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# Impact of unemployment variations on suicide mortality in Western European countries (2000–2010)

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► Additional material is published online only. To view please visit the journal online (<http://dx.doi.org/10.1136/jech-2013-203624>).

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Received 8 November 2013

Revised 26 March 2014

Accepted 30 May 2014

Published Online First

18 June 2014

## ABSTRACT

**Background** A scientific debate is currently taking place on whether the 2008 economic crisis caused an increase in suicide rates. Our main objective was to assess the impact of unemployment rate on suicide rate in Western European countries between 2000 and 2010. We then tried to estimate the excess number of suicides attributable to the increase of unemployment during the 2008–2010 economic crisis.

**Methods** The yearly suicide rates were modelled using a quasi-Poisson model, controlling for sex, age, country and a linear time trend. For each country, the unemployment–suicide association was assessed, and the excess number of suicides attributable to the increase of unemployment was estimated. Sensitivity analyses were performed, notably in order to evaluate whether the unemployment–suicide association found was biased by a confounding context effect ('crisis effect').

**Results** A significant 0.3% overall increase in suicide rate for a 10% increase in unemployment rate (95% CI 0.1% to 0.5%) was highlighted. This association was significant in three countries: 0.7% (95% CI 0.0% to 1.4%) in the Netherlands, 1.0% (95% CI 0.2% to 1.8%) in the UK and 1.9% (95% CI 0.8% to 2.9%) in France, with a significant excess number of suicides attributable to unemployment variations between 2008 and 2010 (respectively 57, 456 and 564). The association was modified inconsistently when adding a 'crisis effect' into the model.

**Conclusions** Unemployment and suicide rates are globally statistically associated in the investigated countries. However, this association is weak, and its amplitude and sensitivity to the 'crisis effect' vary across countries. This inconsistency provides arguments against its causal interpretation.

## INTRODUCTION

Since Durkheim's classic sociological study on suicide at the end of the nineteenth century,<sup>1</sup> increases in suicides during economic downturns are repeatedly observed. However, it remains important to clearly define the actual origin of this increase in order to target it with effective public health policies. In 2008, Western European countries had entered in a period of economic crisis, characterised by a slowdown in economic activity with sharp rises in unemployment rates. A debate is currently taking place about its public health consequences, particularly on an increase of deaths by suicide due to economic downturns. This debate is fuelled by media headlines on a rise in suicides linked to unemployment or fear of job loss (with,

for instance, in France, the succession of suicides at the national telecom company).<sup>2</sup> The scientific discussion is focused on whether the economic crisis has caused the observed increase in suicides.<sup>3–9</sup>

Becoming unemployed is a stressful event, introducing some loss of social roles, and can trigger a feeling of entrapment leading a person to suicide.<sup>10</sup> The individual unemployment–suicide association is already well documented.<sup>10–12</sup> Unemployment was thus the feature used by most of the studies assessing the impact of the 2008 economic crisis on suicide.<sup>3 6 8 13 14</sup> However, these studies have an ecological design: they assess associations between unemployment and suicide rates with aggregated data instead of individual data. Two components of the ecological association are generally distinguished: the individual effect (or 'composition effect'), defined as the impact of becoming unemployed on suicidal behaviour on individuals, and the contextual effect, defined as the social phenomena (job insecurity among employed population, family and friends of unemployed persons) induced by unemployment variations on suicide mortality of the whole population. These two components cannot be distinguished by ecological studies, but they should be both considered in interpreting the results. Caution must be taken with the risk of ecological fallacy: ecological association must not be interpreted only as individual associations. Hence, the overall consequence of unemployment on suicide rates can be explained at the ecological level as a combination of the individual effect (more unemployed people die by suicide) and of the contextual effect on the labour market. Unemployment increase develops tension and anxiety on the labour market, notably by the fear of job loss among employed people.<sup>15 16</sup> These feelings of job insecurity could foster an increase in suicide rates, as suicide mortality increases among employed people when unemployment rates increase in the population.<sup>17 18</sup>

This unemployment–suicide ecological association could be biased by the confounding effects of concomitant features of the economic crisis (hereinafter gathered in the term 'crisis effect'). The economic crisis could impact on suicide mortality by unemployment increase, but also by the effect of other features, whose list is difficult to draw up. The impact of fear of job loss is already known,<sup>15 16</sup> but we can also hypothesise an impact of governmental or private firm policy shifts, or an impact of the way the media handle the consequences of the economic crisis. As an impact of the reporting of suicides in the media has been



► <http://dx.doi.org/10.1136/jech-2014-204487>



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**To cite:** Laanani M, Ghosn W, Jouglu E, et al. *J Epidemiol Community Health* 2015;**69**:103–109.

described as an imitation, or social contagion process,<sup>19–22</sup> we can hypothesise that the media could sustain a climate of socio-economic decline and insecurity, responsible for hopelessness among the population. The impact of unemployment is highly correlated with the impact of the other features of the economic crisis (or ‘crisis effect’), making them difficult to study independently.

The ecological impact of the 2008 economic crisis on suicide rates has been studied in different countries.<sup>3 6–9 14 23 24</sup> Mixed results were obtained because of the use of different methodologies and also because the studies took into account either the effect of unemployment or the ‘crisis effect’. Despite this inconsistency, and the blurred definition of the assessed exposition (unemployment or crisis), a causal association between the 2008 economic crisis and the increase in suicides was suggested.<sup>3 5 9</sup> One of these studies assessed the ‘crisis effect’ on suicide mortality in 54 countries all over the world<sup>9</sup> and found an association between the magnitude (in percentage points) of rises in unemployment and increases in men suicide mortality. The investigators deduced a dose–response effect, consistent with the hypothesis of a causal role of the 2008 economic crisis on rises in suicide mortality.

A recent study found that expenses on labour market policies could mitigate the public health consequences of economic crises, including the increase in suicides.<sup>25</sup> Then, we expect the association to be heterogeneous between countries. Specifically, as France has one of the highest employment protection indexes according to the OECD,<sup>26</sup> the impact of unemployment variations on suicide rate in this country should be low. France also appears with one of the highest suicide rates among Western European countries,<sup>27</sup> suggesting that France deserves a focus on the issue of the unemployment–suicide association.

This study aimed to assess the ecological effect of unemployment rate on suicide rate in Western European countries between 2000 and 2010. Sensitivity analyses were undertaken to assess the robustness of the model regarding different hypotheses, notably regarding a possible confounding ‘crisis effect’. The analysis provided an estimation of the excess number of suicides attributable to the increase of unemployment in each country during the 2008–2010 economic crisis.

## METHODS

### Data

Suicide numbers (ICD-10 codes X60–X84)<sup>28</sup> were collected for Western European countries from Eurostat database by sex, 5-year age group (from 15–19 years to 85 years and over), country and year of death for the period 2000–2010.<sup>29</sup> Corresponding population counts and unemployment rates were also obtained from Eurostat. The analysis was focused on the Western European countries (ie, the 15 member states of the European Union in 1995). Among them were excluded, in order to keep sufficient statistical power, those where the number of suicides was lower than 1000 per year (Denmark, Greece, Ireland, Luxembourg and Portugal) and those with missing data for suicide (Belgium and Italy). Finally, the countries included in the analyses were Austria, Finland, France, Germany, the Netherlands, Spain, Sweden and the UK.

More refined French data, regarding the region of residence and the quarter of death, were available from the Epidemiological Centre on Medical Causes of Death (CépiDc-INSERM)<sup>30</sup> and were used for further analyses. Corresponding yearly population counts and quarterly regional unemployment rates were obtained from the National Institute of Statistics and Economic Studies (INSEE).<sup>31</sup>

## Statistical analyses

The yearly suicide rates in European countries were modelled using a quasi-Poisson model, handling overdispersion. An interaction term was introduced between sex, age and country in order to account for the heterogeneous distribution of suicide rates according to age and sex across countries.<sup>32</sup> A linear time trend  $t(y)$  was inserted in order to consider the underlying suicide mortality trend. This trend was interacted with country, age and sex in order to take into account its statistical heterogeneity. The relative variation of unemployment rate compared with that of 2000 was used to assess the unemployment–suicide association. The choice of relative unemployment instead of absolute unemployment was motivated by the model deviance that was slightly lower for relative unemployment. The relative risks obtained concern a 10% increase in unemployment rate. Relative unemployment was interacted with the country in order to obtain national relative risks. The following model was finally retained:

(E1):

$$\log(\lambda_{s,a,c,y}) = \log(\text{pop}_{s,a,c,y}) + \alpha_{s,a,c} + (\beta_{1,c} + \beta_{2,a} + \beta_{3,s}) \times t(y) + \gamma_c \times \text{UnemployVar}_y$$

where  $\lambda$  refers to the expected value of the number of suicides for a sex ( $s$ ), an age ( $a$ ), a country ( $c$ ) and a year ( $y$ ), and  $\text{pop}$  the corresponding population count;  $t(y)$  is the linear time trend, and  $\text{UnemployVar}$  the 10% variation of unemployment rate;  $\alpha$ ,  $\beta$  and  $\gamma$  are the coefficients to be estimated by the model. National relative risks of suicide for a 10% variation of unemployment rate are obtained with the exponential of  $\gamma$ .

The equations of the sensitivity analyses are presented in the online supplementary resource: E2 and E3 are analyses held on the same European data than the main model (E1); F1, F2 and F3 are analyses held on French refined data.

In E2, a dummy variable (*Crisis*), taking the value 0 for 2000–2007 and 1 for 2008–2010, was introduced by country to estimate the ‘crisis effect’ on suicide rates and to assess whether the association between suicide mortality and unemployment obtained with the previous model was confounded by a ‘crisis effect’. In E3, the time trend terms were suppressed to evaluate the sensitivity of our model to the hypothesis of the existence of an independent linear time trend in suicide mortality, allowing to assess whether unemployment variations could explain all temporal variations in suicide mortality.

F1, on regional and yearly data, assessed whether the results observed with E1 could be modified by using a geographical smaller-scale analysis. F2, on regional and quarterly data, assessed the impact of taking into account a region-specific seasonality of suicide mortality. F3, on regional and quarterly data, assessed a 3, 6 and 12-month lag effect of unemployment variations on suicide mortality.

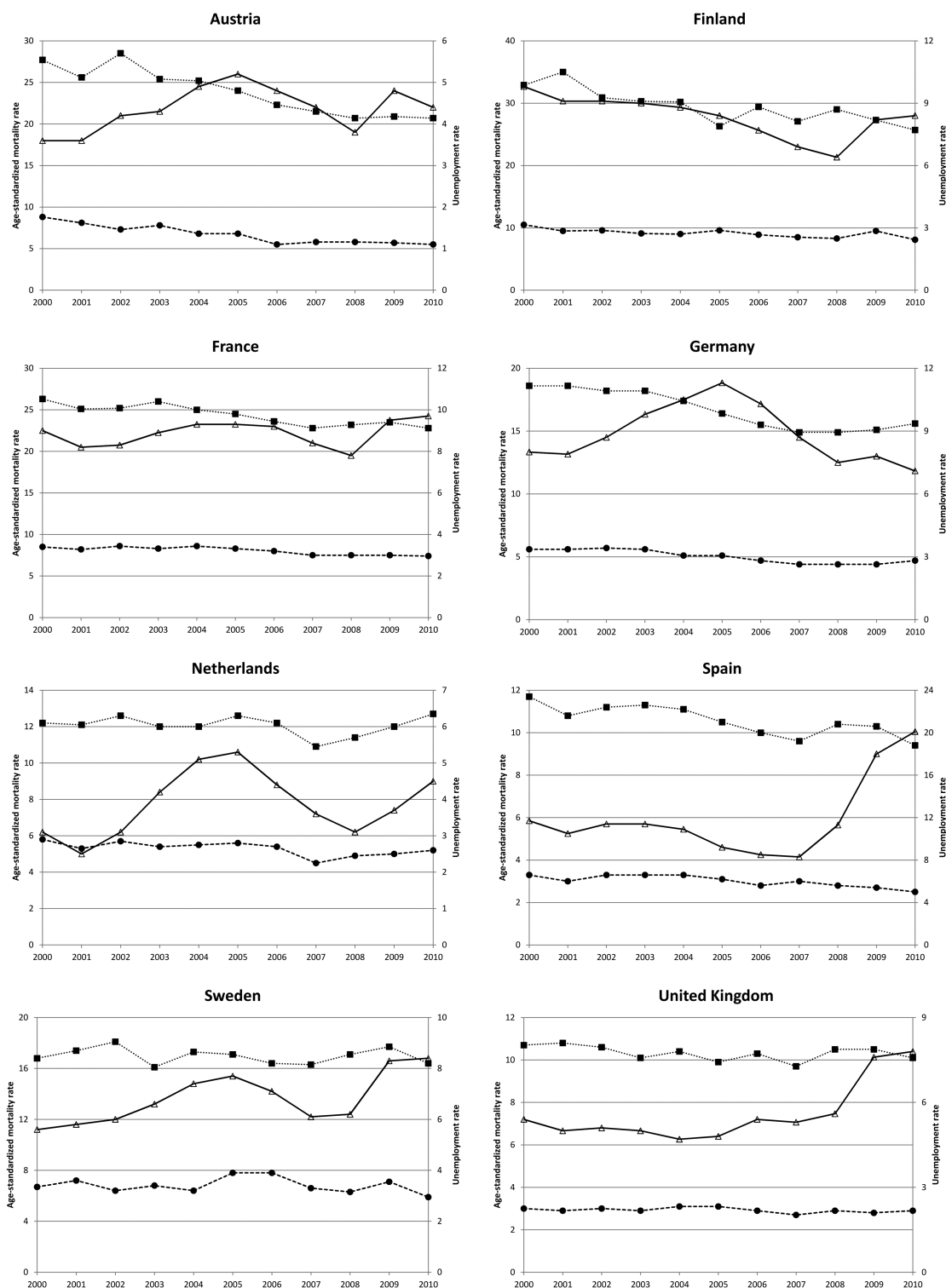
The main model (E1) was used to estimate the *excess number of suicides* attributable to unemployment variations for the period 2008–2010. The *baseline number of suicides* was defined as the number of suicides predicted by the model for the period 2008–2010 if the unemployment rate was that of the last quarter of 2007. The *expected number of suicides* was defined as the number of suicides predicted by the model for the period 2008–2010, with the observed unemployment rate. The *excess number of suicides* attributable to unemployment variations during the 2008–2010 economic crisis was the difference between the expected number of suicides and the baseline

number of suicides. CI of this estimation was calculated using the bootstrap method.<sup>33</sup> The estimation of the excess number of suicides in France and its CI were controlled on French refined data by using the most complete model (F2).

Modelling was conducted in R (V2.15.2).<sup>34</sup>

## RESULTS

In the eight countries included in the analyses, unemployment rate rose between 2008 and 2009 (figure 1). This increase was varying from 0.3 percentage point in Germany to 6.7 percentage points in Spain. In most of the countries, the



**Figure 1** Age-standardised suicide rates (per 100 000 inhabitants, reference population: IARC1976) for men and women, and corresponding unemployment rates (%) for both sexes, by country, 2000–2010 (source: Eurostat). Filled squares: age-standardised mortality rate for suicide (men); filled rounds: age-standardised mortality rate for suicide (women); unfilled triangles: unemployment rate. Scales are not comparable across countries.

age-standardised rate of suicides in men rose between 2008 and 2009, but it remained stable in the UK, and decreased slightly in Spain and more strongly in Finland. Women suicide rates remained nearly stable between 2008 and 2009, with a variation of suicide rate between  $-0.1$  and  $+0.1$  per 100 000 inhabitants in all countries except Sweden ( $+0.8$ ) and Finland ( $+1.2$ ).

Overall, including the eight studied countries, the unemployment–suicide association observed with the main model was statistically significant, with a 0.3% increase in suicide rate for a 10% increase in unemployment rate (95% CI 0.1% to 0.5%). Considering each country, the association was found significant in France, the UK and the Netherlands (table 1). The strongest central estimation of the association was observed in France, with a 1.9% increase in suicide rate for a 10% increase in unemployment rate (95% CI 0.8% to 2.9%).

The overall relative risk associated with unemployment was not modified when adding a ‘crisis effect’ into the model (model E2), even if this ‘crisis effect’ was statistically significant (RR=1.033,  $p<0.001$ , see table 2). Nevertheless, in some countries, this addition changed the results. In Germany, where no association was found with the first model, a significant association was highlighted with E2 (RR=1.009,  $p<0.01$ ) with a significant ‘crisis effect’ (RR=1.074,  $p<0.001$ ). In the UK, the significant association found in E1 disappeared in E2, with a significant ‘crisis effect’ (RR=1.074,  $p<0.01$ ). When the temporal trend was suppressed (model E3), results were deeply changed from E1 for all countries, notably with a significant negative association between suicide and unemployment in Austria and Spain.

In France, results obtained from regional yearly data (F1) and from regional quarterly data (F2) were slightly changed from E1: RR=1.015 ( $p<0.001$ ) for F1 and F2, RR=1.019 ( $p<0.001$ ) for E1 (table 3). The association was reduced when considering an increasing lag time between employment rate and mortality by suicide (model F3).

Compared with what would be expected if unemployment rate stayed at the level of the last quarter of 2007, the excess number of suicides attributable to unemployment variations during the 2008–2010 economic crisis was significant in France, the UK and the Netherlands (respectively 564, 456 and 57 excess suicides, table 4). This estimation was conducted on French regional and quarterly data with the most complete model (F2) as a sensitivity analysis, and very similar results were

obtained (584 excess suicides, 95% CI 234 to 886, instead of 564, 95% CI 277 to 845 with E1).

## DISCUSSION

This study highlights that, in Western Europe, when unemployment rises, suicides rise globally for the investigated countries. However, the association observed with the main model (E1) is slight (a 0.3% increase in suicide rates for a 10% increase in unemployment rate) and varies according to the country (it was significant only in three countries: the Netherlands (0.7%), the UK (1.0%) and France (1.9%)). This inconsistent association was already described in a previous study for the period 1973–1983.<sup>17</sup> In Spain, no unemployment–suicide association was highlighted, whereas it has the strongest increase in unemployment of the eight countries, in line with a previous study.<sup>8</sup> Furthermore, the unemployment–suicide relation found was very sensitive to two main hypotheses: a confounding context effect of the economic crisis (or ‘crisis effect’) and a linear time trend of suicide mortality. This sensitivity varied across countries.

The first hypothesis, tested with the model E2, was that the effect of unemployment on suicide could be explained by a ‘crisis effect’. This ‘crisis effect’ could be the result of the social impact of political decisions such as budgetary cutbacks. Previous studies found that the way suicides are reported by the media is associated with suicide mortality.<sup>19–22</sup> Then, the way the media report, and eventually over-report, the socioeconomic consequences of the crisis (lowered economic outlook, falling household power, etc.) could be another causal path of the ‘crisis effect’ on suicide. The consequences of adjusting on the ‘crisis effect’ were different across countries. In the UK, this adjustment made the observed unemployment–suicide association disappear, with a significant positive ‘crisis effect’, while it remained unchanged in France. This suggests that the unemployment–suicide association observed in E1 was differentially confounded by this ‘crisis effect’. This could be explained, for example, by disparities in the reporting of the socioeconomic consequences of the crisis by the media. Distinguishing the actual origin of the increase in suicides during the economic crisis would help to implement efficient policies.

The second hypothesis was that unemployment could not explain all the variations of suicide mortality, but only its

**Table 1** Relative risks of increase in suicide rates by country, for a 10% increase in unemployment rate, during the period 2000–2010

Model Country	E1		E2 (with ‘crisis effect’)		E3 (without time trend)	
	RR	95% CI	RR	95% CI	RR	95% CI
Austria	1.003	0.989 to 1.017	1.012	0.994 to 1.031	0.964	0.948 to 0.980***
Finland	0.996	0.965 to 1.027	0.987	0.957 to 1.019	1.054	1.026 to 1.083***
France	1.019	1.008 to 1.029***	1.020	1.009 to 1.031***	0.995	0.982 to 1.007
Germany	0.999	0.995 to 1.003	1.009	1.002 to 1.015**	1.011	1.006 to 1.016***
Netherlands	1.007	1.000 to 1.014*	1.013	1.005 to 1.021**	1.003	0.995 to 1.012
Spain	1.000	0.996 to 1.005	0.997	0.991 to 1.003	0.989	0.984 to 0.994***
Sweden	1.009	0.993 to 1.026	1.009	0.993 to 1.026	1.003	0.989 to 1.018
UK	1.010	1.002 to 1.018*	1.000	0.990 to 1.010	0.997	0.990 to 1.004
Overall	1.003	1.001 to 1.005*	1.004	1.001 to 1.006**	0.998	0.996 to 1.001

\* $p<0.05$ .

\*\* $p<0.01$ .

\*\*\* $p<0.001$ .

RR, relative risk.

variations after adjustment on its time trend. The comparison of the results of the models E3 and E1 shows that modelling is deeply sensitive to this time trend hypothesis. Adjusting on this trend is justified by the general reduction in overall mortality such as in suicide mortality observed from 2000 to 2010.<sup>29</sup> It is also a way to adjust on potential effects of prevention campaigns and treatments on suicides and suicide attempts.<sup>35</sup> A linear time trend is probably the safer choice compared with a nonlinear trend in this study as our study period is relatively short (11 years) and has few data points. However, such adjustment, while reasonable, is not based on specific mechanistic hypotheses. Further analyses should adjust models on actual factors of variation (eg, the implementation of public health policies) rather than on vaguely defined effects.

Using more refined data to perform the French estimations, taking into account the regional variability in reporting suicide<sup>36</sup> (F1) and suicide seasonality<sup>37</sup> (F2), slightly weakened the associations. This result argues that the association is only slightly sensitive to the choice of the spatial scale. French refined data allowed also to assess whether there is a time-lag effect of unemployment on suicide (F3). Our results highlight an immediate effect of unemployment variations on suicides in French general population.

Although France has one of the highest OECD employment protection indexes among the analysed countries,<sup>26</sup> it has the strongest central estimation of the unemployment–suicide association, with a 1.9% increase in suicide rate for a 10% increase in unemployment rate. This is an unexpected result on the basis of the conclusions of Stuckler and collaborators' study,<sup>25</sup> which found that expenses on labour market policies could mitigate the increase in suicides during economic crises. Nonetheless, we regretted to have to exclude some countries hardly affected by the economic crisis (particularly, Greece, Ireland, Portugal and Italy). This choice allowed us to keep sufficient statistical power to highlight unbiased associations, but restrains the generalisability of our results to comparable countries.

Our study, based on aggregated data, cannot formally distinguish the contextual from the individual effect. It was not designed to assess whether unemployed people are more likely to die by suicide than employed people. This individual association was already demonstrated,<sup>11</sup> but without concluding on an established causal link, regarding possible confounders including mental illness.<sup>11 38</sup> This individual association may

**Table 3** Relative risks of increase in suicide rates in France, for a 10% increase in unemployment rate, during the period 2000–2010: sensitivity analyses conducted on refined data

Model	RR	95% CI
E1 (results for France)	1.019	1.008 to 1.029***
F1 (regional data)	1.015	1.006 to 1.023***
F2 (regional and quarterly data)	1.015	1.007 to 1.023***
F3 (3-month lag effect)	1.011	1.004 to 1.019**
F3 (6-month lag effect)	1.007	0.999 to 1.014
F3 (12-month lag effect)	0.997	0.990 to 1.003

\* p<0.05.

\*\* p<0.01.

\*\*\* p<0.001.

RR, relative risk.

explain a part of the positive unemployment–suicide association found. This study, like most ecological studies of this kind, allowed to evaluate not only suicides of unemployed people but also by others around them and more generally suicides attributable to pressures on the labour market.<sup>15</sup> A weakness of ecological studies is that they cannot conclude on a causal association. However, Bradford Hill's criteria<sup>39</sup> can be applied to these studies to support cautious causal interpretation. An individual longitudinal study would be helpful to support our findings, but it requires a very large cohort to have enough statistical power as suicides remain relatively rare events.

Another limitation of our study is that differences exist between countries in suicide reporting.<sup>36</sup> In France, for example, the underestimation of suicide number was estimated at 9.4% in 2006.<sup>40</sup> However, on this 11-year study period, the declaration bias is likely to remain reasonably stable within a country,<sup>5 36</sup> allowing us to evaluate suicide rate variations. Nevertheless, the estimations of excess numbers of suicides across countries strongly depend on the quality and comparability of suicide reporting: they have to be interpreted as the excess number of *reported* suicides. These unparalleled reporting rates led us to use a one-level model. Alternatively, a hierarchical model (with years nested within countries, and a country random effect) would search to explain these differences between countries. We preferred to only adjust our models on the country, eliminating the need of a country random effect.

Our results are not comparable with Chang and collaborators' study because, apart from the fact that their model was different from ours, they estimated the excess number of suicides attributable to the economic crisis<sup>9</sup> while we estimated more specifically

**Table 2** Relative risks of increase in suicide rates by country, during the economic crisis period 2008–2010, compared to the period 2000–2007, according to the model E2

Country	RR	95% CI
Austria	1.070	0.981 to 1.167
Finland	1.077	0.998 to 1.163
France	1.016	0.992 to 1.040
Germany	1.074	1.036 to 1.115***
Netherlands	1.107	1.027 to 1.193**
Spain	1.042	0.984 to 1.103
Sweden	1.008	0.940 to 1.081
UK	1.074	1.024 to 1.127**
<b>Overall</b>	<b>1.033</b>	<b>1.019 to 1.047***</b>

\* p<0.05.

\*\* p<0.01.

\*\*\* p<0.001.

RR, relative risk.

**Table 4** Excess number of suicides attributable to unemployment variations during the 2008–2010 economic crisis

Country	Excess number of suicides	95% CI
Austria	9	–36 to 52
Finland	–21	–147 to 104
France	564	277 to 845
Germany	23	–77 to 113
Netherlands	57	9 to 104
Spain	28	–240 to 274
Sweden	122	–81 to 296
UK	456	126 to 763

the excess number of suicides attributable to unemployment rate variations during the crisis. Our estimation concludes to 564 excess suicides between 2008 and 2010 in France, 456 in the UK and 57 in the Netherlands. These are not small numbers and, considering the unreported suicides (of which rates strongly vary across countries), suicide attempts and suicidal ideations, these figures should be considered as the tip of the iceberg of the consequences of the 2008 economic crisis on suicidal behaviour.

Is unemployment increase causal in the rise of suicide rates? Some authors argued that this causal link was already established and that now is the time to think about how to mitigate this public health effect of the financial crisis.<sup>5</sup> Nonetheless, our results tend to temper these interpretations. Although our study highlights a significant unemployment–suicide association, the latter is actually rather weak (in France, where the central estimation of the association is the strongest, there is a 1.9% increase in suicide rate for a 10% increase in unemployment rate). Moreover, the results of this study are strongly sensitive to the hypothesis of a linear trend in suicide mortality, as shown by the results of the model E3. The unemployment–suicide associations found across countries are inconsistently confounded by a ‘crisis effect’. This single ecological study cannot bring a causal conclusion. However, the inconsistent association it highlighted does not come in favour of its causal interpretation. Identifying the actual origins of suicide increase during the financial crisis appears essential in order to implement efficient public health policies.

#### What is already known on this subject

- Increases in suicides during economic downturns are a recurrent observation since the end of the nineteenth century. Suicides have also increased during the 2008 economic crisis in most of countries.
- Economic crisis can impact on suicide mortality by many ways, notably by the increase of unemployment. However, the causal nature of the unemployment–suicide association remains discussed.
- Previous studies on the impact of the 2008 economic crisis on suicide mortality found inconsistent associations.

#### What this study adds

- The ecological unemployment–suicide association is inconsistently confounded across countries by the effect of concomitant features of the economic crisis.
- The unemployment–suicide association, currently discussed by scientists, should not be considered as causal, at least at the ecological level.
- Distinguishing the effect of unemployment from the effect of other concomitant features of the economic crisis is important, particularly in times of economic downturn, in order to implement efficient preventive policies, by targeting the actual origin of the increase in suicide mortality.

**Acknowledgements** We are very grateful to Gérard Pavillon and Alexandre Blake for their skilful assistance in the preparation of the English version of this manuscript.

**Contributors** ML contributed to the analysis and interpretation of data and drafted the manuscript. WG contributed to the statistical design of the study. EJ contributed to the interpretation of data and revised the manuscript. GR designed and supervised the study.

**Funding** This research was supported by the French National Institute of Health and Medical Research.

**Competing interests** None.

**Provenance and peer review** Not commissioned; externally peer reviewed.

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