

## RESEARCH

# Impact of 2008 global economic crisis on suicide: time trend study in 54 countries

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## Abstract

**Objective** To investigate the impact of the 2008 global economic crisis on international trends in suicide and to identify sex/age groups and countries most affected.

**Design** Time trend analysis comparing the actual number of suicides in 2009 with the number that would be expected based on trends before the crisis (2000-07).

**Setting** Suicide data from 54 countries; for 53 data were available in the World Health Organization mortality database and for one (the United States) data came the CDC online database.

**Population** People aged 15 or above.

**Main outcome measures** Suicide rate and number of excess suicides in 2009.

**Results** There were an estimated 4884 (95% confidence interval 3907 to 5860) excess suicides in 2009 compared with the number expected based on previous trends (2000-07). The increases in suicide mainly occurred in men in the 27 European and 18 American countries; the suicide rates were 4.2% (3.4% to 5.1%) and 6.4% (5.4% to 7.5%) higher, respectively, in 2009 than expected if earlier trends had continued. For women, there was no change in European countries and the increase in the Americas was smaller than in men (2.3%). Rises in European men were highest in those aged 15-24 (11.7%), while in American countries men aged 45-64 showed the largest increase (5.2%). Rises in national suicide rates in men seemed to be associated with the magnitude of increases in unemployment, particularly in countries with low levels of unemployment before the crisis (Spearman's  $r_s=0.48$ ).

**Conclusions** After the 2008 economic crisis, rates of suicide increased in the European and American countries studied, particularly in men and in countries with higher levels of job loss.

## Introduction

The 2008 economic crisis has had a far reaching impact on countries around the world. Turmoil in the banking sector led to downturns in stock markets, bankruptcies, housing repossessions, and rises in unemployment. The International Labour Organization estimated that the number of jobless worldwide reached about 212 million in 2009, an increase of 34 million compared with 2007.<sup>1</sup> The World Health Organization has raised concern over the crisis' impact on global health and called for integrated multisectoral actions to closely monitor and protect health, in particular among poor and vulnerable people.<sup>2</sup>

There is widespread concern that suicide rates might increase in countries affected by the global economic crisis,<sup>2</sup> in view of evidence that economic downturns, and associated rises in unemployment, are followed by increases in suicide.<sup>3-10</sup> For example, it is estimated that the 1997 economic crisis in Japan, South Korea, and Hong Kong resulted in over 10 000 excess suicides.<sup>8</sup> Previous research has found that economic downturns tend to have the greatest effects on men of working age; rises in suicide were larger in men than in women and in adults of working age than older people during the Russian economic crisis in the early 1990s<sup>5</sup> and the 1997 Asian economic crisis.<sup>8</sup>

Available studies of the impact on suicide of the 2008 global financial crisis reported data from only a limited number of countries<sup>11</sup> or single countries.<sup>12-14</sup> There has been no systematic investigation into the broader international pattern or the sex/age groups and regions most affected, although this information is urgently needed as there is a concern that governments' austerity measures might inadvertently lead to negative impact on

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**Appendix 1:** Supplementary tables A-F

**Appendix 2:** Trends in age standardised suicide rates in individual countries

population mental health and further increase suicide rates.<sup>15</sup> A recent analysis of data from 10 European countries provided an early indication of the impact of the current economic crisis on suicide; all but one of these countries experienced more suicides in 2009 than in 2007.<sup>11</sup> Three recent studies with data from single countries—England,<sup>12</sup> Italy,<sup>13</sup> and the United States<sup>14</sup>—found a significant rise in suicide during the 2008-10 recession. These analyses, however, were based on a limited number of countries and have yet to assess sex and age specific effects, the extent to which other countries have been affected or to quantify the overall “excess suicides” attributable to the economic crisis.

Using the latest available data on suicides from 27 European and 27 non-European countries, we assessed changes in suicide rates after the economic crisis in 2008 as well as differential effects by sex, age, country, and change in employment.

## Methods

### Data series

We identified 53 countries for which data on suicide in the WHO mortality database (the version released on 11 November 2012)<sup>16</sup> were complete and valid for the period 2000-09 (fig 1↓). To investigate the impact of the global economic crisis, we considered changes in suicide rates in 2009 mainly because it is the first complete year after the crisis began in summer 2008. Four countries (Bahrain, Egypt, Saint Vincent and Grenadines, and South Africa) were excluded because of probable substantial miscoding of suicides, indicated by the low rates of certified suicide and high ratios of undetermined death to suicide.<sup>17 18</sup> The WHO database provides the most comprehensive standardised national mortality statistics for countries around the world.<sup>19</sup> Complete suicide data in 2000-09 for the US (where the 2008 global economic crisis began) were unavailable in the database at the time of the study and were therefore extracted from the online database of the Centers for Disease Control and Prevention.<sup>20</sup> These 54 study countries included 27 European countries, 18 American countries, eight Asian countries, and one African country. Figure 2↓ shows a map of the study countries and their suicide rates in 2009. The 27 European countries included 78% of Europe’s population, and the 18 American countries accounted for 88% of the population in the Americas.<sup>21</sup> In contrast, the Asian and African countries included in the study accounted for only 5% and 0.1% of the population in these two continents. Of the 54 study countries, data for 2010 were also available for 29 countries, including 20 European countries (46% of Europe’s population) and nine non-European countries (fig 1↓).

We used ICD (international classification of diseases) codes to extract suicide data (ninth revision (ICD-9) codes E950-E959, 10th revision (ICD-10) codes X60-X84). Data for events of undetermined intent (ICD-9 E980-E989 and ICD-10 Y10-Y34) were also extracted as previous studies indicated that in some countries a considerable proportion of deaths in this category are probably suicide<sup>17 18</sup>; data for these deaths were included in a sensitivity analysis to investigate the possible impact of misclassification of suicide. Coding for suicide was almost the same in the two ICD revisions, and previous analyses found no impact on the total number of suicide deaths between the two revisions.<sup>22</sup> Eight countries (Austria, Bulgaria, Cuba, Guatemala, Hong Kong SAR, Kazakhstan, Ireland, and Mauritius) used both ICD-9 and ICD-10 over the study period, but none of these changes in ICD versions occurred around the time of the 2008 economic crisis; all other countries used either ICD-9 or ICD-10 alone throughout the study period.

Population data from 19 countries were incomplete in the WHO database and were obtained from the United Nations population database.<sup>21</sup> Annual sex specific age standardised suicide rates for people aged 15 or above were calculated in each country by using the WHO world standard population.<sup>23</sup>

We extracted data for unemployment and gross domestic product (GDP) per capita from the International Monetary Fund’s world economic outlook database.<sup>24</sup> Unemployment was used as the main economic indicator as previous research showed that changes in unemployment were more closely related to short term effects on mortality than other economic indicators,<sup>25</sup> and its rise might have accounted for some of the increases in suicide during previous recessions.<sup>8 9</sup>

### Statistical analysis

To calculate changes in trends in suicide rates and excess suicides related to the global economic crisis requires assessment of time trends and estimation of the expected number of suicides (that is, what would have happened if the economic crisis had not occurred) and then quantification of deviation from these trends.

In the first step of the analysis, we chose the year 2000 as the starting point for estimating trends in suicide before the crisis because rates in some countries in the 1990s were influenced by the recession in the early 1990s<sup>5 6 26</sup> and the Asian economic crisis in the late 1990s.<sup>8</sup> Furthermore, over long time periods population suicide rates can be influenced by factors such as the changing availability of highly lethal methods of suicide and improved detection and treatment of psychiatric disorders.<sup>27</sup> The main analysis focused on suicide rates in 2009, and results for 2008 and 2010 are shown in appendix 1; a previous analysis indicated that some European countries already showed some rises in suicide in 2008 compared with 2007.<sup>11</sup>

We used negative binomial regression models to estimate suicide trend in each country between 2000 and 2007. Linear trends were estimated by including the calendar year in the models; a similar approach was used in a recent paper to estimate excess suicides during recessions in England.<sup>12</sup> Negative binomial regression is Poisson regression with an additional Gamma distributed parameter to adjust for overdispersion (extra-Poisson variation); a likelihood ratio test was used to examine overdispersion by comparing the data fits of Poisson and negative binomial models.<sup>28</sup> As there was evidence for overdispersion in Poisson models in 21 countries, we use negative binomial models throughout. We estimated models for men and women separately because of previously documented sex differences in the association between economic changes and suicide.<sup>5 6 8 29</sup> We included age group (15 categories (nine categories for the US data) starting from age 15-19 up to age ≥85) and an offset term “log(population per year and age group)” to adjust for annual changes in population figures and age structure. Based on these models we estimated the expected sex and age specific numbers of suicides in 2008, 2009, and 2010 in each country, given the pre-2008 trends. Models for men and women in different age groups—that is, aged 15-24 (just entering labour market), 25-44 (early years of employment), 45-64 (later employment), and ≥65 (after retirement)—were also estimated separately to investigate whether the impact of the global economic crisis varied among different subgroups.<sup>5 8</sup>

In the second step of the analysis, to investigate whether suicide rates in 2008, 2009, and 2010 were in line with year on year trends in 2000-07, we calculated excess suicides in 2008, 2009, and 2010—that is, the differences between the actual number of suicides and that expected given the trends before the crisis.

We used the standard errors of the expected number of suicides to estimate the 95% confidence intervals of excess suicides, reflecting the uncertainty in the estimated continuation of past trends. Rate ratios for suicide between the actual and the expected data were also calculated. Overall excess suicides and rate ratios across study countries were calculated by pooling data from individual countries. These were also estimated for European, American, and other countries separately, as well as separately for groups of countries of different continents, to investigate whether the crisis' impact varied in different regions. Within European countries we made a distinction between old (pre-2004) and new (post-2004) European Union (EU) member states and non-EU countries as they had different levels of GDP per capita. For the same reason we grouped American countries as North, Caribbean and Central, and South American countries and Asian countries as East Asian and other Asian countries, based on the United Nations' classification.<sup>30</sup>

To examine whether suicide rates rose more in countries with worse economic downturns, we used Spearman's correlation coefficients to investigate the association between suicide rate ratios in 2009 and percentage point changes in unemployment rates between 2007 (the baseline year) and 2009 (unemployment rates (in %) in 2009 minus unemployment rates (in %) in 2007) across study countries. We also conducted analyses stratified by unemployment level before the crisis (2007), as countries with low baseline unemployment rates and large rises in unemployment during the crisis might show the greatest rises in suicide rates.<sup>9</sup> We used the median of unemployment rates across the 50 countries with available data in 2007 as the cut-off point.

All analyses in this study were conducted with Stata version 12 (StataCorp, College Station, TX, 2011), with two tailed tests used throughout.

## Results

### Economic indicators

Figure 3 shows overall changes in unemployment rates and GDP per capita across the 54 study countries, weighted by population size, in 2000-10, with year 2007 as reference. There was a reverse of previous falls in unemployment and a levelling off of rises in GDP in 2008, followed by 37% rises in unemployment and 3% falls in GDP per capita in 2009, reflecting the onset of the global economic crisis in 2008. Figure 4 shows trends in unemployment in nine different groups of countries. Within Europe all three groups of countries experienced rises in unemployment in 2009 (of between 17% and 35%) and 2010 (25% to 36%). Unemployment rates started rising in North American countries in 2008 (23%), followed by dramatic increases in 2009-10 (94% and 101%). Caribbean and Central American countries also showed 40% to 45% rises in unemployment in 2009-10, while there was no increase in South American countries. East Asian countries experienced rises in unemployment of 26-27% in 2009-10. Data from other Asian countries and one African country (Mauritius) showed no increases in unemployment in 2008-10 compared with 2007.

### Changes in suicide trends and excess suicides

Table 1 shows rate ratios and excess suicides in 2009, relative to those expected given the 2000-07 trends across 54 study countries. The rate ratio of 1.033 (95% confidence interval 1.027 to 1.039) indicates that overall suicide rate in men rose 3.3% (2.7% to 3.9%; (table 1), with an excess of 5124 (4219 to 6029) suicides. In contrast, there was no evidence for a change in rates

in women (-0.5%, -1.3% to 0.3%). When we combined data for men (5124 excess suicides) and women (240 fewer suicides) there were an estimated 4884 (3907 to 5860 excess suicides in 2009. In men, there seemed to be a graded diminution of increases in suicide with increases in age: 5.8% (3.5% to 8.1%), 4.1% (2.3% to 6.0%), 3.6% (0.8% to 6.5%) in those aged 15-24, 25-44, and 45-64, respectively, and no change (-2.3%, -6.4 to 2.2%) in those aged  $\geq 65$ .

Rises in suicide rates in men in 2009 were mainly seen in the 27 European countries (4.2%, 95% confidence interval 3.4% to 5.1%; 2937 (2400 to 3475) excess suicides) and the 18 American countries (6.4%, 5.4% to 7.5%; 3175 (2692 to 3658) excess suicides). There was also a small rise in suicide rates in women in American countries (2.3%, 1.1% to 3.5%); in contrast there was no increase in European women. European men aged 15-24 had the greatest increases in suicide rates (11.7%, 7.2% to 16.6%) in all age groups, while in American countries men aged 45-64 showed the greatest increase (5.2%, 3.1% to 7.3%).

There was no strong evidence for a change in suicide rates in men or women in 2008 compared with previous trends when we combined data for all 54 countries (table A in appendix 1). Data for the 27 European countries showed a small decrease in suicide rates in men (-0.9%, 95% confidence interval -1.6% to -0.2%) but no change in rates in women, while rates increased 4.8% (3.9% to 5.7%) and 2.6% (1.5% to 3.7%) in men and women, respectively, in the 18 American countries and decreased 6.7% (5.4% to 7.9%) and 4.4% (2.7% to 6.0%), respectively, in the nine non-European/non-American countries.

Available data for 2010 from 20 European countries showed a 10.8% (95% confidence interval 10.1% to 11.6%) rise in suicide in men and a 4.8% (3.8% to 5.8%) rise in suicide in women, with the largest proportional increase shown in men aged 15-24 (table B in appendix 1). In contrast, rates in men and women decreased by 6.2% (5.0% to 7.3%) and 8.3% (6.7% to 10.0%), respectively, in nine non-European countries.

Tables 3-4 show results in each study country, grouped by region in 2009. Within Europe, new EU member states, as a group, showed the largest increase in suicide rates in men (13.3%) versus a 6.4% increase in old EU member states and no change in non-EU European countries (table 2). Among American countries, Northern American countries and Caribbean and Central American countries showed 8.9% and 6.4% increases, respectively, versus a smaller increase (1.3%) in South American countries (table 3). In women, only new EU member states experienced an increase in suicide (7.7%) within Europe; Northern American and Caribbean and Central American countries showed an increase (2.3% and 25.4%, respectively) among American countries, while non-EU European countries and Southern American countries showed some reductions (-2.7% and -5.8%). Out of 27 European countries, 24 showed an increase in suicide rates in men ( $P < 0.05$ ), with Poland showing the largest absolute number of excess suicides (763, 95% confidence interval 677 to 849). Among American countries, men in the US showed the largest number of excess suicides (2309, 1850 to 2767). Appendix 2 shows age standardised suicide rates for men and women in each country in 2000-09, as well as the fitted linear trends based on data for 2000-07. Tables C and D in appendix 1 show results by country in 2008 and 2010, respectively.

There was some evidence for an association between the increases in suicide after the crisis and the increases in unemployment across study countries, particularly in men and in countries where the unemployment level before the crisis (2007) was relatively low (table 5). Spearman's correlation

coefficients between suicide rate ratios in 2009 and percentage point changes in unemployment rates between 2007 and 2009 were 0.25 ( $P=0.075$ ) in men and 0.10 ( $P=0.49$ ) in women. In men, the correlation coefficient was 0.48 ( $P=0.016$ ) in men countries with relatively low unemployment levels ( $<6.2\%$ ) before the crisis and 0.31 ( $P=0.13$ ) in countries with high unemployment levels ( $\geq 6.2\%$ ) before the crisis.

### Sensitivity analysis

The results were similar when we excluded six small countries (population aged  $\geq 15$   $<500\,000$ ; Aruba, Belize, Iceland, Luxembourg, Malta, and Suriname) that showed relatively unstable trends. Data for certified suicides and undetermined deaths combined showed similar findings (table E in appendix 1). When we used data for 2000-06 to estimate trends before the crisis, the pattern of rises in suicide in 2009 was similar (table F in appendix 1).

### Discussion

We found a clear rise in suicide after the 2008 global economic crisis; there were about 4900 excess suicides in the year 2009 alone compared with those expected based on previous trends (2000-07). There were important differences in men and women as well as in the age pattern in different groups of countries. The increases were mainly in men from the 27 European countries and 18 American countries studied. All age suicide rates in European and American men were, respectively, 4.2% and 6.4% higher in 2009 than expected if past trends had continued. In contrast there was no change in European women and a relatively smaller (2.3%) increase in American women. In European countries, the impact has been felt most strongly by men aged 15-24, while men aged 45-64 were most affected in American countries. Rises in national suicide rates in 2009 seemed to be associated with the magnitude of increases in unemployment, particularly for men and in countries with low unemployment levels before the crisis. Our finding is likely to be an underestimate of the true global impact of the economic crisis on suicide as some affected countries, such as Australia and Italy, were not included. The rise in the number of suicides is only a small part of the emotional distress caused by the economic downturn. Non-fatal suicide attempts could be 40 times more common than completed suicides,<sup>31</sup> and for every suicide attempt about 10 people experience suicidal thoughts.<sup>32</sup>

### Strengths and limitations

This study is the first systematic investigation of the impact of the 2008 global economic crisis on international trends in suicide and the demographic groups/regions most affected. There are several limitations to our analysis. Firstly, this study is an observational analysis based on aggregate data. As we are explicitly considering the impact of the economic crisis on national suicide rates we considered the ecological design to be the most appropriate. While events other than the economic crisis could have influenced suicide trends in individual countries, it is unlikely that all study countries were affected at the same time as the crisis by different specific events given the magnitude of increases in suicide across study countries. Secondly, data on suicides during the relevant period were not available for some large economies severely affected by the economic crisis. Other countries with a large population—such as China and India—were not included because of unavailability of data, but their economies were less affected by the economic crisis (GDP growth 9.2% and 6.6% in 2009, respectively).<sup>24</sup> The Asian countries and one African country (Mauritius) included

in the study are not representative of all Asian and African countries. Most of the European and American population, however, were included. Thirdly, as the global economic crisis hit different countries at different times, monthly or quarterly data might show more detailed patterns of changes in trends in suicide than the annual data used in our study; such detailed data, however, were unavailable in the WHO mortality database. The study was also limited by data lags. Data for more additional years after the economic crisis, such as 2010 or later, might better show the trajectory of the impact, but they would not change the results for the years 2008-09 as presented in this study. Fourthly, variations in level of misclassification of suicide could lead to potential bias between countries.<sup>33</sup> Our analysis focused on variations within countries, however, which adjusts for such varying surveillance. Furthermore, poor quality of data from single countries over time will lead only to non-differential misclassification of the outcome and so attenuate estimates of recession effects. Our sensitivity analysis based on certified suicides and undetermined deaths combined also showed similar findings.

### Comparison with previous findings

Several lines of evidence suggest a causal role of the 2008 global economic crisis on subsequent rises in suicide in affected countries. Several recent studies have shown an increased prevalence of depression or anxiety after the economic crisis in Hong Kong,<sup>34</sup> south Australia,<sup>35</sup> Greece,<sup>36</sup> England,<sup>37</sup> and Spain.<sup>38</sup> Such deterioration in mental health was particularly seen in people who experienced unstable employment or financial problems.<sup>34 35 38</sup> Our finding is consistent with the documented increases in suicide during past recessions, such as the Great Depression in the 1930s,<sup>3 4 7</sup> the Russian crisis in the early 1990s,<sup>5 6</sup> and the Asian economic crisis in the late 1990s.<sup>8</sup> Our data showed an association between the magnitude of rises in unemployment and increases in suicide in men, suggesting a dose-response effect. Several countries showed a downward trend in suicide before the 2008 economic crisis, particularly in men, and such trends were reversed afterwards (appendix 2), suggesting the impact of the crisis.

Our estimate of excess suicides (about 5000 in the year 2009) is lower than the 10 000 excess suicides in 1998 proposed in the study of the Asian economic crisis.<sup>8</sup> This is in part because of the different nature of the economic shock and our focus in this study on estimating excess suicides across all countries (several of which have not been affected), whereas the analysis of Asian data focused solely on the three affected countries.

Our finding of a greater increase in suicide in men than in women is consistent with increases seen during the Russian crisis<sup>5 6</sup> and the Asian economic crisis.<sup>8</sup> Recent studies of risks of depression in Spain<sup>38</sup> and the UK<sup>37</sup> corroborate our observations that men have greater mental health risks in the context of economic recession. Men are more likely to be the main earner in the family and thus more affected by the recession than women; they might experience a greater degree of shame in the face of unemployment and are less likely to seek help. The current crisis, however, tended to affect younger European men in contrast with the previous recessions,<sup>5 8</sup> possibly attributable to the proportionally larger increases in unemployment in this group than other age groups since 2008.<sup>39</sup> The causes of the greater impact on middle aged men than other age groups in American countries are less clear and need further investigation.<sup>40</sup>

There are considerable variations in the effect of the crisis on risk of suicide across countries. Such variations probably relate

to the severity of the recession as well as to varying social support and labour market protections in different countries.<sup>9,41-42</sup> In parallel to our findings, previous research has shown a strong association between changes in unemployment rates and suicide rates.<sup>9,10,29,43</sup> Observational studies indicate that unemployed people have two to three times increased risk of suicide.<sup>29</sup> Consistent with previous findings<sup>44,45</sup> we found stronger associations between increases in national suicide rates and unemployment rates in countries with low baseline unemployment rates than in countries with high unemployment rates. Acute economic downturns and rises in unemployment could lead to greater fear and anxiety in countries with lower baseline rates and thus greater increases in risk of suicide.<sup>9</sup> Another possibility is a social density effect—if many people are already unemployed at baseline, the stigma of unemployment could be less and the impact of recession smaller.

## Implications

Our findings show that economic crises pose considerable suicide risks; though previous studies suggest that these risks are not inevitable. Research has shown that active labour market programmes can help to offset the impact of economic recession on suicide,<sup>9</sup> as successful re-employment has been found to substantially reduce, and in some cases eliminate, mental health risks of job loss. At a time of state retrenchment, countries with limited resources might usefully target labour market support at young and working age men. In many countries, however, government austerity is resulting in further job losses, posing additional suicide risks. Urgent action is needed to prevent the economic crisis leading to further increases in suicides.

Contributors: DG and S-SC had the idea for the study and designed the study with input from DS and PSFY. S-SC was responsible for obtaining data and statistical analysis, with input from PSFY. S-SC, DG, and DS led interpretation of the findings with additional input from PSFY. S-SC wrote the first draft, with input from DG and DS, and all authors contributed to successive drafts. S-SC is guarantor. All authors had full access to all of the data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis.

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. S-SC is supported by the Hong Kong Research Grants Council (RCG) general research fund (grants HKU784210M and HKU784012M) and a grant from the University of Hong Kong (Project Code 201203159017). DS is funded by a European Research Council investigator award. DG is a UK National Institute for Health Research senior investigator. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing interest: All authors have completed the ICMJE uniform disclosure form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) (available on request from the corresponding author) and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Ethical approval: Not required.

Data sharing: No additional data available.

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**What is already known on this topic**

Research with data from a few mainly European countries indicated an increase in suicide rates after the 2008 global financial crisis. It is unknown whether similar rises have occurred in other countries affected by the crisis and which sex/age groups are most affected.

**What this study adds**

There have been increases in suicide rates after the 2008 economic crisis in the European and American countries studied. Rises in suicide have mainly occurred among men and in countries with higher levels of job loss. In Europe, men aged 15-24 have been particularly affected.

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**Accepted:** 12 August 2013

Cite this as: *BMJ* 2013;347:f5239

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## Tables

**Table 1 | Rate ratios and excess suicides in 2009 relative to those expected based on trend 2000-07 in 54 countries\* after world financial crisis in 2008**

	Rate ratio (95% CI)	Excess suicide (95% CI)	P value
<b>All study countries (n=54)</b>			
All age groups:			
Men	1.033 (1.027 to 1.039)	5124 (4219 to 6029)	<0.001
Women	0.995 (0.987 to 1.003)	-240 (-607 to 126)	0.20
Aged 15-24:			
Men	1.058 (1.035 to 1.081)	1026 (645 to 1407)	<0.001
Women	1.017 (0.971 to 1.066)	88 (-158 to 333)	0.48
Aged 25-44:			
Men	1.041 (1.023 to 1.060)	2179 (1227 to 3130)	<0.001
Women	1.012 (0.974 to 1.054)	173 (-383 to 729)	0.54
Aged 45-64:			
Men	1.036 (1.008 to 1.065)	1980 (476 to 3484)	0.010
Women	1.001 (0.974 to 1.029)	11 (-416 to 437)	0.96
Aged ≥65:			
Men	0.977 (0.936 to 1.022)	-693 (-2014 to 627)	0.30
Women	0.963 (0.908 to 1.025)	-462 (-1215 to 290)	0.23
<b>European countries (n=27)</b>			
All age groups:			
Men	1.042 (1.034 to 1.051)	2937 (2400 to 3475)	<0.001
Women	1.003 (0.995 to 1.010)	49 (-87 to 186)	0.48
Aged 15-24:			
Men	1.117 (1.072 to 1.166)	811 (521 to 1101)	<0.001
Women	1.106 (1.028 to 1.197)	149 (43 to 255)	0.006
Aged 25-44:			
Men	1.055 (1.031 to 1.080)	1302 (753 to 1852)	<0.001
Women	1.009 (0.967 to 1.055)	41 (-160 to 241)	0.69
Aged 45-64:			
Men	1.048 (1.013 to 1.086)	1177 (321 to 2033)	0.007
Women	1.003 (0.975 to 1.033)	19 (-164 to 203)	0.84
Aged ≥65:			
Men	1.018 (1.004 to 1.033)	246 (51 to 440)	0.013
Women	0.990 (0.965 to 1.017)	-56 (-206 to 95)	0.47
<b>American countries (n=18)</b>			
All age groups:			
Men	1.064 (1.054 to 1.075)	3175 (2692 to 3658)	<0.001
Women	1.023 (1.011 to 1.035)	305 (144 to 466)	<0.001
Aged 15-24:			
Men	1.009 (0.983 to 1.036)	75 (-141 to 292)	0.50
Women	1.012 (0.966 to 1.064)	30 (-87 to 146)	0.62
Aged 25-44:			
Men	1.036 (1.015 to 1.057)	656 (289 to 1023)	<0.001
Women	0.994 (0.969 to 1.020)	-28 (-151 to 94)	0.65
Aged 45-64:			
Men	1.052 (1.031 to 1.073)	850 (525 to 1174)	<0.001
Women	1.010 (0.982 to 1.040)	53 (-94 to 199)	0.48

Table 1 (continued)

	Rate ratio (95% CI)	Excess suicide (95% CI)	P value
Aged ≥65:			
Men	1.038 (1.017 to 1.060)	286 (133 to 439)	<0.001
Women	1.023 (0.987 to 1.061)	32 (-19 to 83)	0.22
<b>Non-European and non-American countries (n=9)</b>			
All age groups:			
Men	0.974 (0.960 to 0.988)	-989 (-1533 to -444)	<0.001
Women	0.963 (0.945 to 0.981)	-595 (-895 to -295)	<0.001
Aged 15-24:			
Men	1.055 (1.008 to 1.106)	140 (21 to 258)	0.021
Women	0.938 (0.831 to 1.076)	-91 (-279 to 97)	0.34
Aged 25-44:			
Men	1.020 (0.961 to 1.086)	221 (-464 to 905)	0.53
Women	1.034 (0.935 to 1.157)	160 (-344 to 665)	0.53
Aged 45-64:			
Men	0.997 (0.920 to 1.087)	-47 (-1240 to 1146)	0.94
Women	0.985 (0.908 to 1.077)	-62 (-418 to 295)	0.73
Aged ≥65:			
Men	0.869 (0.764 to 1.009)	-1225 (-2522 to 72)	0.064
Women	0.918 (0.807 to 1.065)	-439 (-1174 to 297)	0.24

\*As listed in figure 1. Two countries (Belize and Kuwait) had no suicides in certain sex/age groups in 2000-09 and were excluded from analyses stratified by sex and age group. Sum of age specific excess suicides was not exactly equal to all age excess suicides because age specific estimates were based on age specific time trends, which can differ from trends in all age suicide rates.



Table 2 | Rate ratios and excess suicides in 2009 in 27 European countries relative to those expected based on trends over 2000-07

	Men			Women			Population aged ≥15 (2009)*
	Rate ratio (95% CI)	Excess suicide (95% CI)	P value	Rate ratio (95% CI)	Excess suicide (95% CI)	P value	
<b>Old (pre-2004) EU countries (n=11)</b>							
All countries	1.064 (1.056 to 1.071)	1514 (1350 to 1678)	<0.001	1.006 (0.996 to 1.016)	49 (-31 to 130)	0.23	258 401
Austria	1.034 (1.009 to 1.060)	31 (8 to 54)	0.007	1.087 (1.043 to 1.135)	24 (12 to 36)	<0.001	7111
Finland	1.082 (1.051 to 1.114)	57 (37 to 78)	<0.001	1.133 (1.079 to 1.192)	32 (20 to 44)	<0.001	4449
France	1.047 (1.032 to 1.062)	344 (237 to 451)	<0.001	0.989 (0.971 to 1.007)	-30 (-81 to 20)	0.24	50 974
Germany	1.055 (1.042 to 1.069)	376 (291 to 461)	<0.001	1.007 (0.990 to 1.024)	16 (-24 to 56)	0.43	70 797
Greece	1.104 (1.053 to 1.160)	31 (17 to 46)	<0.001	0.886 (0.798 to 0.995)	-7 (-15 to 0)	0.041	9664
Ireland	1.243 (1.199 to 1.289)	82 (70 to 94)	<0.001	1.175 (1.088 to 1.277)	15 (8 to 23)	<0.001	3522
Luxembourg	0.925 (0.834 to 1.038)	-4 (-9 to 2)	0.18	0.741 (0.603 to 0.959)	-5 (-9 to -1)	0.026	409
Netherlands	1.052 (1.026 to 1.079)	52 (27 to 78)	<0.001	1.049 (1.008 to 1.093)	21 (4 to 39)	0.019	13 612
Spain	1.072 (1.051 to 1.094)	178 (129 to 228)	<0.001	0.974 (0.948 to 1.002)	-20 (-42 to 2)	0.069	39 114
Sweden	1.083 (1.053 to 1.115)	68 (44 to 91)	<0.001	0.973 (0.929 to 1.021)	-10 (-27 to 7)	0.26	7753
UK	1.099 (1.078 to 1.121)	298 (240 to 356)	<0.001	1.015 (0.984 to 1.047)	13 (-15 to 42)	0.35	50 996
<b>New (post-2004) EU countries (n=10)</b>							
All countries	1.133 (1.121 to 1.144)	1574 (1454 to 1693)	<0.001	1.077 (1.060 to 1.096)	196 (154 to 239)	<0.001	82 691
Bulgaria	1.125 (1.090 to 1.162)	73 (55 to 92)	<0.001	1.123 (1.068 to 1.185)	23 (13 to 32)	<0.001	6561
Czech Republic	1.063 (1.033 to 1.095)	73 (39 to 106)	<0.001	1.027 (0.979 to 1.079)	6 (-5 to 17)	0.28	9003
Estonia	1.262 (1.198 to 1.334)	46 (36 to 55)	<0.001	1.261 (1.150 to 1.394)	10 (6 to 14)	<0.001	1139
Hungary	1.122 (1.096 to 1.148)	206 (167 to 245)	<0.001	1.099 (1.057 to 1.145)	50 (30 to 70)	<0.001	8538
Latvia	1.297 (1.247 to 1.351)	95 (82 to 108)	<0.001	1.314 (1.238 to 1.400)	24 (19 to 29)	<0.001	1,945
Lithuania	1.209 (1.169 to 1.252)	164 (137 to 191)	<0.001	1.135 (1.076 to 1.201)	22 (13 to 31)	<0.001	2837
Malta	1.431 (1.202 to 1.768)	10 (5 to 14)	<0.001	1.245 (0.894 to 2.053)	1 (0 to 2)	0.22	349
Poland	1.161 (1.140 to 1.182)	763 (677 to 849)	<0.001	1.161 (1.123 to 1.201)	129 (102 to 156)	<0.001	32 338
Romania	1.067 (1.041 to 1.095)	137 (86 to 189)	<0.001	0.848 (0.816 to 0.883)	-68 (-85 to -50)	<0.001	18 224
Slovenia	1.020 (0.977 to 1.066)	7 (-8 to 22)	0.37	1.005 (0.942 to 1.077)	0 (-6 to 7)	0.89	1757
<b>Non-EU European countries (n=6)</b>							
All countries	0.996 (0.981 to 1.011)	-151 (-648 to 347)	0.55	0.973 (0.960 to 0.987)	-196 (-298 to -95)	<0.001	137 750
Croatia	1.149 (1.103 to 1.198)	80 (58 to 102)	<0.001	0.887 (0.841 to 0.939)	-22 (-33 to -11)	<0.001	3751
Iceland	1.395 (1.210 to 1.648)	8 (5 to 11)	<0.001	0.808 (0.646 to 1.076)	-2 (-4 to 0)	0.13	253
Norway	1.218 (1.170 to 1.269)	74 (60 to 88)	<0.001	0.922 (0.864 to 0.988)	-13 (-24 to -2)	0.021	3914
Republic of Moldova	1.062 (1.018 to 1.110)	32 (10 to 55)	0.005	1.034 (0.947 to 1.140)	3 (-5 to 12)	0.47	2963
Russian Federation	0.988 (0.972 to 1.004)	-388 (-884 to 108)	0.13	0.975 (0.961 to 0.990)	-162 (-261 to -64)	0.001	120 663
Serbia	1.045 (1.019 to 1.072)	43 (19 to 67)	<0.001	0.998 (0.957 to 1.043)	-1 (-17 to 16)	0.94	6206

EU=European Union.

\*1000 population.

Table 3| Rate ratios and excess suicides in 2009 in 18 American countries relative to those expected based on trends over 2000-07

	Men			Women			Population aged ≥15 (2009)*
	Rate ratio (95% CI)	Excess suicide (95% CI)	P value	Rate ratio (95% CI)	Excess suicide (95% CI)	P value	
<b>North American countries (n=2)</b>							
All countries	1.089 (1.072 to 1.106)	2603 (2142 to 3064)	<0.001	1.023 (1.006 to 1.041)	195 (51 to 339)	0.008	273 202
Canada	1.110 (1.089 to 1.132)	294 (243 to 346)	<0.001	1.016 (0.987 to 1.047)	14 (-12 to 40)	0.29	28 078
United States	1.087 (1.068 to 1.106)	2309 (1850 to 2767)	<0.001	1.024 (1.005 to 1.044)	181 (39 to 323)	0.012	245 124
<b>Caribbean and Central American countries (n=9)</b>							
All countries	1.064 (1.052 to 1.076)	390 (319 to 461)	<0.001	1.254 (1.219 to 1.290)	326 (290 to 363)	<0.001	110 439
Aruba	0.578 (0.427 to 0.891)	-3 (-5 to 0)	0.018	—†	-2 (-3 to 0)	0.005	86
Belize	1.770 (1.390 to 2.437)	5 (3 to 6)	<0.001	4.316 (2.718 to 10.470)	3 (3 to 4)	<0.001	196
Costa Rica	0.827 (0.781 to 0.879)	-49 (-66 to -32)	<0.001	0.703 (0.615 to 0.819)	-16 (-24 to -9)	<0.001	3423
Cuba	1.168 (1.138 to 1.200)	164 (138 to 190)	<0.001	1.506 (1.445 to 1.572)	112 (103 to 121)	<0.001	9268
El Salvador	1.085 (1.026 to 1.151)	31 (10 to 51)	0.004	1.141 (1.071 to 1.222)	13 (7 to 19)	<0.001	4145
Guatemala	1.271 (1.195 to 1.356)	76 (58 to 94)	<0.001	1.908 (1.698 to 2.178)	64 (55 to 72)	<0.001	8163
Mexico	1.054 (1.039 to 1.070)	203 (149 to 258)	<0.001	1.157 (1.111 to 1.207)	120 (89 to 152)	<0.001	79 000
Nicaragua	0.960 (0.913 to 1.013)	-11 (-26 to 4)	0.14	1.396 (1.269 to 1.552)	24 (18 to 30)	<0.001	3709
Panama	0.852 (0.799 to 0.914)	-25 (-37 to -14)	<0.001	1.442 (1.256 to 1.693)	8 (6 to 11)	<0.001	2449
<b>South American countries (n=7)</b>							
All countries	1.013 (1.004 to 1.022)	182 (59 to 306)	0.004	0.942 (0.927 to 0.958)	-216 (-279 to -154)	<0.001	233 138
Argentina	0.977 (0.950 to 1.006)	-54 (-121 to 13)	<0.001	0.944 (0.905 to 0.987)	-33 (-59 to -7)	0.011	29 988
Brazil	1.006 (0.995 to 1.017)	43 (-37 to 124)	0.29	0.928 (0.908 to 0.948)	-142 (-184 to -99)	<0.001	143 236
Chile	1.109 (1.083 to 1.137)	168 (131 to 205)	<0.001	1.129 (1.073 to 1.191)	47 (28 to 66)	<0.001	13 124
Colombia	1.102 (1.078 to 1.126)	162 (127 to 196)	<0.001	1.037 (0.981 to 1.099)	15 (-8 to 38)	0.21	32 352
Ecuador	0.830 (0.794 to 0.870)	-142 (-180 to -104)	<0.001	0.709 (0.666 to 0.759)	-92 (-113 to -72)	<0.001	9880
Paraguay	1.041 (0.968 to 1.127)	8 (-7 to 23)	0.29	0.855 (0.760 to 0.977)	-11 (-21 to -2)	0.023	4188
Suriname	0.972 (0.886 to 1.077)	-3 (-13 to 7)	0.57	0.986 (0.827 to 1.223)	0 (-6 to 5)	0.89	370

\*1000 population.

†Zero suicides.

Table 4| Rate ratios and excess suicides in 2009 in East Asian and African countries relative to those expected based on trends over 2000-07

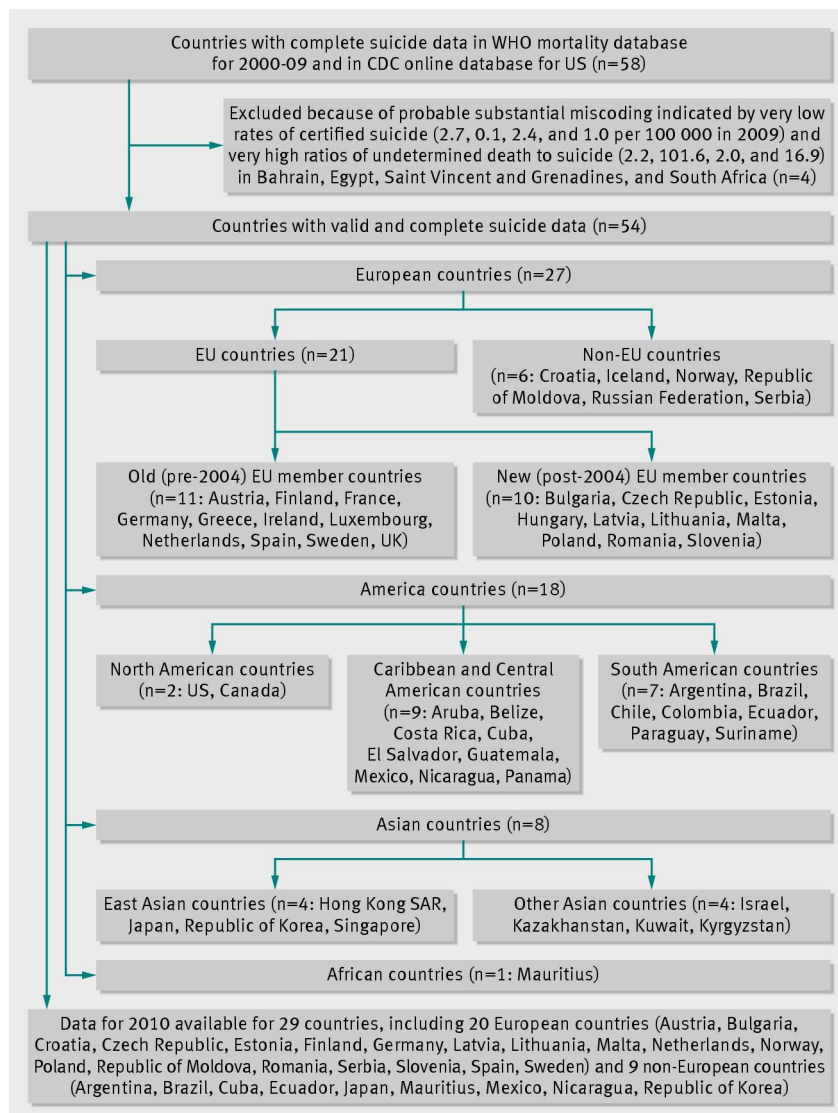
	Men			Women			Population aged ≥15 (2009)*
	Rate ratio (95% CI)	Excess suicide (95% CI)	P value	Rate ratio (95% CI)	Excess suicide (95% CI)	P value	
<b>East Asian countries (n=4)</b>							
All countries	0.970 (0.955 to 0.986)	-1009 (-1548 to -470)	<0.001	0.956 (0.938 to 0.976)	-658 (-957 to -360)	<0.001	159 424
Hong Kong SAR	0.866 (0.825 to 0.913)	-96 (-133 to -60)	<0.001	0.957 (0.912 to 1.005)	-18 (-38 to 2)	0.079	6130
Japan	0.987 (0.971 to 1.004)	-283 (-663 to 96)	0.14	0.967 (0.945 to 0.990)	-289 (-492 to -86)	0.005	108 955
Republic of Korea	0.940 (0.907 to 0.975)	-632 (-1012 to -251)	0.001	0.944 (0.910 to 0.981)	-320 (-538 to -102)	0.004	41 273
Singapore	1.011 (0.954 to 1.075)	3 (-11 to 16)	0.71	0.781 (0.728 to 0.844)	-31 (-42 to -20)	<0.001	3066
<b>Other Asian countries (n=4)</b>							
All countries	1.003 (0.983 to 1.024)	10 (-67 to 88)	0.79	1.081 (1.046 to 1.119)	68 (40 to 95)	<0.001	23 040
Israel	1.120 (1.072 to 1.172)	33 (21 to 45)	<0.001	1.059 (0.971 to 1.163)	5 (-3 to 13)	0.20	5399
Kazakhstan	0.978 (0.955 to 1.002)	-69 (-144 to 5)	0.068	1.081 (1.041 to 1.125)	52 (27 to 77)	<0.001	12 064
Kuwait	0.899 (0.772 to 1.078)	-4 (-12 to 3)	0.23	1.430 (1.128 to 1.953)	6 (2 to 10)	0.002	1955
Kyrgyzstan	1.170 (1.117 to 1.229)	52 (37 to 66)	<0.001	1.046 (0.943 to 1.175)	4 (-6 to 14)	0.41	3622
<b>African countries (n=1)</b>							
Mauritius	1.120 (1.027 to 1.230)	10 (2 to 17)	0.009	0.842 (0.734 to 0.989)	-4 (-7 to 0)	0.037	966

\*1000 population.

**Table 5| Correlation between unemployment rate (%) point changes between 2007 and 2009 and suicide rate ratios in 2009 relative to expected from 2000-07 trend in 50 countries and stratified by unemployment level before crisis in 2007**

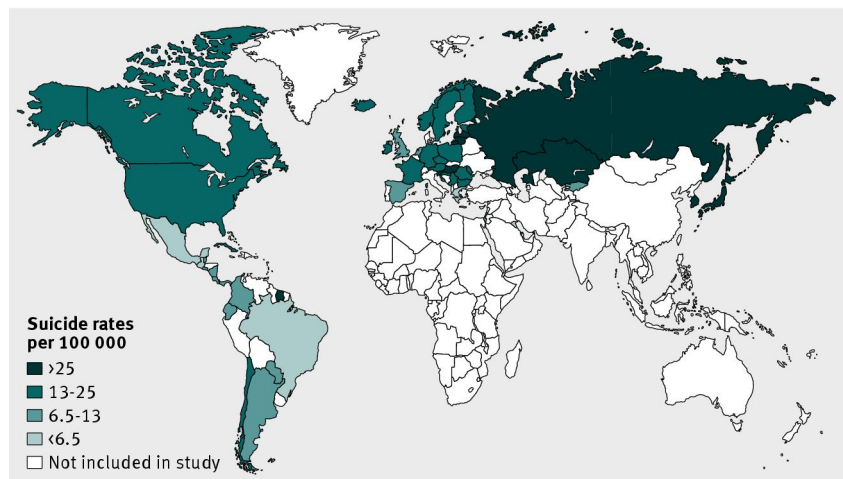
	No of countries	Spearman's $r_s$ (95% CI)	P value
<b>All countries</b>			
Men	50	0.25 (-0.03 to 0.50)	0.075
Women	50	0.10 (-0.18 to 0.37)	0.49
<b>Countries with low unemployment level (&lt;6.2%) before crisis</b>			
Men	25	0.48 (0.10 to 0.73)	0.016
Women	25	0.13 (-0.28 to 0.50)	0.55
<b>Countries with high unemployment level (<math>\geq</math>6.2%) before crisis</b>			
Men	25	0.31 (-0.10 to 0.63)	0.13
Women	25	0.20 (-0.21 to 0.55)	0.34

## Figures

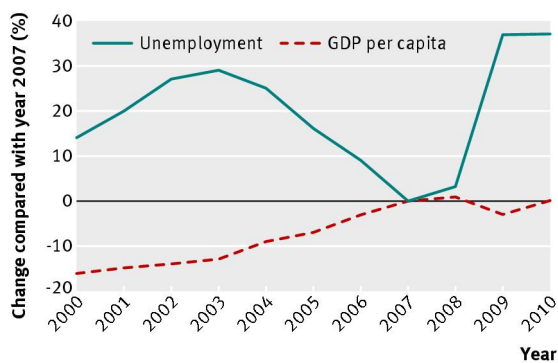


**Fig 1** Countries included in study (n=54). Nineteen countries (Argentina, Aruba, Belize, Brazil, Canada, Chile, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, France, Guatemala, Kuwait, Mexico, Nicaragua, Panama, Paraguay, Suriname) had incomplete population data for study period in WHO mortality database; their population data were obtained from United Nations population database<sup>21</sup>

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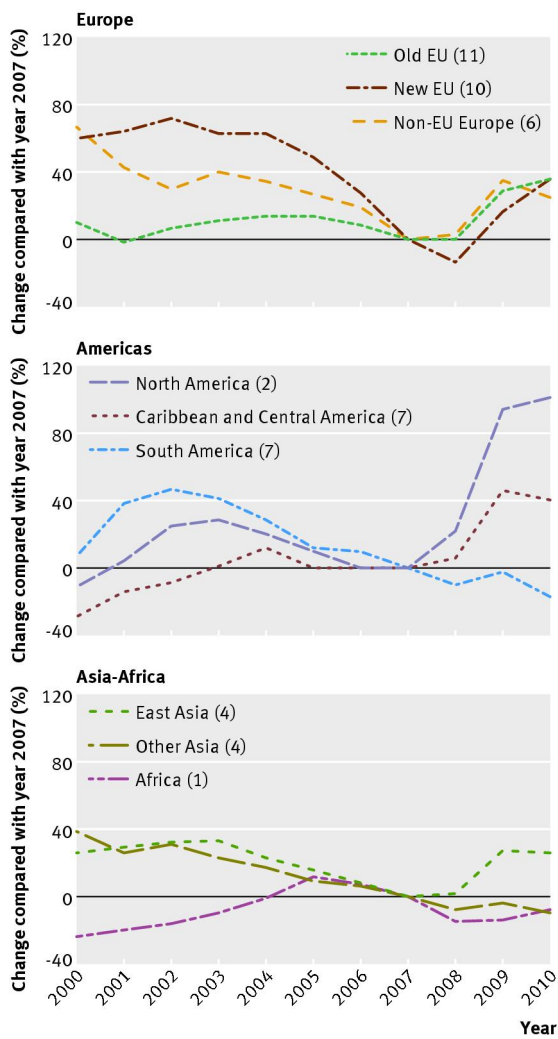


**Fig 2** Map of study countries and their suicide rates in 2009



**Fig 3** Changes in unemployment rates and gross domestic product (GDP) per capita in 54 study countries

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**Fig 4** Changes in unemployment rates in nine different regions (number of countries included in region), 2000-10. Data weighted by countries' population sizes in 2009. Unemployment data for two American countries (Aruba and Guatemala) were unavailable

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