10: Y10–Y34<sup>26</sup>) should also be included when analysing suicides to avoid underestimation.<sup>33</sup> However, these were not available in a form disaggregated by the variables required (including region and age group). There were only between 1 and 19 deaths per month nationally from events with undetermined intent during the period of study, so even if all had been a suicide, it would have had little impact on the results.

### Interpretation and implications

Our study alone cannot establish whether the association found between the financial crisis and suicides is causal; however, this explanation is supported by the relatively large magnitude of effect,



**Figure 2** Proposed mechanisms for the relationship between economic instability and mental illness and suicides

consistency with previous studies, coherence with existing theory dating back to Durkheim<sup>1</sup> and the existence of numerous plausible mechanisms for the relationship between financial crises and suicides (figure 2).<sup>34–36</sup> Perhaps the most researched mechanism is through the effects of the financial crisis on unemployment and its association with suicide. Spain has experienced a dramatic rise in unemployment during the financial crisis (Supplementary Appendix 2); numerous studies have found strong associations between increasing unemployment and suicides in the past.<sup>3,5,37</sup> Initial evidence from the current financial crisis in other European countries appears to suggest the same pattern is occurring.<sup>17</sup> Furthermore, although formal statistical analysis would be required, the groups in the stratified analysis that showed evidence of increases in the suicide rate above the underlying trend appear to coincide relatively well with those that have experienced the biggest absolute increases in unemployment rate between the start and the end of the study period, including the Mediterranean region of Spain, males and those of younger working age groups (Supplementary Appendix 8).

This study is the first to show the association between the financial crisis and suicides in Spain; it is also perhaps the strongest evidence to date of the detrimental impact that the current financial crisis may be having on mental health. The association found with suicides is likely to represent only the tip of the iceberg of a possible effect of the financial crisis on wider mental health. In addition, by 2010 the biggest effects of the financial crisis in Spain had yet to manifest themselves, as many of the major social spending cuts had only just been introduced.<sup>14</sup> It may therefore be that, if the association found in this study is causal, a further increase in suicide rates will already have occurred and will continue unless mitigating interventions are introduced promptly. Potential interventions include active labour market programmes, family support programmes and debt relief programmes.<sup>36</sup> The results of the stratified analysis undertaken in this study may help to identify which groups should be targeted with such interventions.

### Future research

Although this study has provided important insight into one of the harmful impacts the financial crisis may be having on health, there remains a need for further research. Firstly, a number of potentially at risk groups have been identified during the stratified analysis and possible reasons for the increased risk in these groups have been hypothesized, but we were underpowered to test whether these were true differences or due to chance. Further investigation is needed to try to establish whether these subgroups are truly at

greatest risk and if so why this is the case. Secondly, given the global nature of the financial crisis, further international studies are required to establish whether similar effects are being seen with suicide rates elsewhere to help identify whether certain policies implemented by some countries may have a protective effect. Thirdly, further research is needed to identify the effectiveness of mitigating interventions and how they are best implemented.

### Supplementary data

Supplementary data are available at *EURPUB* online.

### Ethical approval

Ethical approval was obtained from the London School of Hygiene and Tropical Medicine research ethics committee.

### Acknowledgements

We would like to thank Isabel Ruiz, M<sup>a</sup> José Sánchez and Esther Molina from the Andalusian School of Public Health for their comments and suggestions.

### Funding

There was no specific funding for this study; J.L.B. was supported by a National Institute of Healthcare Research Academic Clinical Fellowship; A.G. was supported by a Medical Research Council Research Methodology Fellowship.

*Conflicts of interest:* None declared.

### Key points

- In Spain, the financial crisis has been associated with a substantial increase in suicide rates over and above the underlying trend.
- Public health interventions focussing on mitigating the impact of the financial crisis on mental health and suicide should be established.
- The effect of the financial crisis on suicides appears to be greatest amongst men and amongst those of working age; these groups may benefit most from targeted interventions.



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