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Systematic review of suicide in economic recession

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Abstract

AIM: To provide a systematic update of the evidence

concerning the relationship between economic recession and suicide.

METHODS: A keyword search of Ovid Medline, Embase, Embase Classic, PsycINFO and PsycARTICLES was performed to identify studies that had investigated the association between economic recession and suicide.

RESULTS: Thirty-eight studies met predetermined selection criteria and 31 of them found a positive association between economic recession and increased suicide rates. Two studies reported a negative association, two articles failed to find such an association, and three studies were inconclusive.

CONCLUSION: Economic recession periods appear to increase overall suicide rates, although further research is warranted in this area, particularly in low income countries.

Key words: Economic recession; Suicide; Unemployment; Time series; Systematic review

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Core tip: This review provides evidence for an association between economic recession and suicide at the ecological level. There is also evidence that the most recent recession is associated with an increase in suicide rates in high income countries such as Europe and North America. Methodological issues somewhat limit the comparability of some of the studies. High income countries were overrepresented in included studies, meaning that future studies in this area should focus their analyses on low and middle income countries wherever possible. More individual level analyses are also required in order to identify causal associations between economic recession and suicide.

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INTRODUCTION

In the aftermath of the deepest recession since the 1930s, which resulted in a global economic downturn and a subsequent loss of an estimated 30 million jobs worldwide^[1], it is worth revisiting the academic literature on the public health effects of economic recession. Of particular interest is the effect of economic recession on suicide rates, as increased suicide rates can be understood as a manifestation of psychosocial stress in populations, which may increase in periods of recession. This area was a topic of interest for academics even in the preceding two centuries^[2,3] and suicide has become an increasing public and global health problem, with a 60% increase in global suicide rates over the last 45 years^[4].

An economic recession can be described as a sustained reduction in economic productivity which is often measured through indicators such as gross domestic product (GDP) and unemployment rates. An economic recession can also be placed within an economic (or business) cycle in which there are cyclical upturns and downturns in the performance of an economy; with economic recessions representing cyclical downturns^[5]. Thus, the National Bureau of Economic Research in America defines economic recessions as "contractions that occur within an economic cycle"^[6]. Suicide rate changes in relation to the economic cycle can be described as pro-cyclical if the rate increases as an economy experiences a cyclical upturn, or counter-cyclical if the rate increases during a cyclical downturn in the performance of an economy^[5].

Previous studies have either reviewed the literature that has been published within a year^[7], or have systematically examined all the literature published in the last few decades^[8-10], or have analysed specific major recessions^[11]. In this review we aim to critically examine the literature focused on the relationship between completed suicide rates and economic recession. Thus, this review adds to previous studies by also including literature published in the last few years, with a focus on the effects of the most recent economic recession, which commenced in 2007 and is known as The "Great Recession".

MATERIALS AND METHODS

The "Ovid SP" database search interface was used to search for articles published over the period from January 1992 to March 2014 pertaining to our research topic in the following databases: Ovid Medline (R), PsychINFO, Embase Classic, Embase and PsychARTICLES. The search strategy used the

following keywords including cross-referencing: (econom*, financ*, cris*, cycl*, recessio*, depressio*, trend*decline, stagnation, contraction*, downturn*) and (suici*, mortality, mental health).

The search was limited to English language papers only. In addition, the world- wide web, google scholar and citation tracking were used to identify papers in the "grey" literature outside the above official databases.

The following inclusion criteria were applied to the abstracts or the full article as appropriate: (1) Studies published in peer-reviewed journals; (2) Only studies focused on the association between economic recession and suicide "completions" were included, *i.e.*, studies reporting on suicide attempts were not considered; (3) Economic indicators such as unemployment rate and GDP had to be reported in order to define a recession period or to act as a proxy for an economic recession; and (4) All age groups were considered.

Exclusion criteria were: (1) Qualitative studies, *i.e.*, with no quantitative data at all; and (2) Studies based solely on cities/neighbourhoods and not including national data or trends.

RESULTS

The literature search initially yielded 3086 references of which 93 were identified for full text review. Of these 93 studies, 38 were included in this review (Figure 1). Specifically, 31 studies found a positive association between economic recession and increased suicide rates following the onset of recession. Two studies reported a clear overall negative association between economic recession and suicide (*i.e.*, economic recession appearing to be a protective factor for suicide at the ecological level), two studies did not find an association and three studies were inconclusive in their findings (Tables 1 and 2). Tables 3 and 4 provide a short critique of every included study.

Positive association studies

Of the studies finding a positive association between economic recession and suicide, 29 were time-series studies (Table 1) and two were cohort studies^[12,13]. Five of the positive association studies only used descriptive statistics to clarify the relationship between economic recession and suicide^[14-18]. The remaining positive association studies generally utilised regression or correlation analyses (or both) to investigate this association. A subset of the positive association studies used similar study designs where regression analyses were performed on panel data^[19-25]. In these studies, national and regional unemployment rates were used to proxy economic cycles consisting of recessions and booms. A few studies also used statistical techniques which provided estimates of excess mortality attributable to recession^[23,24,26-28]. Most of the positive association studies were conducted in

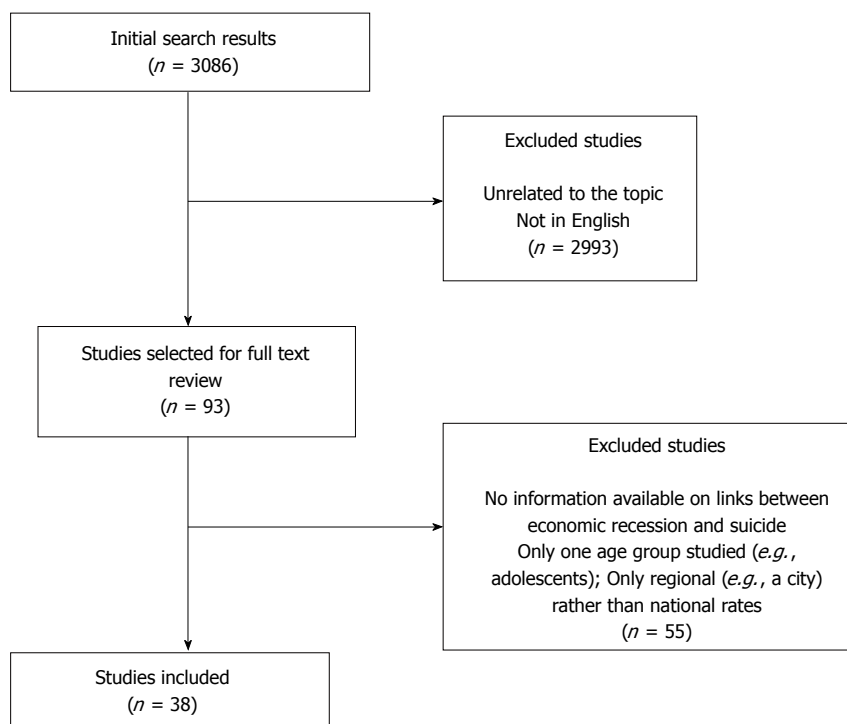


Figure 1 Flow chart of systematic literature search and review.

high income countries, particularly in the United States and Europe. A few studies were conducted in Asian countries^[14,15,28-30], the Asian Financial Crisis in the late 1990s being the economic recession of interest for most of these studies^[14,15,28]. In addition to the Asian Financial crisis other positive association studies investigated the "Great Recession", which began in 2007^[17,23-27,30-34], the recession associated with the collapse of the Soviet Union in the early 1990s^[16,21,35], and the Great Depression of the 1930s^[18].

Negative association studies and inconclusive studies

Seven studies^[35-41] either reported a clear negative association between economic recession and suicide, no association or were inconclusive. Of note, all these studies were time-series studies (Table 2) with the majority of them using panel data. Two of the studies in this category reported a clear overall negative association between economic recession and suicide^[36,37]. Two studies failed to find an association between economic recession and suicide rates^[39,41] and the results of three studies were inconclusive^[35,38,40]. These studies were classified as "inconclusive" due to either reporting both positive and negative associations between economic recession and suicide across different countries^[38], mixed results depending on the specific analysis^[40]; or a lack of power to infer robust conclusions from the results^[35].

Studies in this category either investigated the impact of multiple economic cycles on suicide rates^[36,39,40], or the impact of specific recessions such as the Great Recession^[38,41], the Post-Soviet economic collapse^[35] and others^[37]. Nearly all the study settings were

European countries with the exception of one study conducted in Mexico^[36].

DISCUSSION

This systematic review appears to show an association between economic recession and increased suicide rates. However, several methodological limitations must be considered when interpreting these results.

Methodological issues

The designs of the included studies varied widely, particularly the way in which economic recession was defined. This heterogeneity in study design and exposure measures limited comparisons across the studies. The main methodological difference concerning statistics across the selected studies was whether regression or correlation analyses were performed rather than only performing descriptive analyses on time-series data. There were also studies investigating the interaction between economic recession and suicide over multiple economic cycles which did not allow us to draw conclusions from specific recession periods within the study periods that were investigated^[12,19,20,22,29,36,39,40,42-49]. These studies used regression analyses to analyse the impact of these economic cycles on suicide rates. Thus, domestic product or national and regional unemployment rates, were used as recession indicators where cyclical variations in unemployment rates or GDP represented booms (periods of high economic productivity) and recession periods. These studies were therefore difficult to compare with those using pre-defined

Table 1 Positive Association Studies

Ref.	Countries studied	Study design	Suicide data source	Recession period	Economic indicator(s) used	Findings
Yang ^[45]	United States	Time series study Multiple regression analysis	Hollinger P.C Violent Deaths in the United States New York: Guild 1987 ^[63]	Not Specified	Gross National Product per capita Unemployment rate	Total suicide rates were significantly and positively associated with increases in gross national product per capita and unemployment rate ($P < 0.05$ for both) However, total suicide rates were significantly and negatively associated with increases in gross national product with a one year lag ($P < 0.05$)
Lester <i>et al.</i> ^[67]	United States and Japan	Time series study Pearson correlation analyses and regression analyses	Annual volumes of Vital Statistics of the United States	Not Specified	Change in Gross National Product Unemployment Rate	Increase in unemployment was significantly and positively correlated with increase in suicide rates in both the United States and Japan ($P < 0.05$ for both). Regression analyses, however, only showed a positive and significant relationship between unemployment and suicide rates in Japan ($P < 0.05$)
Gavrilova ^[6]	Russia	Time series study Descriptive statistics	Gokomstat (Russian statistical committee)	1992-1993	Average real earning and consumer prices	Male suicide rate + 61% and Female Suicide Rate + 22% over 1991-1994 Male mortality rate (per 100000) 1991: 47.7 1994: 76.9 Female Mortality Rate (per 100000) 1991: 11.6 1994: 13.2
Ruhm ^[69]	United States	Panel Study Regression analysis	US Census Bureau	Not Specified	Unemployment Rate	Suicide rate predicted to increase by 1.3% for every percentage point increase in unemployment rate ($P = 0.05$)
Brainerd ^[21]	22 former Soviet Bloc Countries	Panel study using regression analysis	World Health Organisation "Health For All" Database 2000	1990-1994	Gross national product per capita and employment to population ratio	A \$100 increase in GNP per capita predicted a decrease in suicide rate by 0.14% ($P > 0.05$) to -0.20% ($P < 0.01$) in males A one percentage point increase in employment to population ratio predicted decreased suicide rates in males by 3% ($P < 0.01$)
Lester ^[62]	United States	Panel Study Regression analysis	Statistical Abstract of the United States	Not Specified	Gross state product per capita Female labour force participation	A one percent increase in gross state product per capita was associated with a 0.45% decrease in total state suicide rates and a 0.55% decrease for male suicide rates ($P < 0.05$ for both)
Kim <i>et al.</i> ^[28]	South Korea	Time Series Study Descriptive statistics and regression analysis	1999 report on cause specific mortality by the South Korean Statistical office	1997-1999	Unemployment rates and GDP	Suicide cases increased for three months after the recession onset, but decreased after this point Estimated excess suicide mortality caused by recession = 5.1 in 1998 and 0.5 in 1999 ($P < 0.01$ for both estimates)
Gerdtham <i>et al.</i> ^[21]	Sweden	Cohort Study using descriptive statistics and probit regression	Statistic Sweden's Survey of living conditions	Not specified	Advanced notification of job loss, changes in GDP, deviation from GDP trends unemployment rates, industry capacity utilisation, and industry confidence indicators	A one standard deviation increase in GDP decreased the risk of suicide by 22.7% ($P < 0.05$) A one standard deviation increase in the confidence indicator reduces suicide risk by 22.3% ($P < 0.05$). A one standard deviation decrease in the advanced notification of job loss rate, decreased suicide risk by 21.5% ($P < 0.05$)
Khang <i>et al.</i> ^[15]	South Korea	Time-series Study Descriptive statistics	Death certificates from South Korean Statistical office	1997-2002	Unemployment rate and GDP per capita	Substantial increase in suicide rates post 1997 in males and females, and then a decline in the rate in both sexes until 2000 Age specific male and female suicide rates (per 100000) in 1996 and 1998: 1-14: MF = 0.8 (1996) and 0.8 (1998) 15-34: MF = 13.5 (1996) and 16.5 (1998) 34-65: M = 26.4 (1996) and 44.3 (1998) F = 8.9 (1996) and 11.9 (1998) 65-79: M = 42.4 (1996) and 58.5 (1998) F = 15.8 (1996) and 22.3 (1998)
Tapia Granados ^[44]	United States	Time series study Regression analysis	Historical Statistics of the United States	Not Specified	Unemployment rates	Suicide rates significantly associated with increases in the rate of change of unemployment rates from 1920-1944 ($P < 0.01$) and 1920-1996 ($P < 0.01$)
Granados ^[20]	Spain	Panel study Regression analysis	Instituto Nacional de Estadística. (National Statistics Institute)	Not specified	National and province level unemployment rates	Suicide rate predicted to increase by 1.28% for every percentage point increase in the unemployment rate ($P = 0.05$)

Chang <i>et al.</i> ^[21]	27 European Countries 18 American Countries 8 Asian Countries One South African Country	Time series study	World Health Organisation Mortality Database and The Center for Disease Control Online Database (for the United States)	2008-2010	Gross Domestic Product and Unemployment	Overall suicide rates in men rose 3.3% (95%CI: 2.7-3.9) with a rate ratio of 1.033 (95%CI: 1.027-1.039) and an estimated excess mortality of 5124 (95%CI: 4219-6029) that could be attributed to the recession
Garcy <i>et al.</i> ^[13]	Sweden	Time series study Cox regression	Swedish work and mortality database	1993-1996	Unemployment rates	No excess hazard of suicide mortality attributable to unemployment during the recession in men or women, although an excess hazard post-recession (1997-2002) in men (Hazard ratio = 1.43, 95%CI: 1.31-1.56) and women (Hazard ratio = 1.26, 95%CI: 1.04-1.54)
Chan <i>et al.</i> ^[30]	South Korea	Time Series Study Regression analysis	National Statistical office of Korea	January 2009 to December 2010	Unemployment Rates	Between 2009 and 2010, there was a statistically significant positive association ($P < 0.001$ for most associations) between suicide rates and national unemployment rates in both the employed and unemployed except in employed men and women aged 50-59 and unemployed men aged 30-39
Madianos <i>et al.</i> ^[23]	Greece	Time series study Descriptive statistics correlation and regression analyses	Vital Statistics Bureau of the Hellenic Statistical Authority	2008-2011	Unemployment Rates Debt as a percentage of Gross Domestic Product	Unemployment and debt as percentage of GDP were significantly and positively correlated with suicide rates $\rho = + 0.64$, $P < 0.001$ for unemployment, and $\rho = +0.47$, $P < 0.05$ for debt as a percentage of GDP
Phillips <i>et al.</i> ^[25]	United States	Panel study Regression analysis	National Center for Health Statistics	2007-2009/2010	Unemployment Rates	In regression models, increases in unemployment and debt as percentage of GDP were significantly associated with increases in suicide rate ($P < 0.05$ for debt as a percentage of GDP and $P < 0.01$ for unemployment)
Pompili <i>et al.</i> ^[33]	Italy	Time series analysis Joinpoint regression	Italian Mortality Database	2007-2010	Gross Domestic Product Unemployment rate	Unemployment significantly ($P < 0.05$) and positively associated with changes in suicide rates but not in the elderly (65+) or young (15-24)
Reeves <i>et al.</i> ^[26]	Europe and North America	Time series study	World Health Organisation Mortality Database and The Center for Disease Control Database	2008-2010 (Europe) 2008-2009 (Canada)	Unemployment rates	2006-2010: Age specific suicide rates increased in working age men (25-64) by 12% (RR = 1.12; 95%CI: 1.04-1.19), but not in older (65-85+) or younger age groups (1-24) Using 2007 as a baseline, the excess suicide mortality attributable to the recession across the United States, Canada and Europe was 10000

recession periods and performing descriptive trend analyses on time series data^[14-18,35], since the exposure measures differed so greatly. Since most of the included studies were ecological, inferences concerning individual suicide risk during times of recession should be made with caution. Only two studies^[12,13] used a study design (cohort study) that allowed for individual level analyses and causality associations to be made.

Risk of bias

The main sources of bias in included studies are likely to come from deficiencies in mortality data. Omitted variables which influence suicide rates and are associated in some way with the onset of recession, are also a major source of bias. In the case of mortality data it is reasonable to assume that suicides are more likely to be underreported or misclassified rather than overreported since socio-cultural factors and the stigma associated with suicide, may potentially lead to underreporting. Indeed, one of the included studies^[15] has raised concerns regarding the potential misclassification of suicides due to stigma. Because of this misclassification bias and the different ways in which suicides are classified and coded across countries, making international comparisons based on suicide data from different countries remains a contentious issue^[34]. Since most of the studies in this review analysed populations in high income countries, with well-developed statistical authorities, it is unlikely that collected suicide statistics were grossly inaccurate and if a proportion were misclassified, the negative association between recession and suicide would be even more marked, meaning the findings of this review would underestimate the strength of the association.

Omitted variable bias may be a focus of concern in all selected studies, particularly those that did not conduct statistical analyses to take this potential bias into account. A number of panel studies attempted to mitigate the impact of omitted variable bias by using fixed effect regression analysis^[12,19-22,24,25,40]. This kind of analysis

Table 2 Negative Association Studies and studies with inconclusive results

Ref.	Country studied	Study design	Suicide data source	Recession period	Economic indicators	Findings
Hintikka <i>et al.</i> ^[97]	Finland	Time series Study Regression analyses	Causes of death statistics reported by Statistics Finland in 1996	1990-1995	Unemployment Rate and Female and Male Suicide rates positively associated with increases in GDP ($P < 0.05$)	
Rancans <i>et al.</i> ^[95]	Latvia	Time series study Descriptive statistics	Statistical Yearbooks of the Medical Statistics Bureau of the Latvian Ministry of Health and the Demographic Yearbooks of the Latvian Central Statistical Bureau	1990-1994	Gross Domestic Product and Unemployment rates	Rapid increase in suicide rates after 1989 reaching a maximum in 1993 (42.5 per 100000) The drop in GDP after 1990/1991 and the subsequent rise in unemployment did not correspond strictly with suicide rates changes A decrease in suicides for every percentage point increase in unemployment rate in males (0.98% decrease $P < 0.1$) and females (1.9% decrease $P < 0.05$) A decrease in suicides for every percentage point increase in unemployment rate in males (1.22% decrease NS) and females (1.97% decrease in females $P < 0.01$) Sensitivity analysis found that decreases in suicide rates were not associated with recession
Neumayer ^[40]	Germany	Panel study using regression analyses	The German Federal Statistical Office	Not specified	Unemployment rates for initial analysis and gross domestic product for sensitivity analysis	
Gonzalez <i>et al.</i> ^[96]	Mexico	Panel study using regression analysis	Administrative records of death certificates	Not Specified	State Gross Domestic Product Per Capita	Decreases in state GDP per capita associated with decreases in the overall suicide rate across all states ($P < 0.01$)
Mackenbach <i>et al.</i> ^[99]	25 European countries in Western and Eastern Europe	Time series study with regression analysis	International Mortality Data Base of the National Center for Health Statistics of the Centers for Disease Control	Not Specified	Gross Domestic Product	Changes in gross domestic product were not significantly associated with overall suicide rates across all countries in men and women
Saurina <i>et al.</i> ^[41]	England and its sub-regions	Panel study using conditional and hierarchical mixed regression modelling	United Kingdom Office for National Statistics	2008-2010	Unemployment Rates	The increase in suicides between 2008 and 2010 was not statistically significant No significant association between unemployment rates and suicide at the national level, although at the regional level there were statistically significant negative and positive associations Overall 0.3% increase in suicide rates for every 10% increase in unemployment overall (95% CI: 0.1-0.5) Associations between unemployment and suicide within countries were inconsistent A positive significant association between unemployment and suicide in three countries: Netherlands, United Kingdom and France was found
Laanani <i>et al.</i> ^[98]	Austria, Finland, France, Germany, the Netherlands, Spain, Sweden and the United Kingdom	Panel Study using regression analysis	Eurostat mortality database	2008-2010	Unemployment Rates	

NS: Non-significant; RR: Rate ratio; GDP: Gross domestic product.

reduces the effects of contextual differences that states or regions in a panel may have. This means that panel studies using fixed effects regression have the advantage of assessing the relationship between economic recession and suicide across many samples within a panel whilst also controlling for the effects exerted by unselected variables^[19,25]. Other studies^[36,37,39,42,45-47,49,50], which did not use panel data, attempted to reduce the effect of omitted variable bias by including variables that were anticipated to exert a confounding effect in regression models.

While a number of time-series analyses did not include potential confounders (such as alcohol consumption, divorce rates, public health expenditure or female labour force participation) in regression models, they attempted to make adjustments for trends within studied nation states that may have obscured the relationship between economic recession and suicide. Three of these analyses^[28,30,41], attempted to adjust for autocorrelation within time series data; with seasonal variations in suicide rates being a manifestation of such autocorrelation. Studies using the aforementioned techniques to reduce the effects of omitted variable bias are less likely to have their

Table 3 Critique of Positive Association Studies

Ref.	
Yang ^[45]	This study uses aggregated population data and only investigates contemporaneous and very short term lagged effects of economic variables on suicide rates. This study supports the evidence of other studies based in the United States that economic recession can exert a short term impact on suicide rates; although the utility of this study in identifying causal associations is questionable
Lester <i>et al</i> ^[47] Gavrilova ^[16]	No individual level evidence included in this study. Suicide rates by age category were not computed Mortality data quality is questionable as is cause of death coding. Suicide data could have been inaccurately coded leading to underestimates of suicide mortality. No individual level evidence was included and only descriptive statistical analysis was performed
Ruhm ^[19]	No individual level data was included in the study. No information on suicide rates by gender was provided. The inclusion of 4 yr lags for unemployment lags, whilst an improvement on similar published studies only provides a short term insight into the interaction between fluctuations in unemployment and suicide rates
Brainerd ^[23]	Gross national product per capita and employment rates used in the study are likely to be underestimates. This means that regression estimates are more likely to identify regressors as not exerting an effect on suicide rates. The panel used in this study is biased by missing or incomplete data for a number of included countries. No individual-level data was included in the study
Lester ^[42]	Spatial analyses of suicide rates within states were not performed, thus providing no insight into any clustering of suicide mortality within states. Age specific suicide rates were not included although a breakdown of suicide mortality by ethnicity was. No individual level data was included in the study
Kim <i>et al</i> ^[28]	Mortality data was derived from death certificates which may not be fully accurate. The use of aggregated population data limits the ability to make causal inferences about the interaction between economic recession and suicide. An age breakdown of suicide rates was not provided
Gerdtham ^[12]	Unlike most other included studies, a large individual level dataset was collected using a prospective cohort study design. Numerous sensitivity analyses were performed to address potential flaws with the initial study design. However, the decrease in the male mortality rates is concentrated in the first few years of the study period meaning there may be an variable that has not been accounted for in the study that is causing this effect
Khang <i>et al</i> ^[15]	Concerns have been raised by this study about the quality of cause of death coding in South Korea which may have affected the accuracy of data in this study. Total suicides may have been underreported due to a miscoding of such deaths as being unintentional - as a result of stigma. Only descriptive analyses of suicide data were performed, meaning any omitted variable bias has not been corrected for
Tapia Granados ^[44]	This study benefits from analysing the impact of a number of economic cycles on suicide mortality over a long period of time. Data on suicide mortality and economic indicators were taken from a range of official statistical sources, to provide data for the century studied in the study. This study does not explore the effect of mediating factors which relate economic recession to suicide. By studying aggregated population data rather than individual level data, this study only provides evidence for an association between recession and suicide
Granados ^[20]	The study design used is very similar to the design used in Ruhm (2000) ^[19] and the finding that suicide rates increase during recessions is consistent with Ruhm's study. This study also expands on Ruhm's work by providing sex specific mortality rates. However like Ruhm's study, only short term effects of recession on suicide rates are explored; and the use of panel data can exacerbate attenuation bias resulting from underestimates of suicide mortality in official data. As with all ecological studies, the ability to make causal inferences between recession and suicide is impaired by a lack of individual level data
Berk <i>et al</i> ^[50]	Seasonality in suicide rates was not adjusted for in this study. No individual level data was included in this study either. Lagged effects of changes in included economic indicator were not computed
Granados ^[29]	Correlation and regression analyses were both performed in this study to elucidate the relationship between recession and suicide. The time series data in this study has also been detrended to make it more suitable for regression analysis. As the author suggests, the study would have been strengthened if a panel study design had been used as the association between economic recession and suicide could be tested across many sub-regions in Japan
Altinahtar <i>et al</i> ^[49]	This study is notable for using auto regressive distributed lags which allow for the exploration of long run relationships between variables. This study's focus on Turkey is also notable as it is a middle income rather than a high income country and high income countries form the majority of countries studied by the literature. This study however does not study suicides according to age and gender and no individual level data has been included
Chang <i>et al</i> ^[14]	This study provides one of the first analyses of the effects of the 1998 Asian financial crisis on the main countries in the region who were affected. Of concern is the potential difference in the accuracy of suicide coding practices across studied countries as well as the completeness of suicide data. State specific effects such as political unrest (<i>e.g.</i> , in Hong Kong) were not fully controlled for in this study
Tapia Granados <i>et al</i> ^[18]	Regression analyses of the interaction between the depression and overall mortality were performed but not for suicide rates specifically. Only descriptive statistics were used to describe the interaction between suicide rates and the depression. A breakdown of suicide rates by age or gender was not provided
Stuckler <i>et al</i> ^[22]	Of note in this study is the analysis of the effect of social protection spending on the interaction between unemployment and suicide that this study performed. Using unemployment as a proxy for economic conditions, the effects of both smaller and larger increases in unemployment on suicide rates was tested as well. Other included studies tended to not perform the aforementioned analyses. This study only analysed the short term effects of recession and as with many of the included studies, this study was analysing the impact of recession on populations rather than individuals
Wu <i>et al</i> ^[46]	The authors of this study opted to detrend time series data in order to make it more suitable for regression analysis. The risk of omitted variable bias was well mitigated with the inclusion a range of potential confounders. The authors state that the results should be approached with caution due to data limitations, but these limitations were not specified
Ceccherini-Nelli <i>et al</i> ^[48]	Variations in suicide documentation across the four countries studied may vary which complicates comparisons made between these countries. The co-integration analyses performed in this study allow for the analysis of the long term interactions between economic variables proxying economic conditions and suicide rates; which is a major strength of this study. These analyses however only test for associations rather than causality

Luo <i>et al</i> ^[43]	The nonparametric analyses used in these studies did not allow for the analysis of the effect of recession severity or length on suicide rates, as all recessions were presumed to be of the same length and severity. Multiple regression analysis was not performed thus increasing the likelihood that omitted variables have biased the results
Stuckler <i>et al</i> ^[17]	This study represents a very preliminary analysis of suicide data from 2009. This means that any effects of the 2008 recession would not have arisen fully and any conclusions made based on data analysis may be premature
Barr <i>et al</i> ^[23]	The unemployment rate in this study is based upon the number of claimants of unemployment benefits which may underestimate the true unemployment rate. At the national level, the level of fiscal consolidation within England, does not seem to have been estimated or controlled. This is significant as this variable could influence both the unemployment and suicide rates, thus acting as a confounder. The sub-regions of England investigated in this study have different levels of deprivation and the unemployment rate may have differing impacts on the suicide rate in these regions, which are not expressed in the study itself. Only the immediate effects of economic recession have been investigated as the lagged effects have not been calculated
Reeves <i>et al</i> ^[24]	United States suicide data may underestimate the true suicide rate. The excess mortality estimates rely on short term extrapolations of pre-recession suicide trends
Lopez Bernal <i>et al</i> ^[31]	The use of interrupted time series analysis allowed for the controlling of seasonality in time series data. Unlike many other included studies, the extent of residual autocorrelation in the time series data was estimated and a control analysis was conducted; using mortality from accidental falls as an outcome measure rather than suicide mortality. Because of the low number of monthly suicide rates in some regions of Spain, regions within the country had to be combined in order to increase statistical power. This means there were less units of observation for the interaction between economic recession and suicide
Chang <i>et al</i> ^[27]	Differences in coding and classification of suicide may lead to an introduction of bias between countries, which may be exacerbated by the large number of countries studied (54 countries in this study). The sample of studied countries is also skewed by the presence of a large number of high income countries and an underrepresentation of low income countries; particularly from Sub-Saharan Africa. This means that overall excess mortality estimates may be more of a representation of the relationship between economic recession and suicide in high income countries than in low income countries
Garcy <i>et al</i> ^[13]	As in [12], this study analyses individual level evidence and the results seem to suggest a causal association. The great strength of this study is its very large sample size of individuals (more than 3 million) and the inclusion of a range of socioeconomic variables within the cox regression analyses that were conducted. As this study provided further analyses where individuals who had previously attempted suicide or had a previous mental health diagnosis were excluded, the relationship between unemployment and suicide in this study is less likely to be spurious; especially considering the fact that this study has been conducted at the individual level. However this study could not test whether mental health deteriorated as a result of unemployment meaning the behaviour of an important mediating factor has not been elucidated in this study
Chan <i>et al</i> ^[30]	Suicide data derived from death certificates may be more vulnerable to misreporting bias. This study attempts to focus the study of the South Korean population by stratifying by occupational status as well as gender; although the flaws associated with using aggregated population data remain. The inclusion of students and housewives in the “unemployed” label used by the S. Korean national statistical office, may distort the relationship between economic recession and suicide rates as these groups may respond to the onset of recession quite differently compared to those who lost their jobs as a result of recession
Madianos <i>et al</i> ^[32]	The study only explores the short term effects of economic recession on suicide rates. Monthly and regional suicide rates which may have provided a greater insight into the timing and spatial distribution of suicides were not included
Phillips <i>et al</i> ^[25]	This study performed age and sex stratified analyses of the association of between included economic variables and suicide rates. The authors acknowledge the potential impact of omitted variables such as gun ownership which were not included in analyses because of a lack of comprehensive data
Phillips <i>et al</i> ^[25]	This study only provides evidence of changes in suicide mortality during an economic recession. Data is provided up until 2010 but negative GDP growth only stopped in 2013 with a return to recession in 2014. Therefore this study does not capture the full extent of the suicide mortality response to recession conditions
Reeves <i>et al</i> ^[26]	The confidence intervals for the estimated excess European suicide mortality attributable to the recession are quite wide. The unadjusted difference between baseline suicide rates and recession suicide rates are compared to estimate suicide rates; meaning that the impact of confounders has not been adjusted for, nor has any seasonality in the time series data been controlled

results distorted by such a bias compared to those selected studies using only descriptive statistics^[14-18,35].

Differences in the use of economic indicators

The use of different economic indicators in the included studies to proxy or define the occurrence of an economic recession may have affected the results. For instance, using GDP, which is one of the main economic indicators used to demarcate a recession period, might be to some extent distant from the experience of people living through recessions. Also, this is a measure which provides no insight into how wealth is distributed within countries. For instance, a country experiencing a recession in which there is a moderate contraction in GDP, could be more severely affected than another country that had a more equal distribution of wealth but a more severe contraction in GDP.

However, unemployment rates may be an insensitive indicator of recession as demonstrated by one of the

selected studies^[40]. The negative association found between economic recession and suicide in this analysis (with unemployment rates as an economic indicator) was not supported by a further sensitivity analysis performed within the study using GDP growth as an indicator^[40]. Hence, this may indicate that certain markers are less effective indicators of economic conditions.

Unemployment rates also tend to be a lagging indicator of recession, so using unemployment rates alone may cause a different period of time to be specified as a recession period, rather than the actual recession period as defined by conventional GDP measures. Alternatively, studies including multiple economic indicators could more accurately proxy and define economic recession. In one study^[12], only half of the economic indicators used were associated with changes in suicide rates. Therefore, it could be speculated that if only one indicator was used in this

Table 4 Critique of Negative Association and Inconclusive Studies

Ref.	
Hintikka <i>et al</i> ^[37]	Potential confounding variables such as state health expenditure were not included. Finnish suicide data seems to be highly reliable so incomplete data is less likely to be a major source of bias. The finding that rapid increases in unemployment were not associated with increases in suicide rates is interesting, but the lack of individual level evidence means that underlying explanations for this association cannot be arrived at from this study alone
Rancans <i>et al</i> ^[35]	Only a descriptive analysis of economic and suicide data was performed here meaning the effect of any confounding variables was not controlled for. This study only demonstrates a simple temporal association (or strict lack of it) between unemployment rates, gross domestic product, and suicide rates
Neumayer ^[40]	The panel study design used here is very similar to Ruhm, 2000 ^[19] . Interestingly on sensitivity analysis using gross domestic product as the main proxy for economic fluctuations, variations in suicide mortality no longer behave pro-cyclically. As with the other included panel studies, attenuation bias may be a problem if suicide statistics underestimate suicide mortality
Gonzalez <i>et al</i> ^[36]	Age breakdowns for suicide mortality were not provided. No individual level analyses were performed in this study. This study takes great care in ensuring the quality of its mortality data; going as far as to test whether quality of death classification varies with the economic cycle
Mackenbach <i>et al</i> ^[39]	Differences in the accuracy and quality of cause of death coding and classification between countries and within countries over time may have biased the results of this study. The investigation into the relationship between income and mortality in this study implies a causal relationship between the two, although this is contentious
Saurina <i>et al</i> ^[41]	Using a different regression model to Barr <i>et al</i> , this study contradicts the findings of Barr <i>et al</i> despite the fact that the study location (England) and the study period are very similar. The authors of this paper argue that Barr <i>et al</i> 's methodology is incomplete and has probably produced a spurious relationship between recession and suicide due to not controlling for confounding variables; particularly those with a regional dimension. Despite claiming to improve upon Barr <i>et al</i> 's methodology, this study is still probably biased by the change in classification from ICD-9 to ICD-10 (although Barr <i>et al</i> 's study would be similarly affected). Furthermore the location of suicide (<i>e.g.</i> , rural or urban) may have a confounding effect; and this kind of spatial confounding may not have been adequately controlled for in this study
Laanani <i>et al</i> ^[38]	This study provides an interesting insight into the question of a causal link between recession and suicide. By performing a sensitivity analysis to check for confounding by a "crisis effect", this study found that such an effect varied between countries and the association between unemployment and suicide in studied countries was statistically significant, but fairly weak and variable. This however may be a reflection of the quality of unemployment as a proxy for economic conditions in studies that investigate multiple countries at once. This study also emphasises the inherent problem in trying to investigate causal associations between economic recession and suicide using ecological study designs

study, a spurious relationship between economic recession and suicide may have been found.

Study locations

Of relevance, the vast majority of the selected studies were conducted in either high or middle income countries. Hence, the relationship between economic recession and suicide in low income countries remains unclear and further research is therefore needed in this area.

The impact of high profile economic recessions in high and middle income countries, such as the Great Recession, the post-communist period in Russia (1991-1994) and the Asian Financial Crisis (1997-1998/9) have been the focus of recent research rather than recessions in low income countries, *e.g.*, 18 of 38 studies included in this review, reported on these recessions.

Mediating factors between economic recession and suicide

The effects of economic recession on suicide rates are multi-level; so its onset influences both the macro-socioeconomic and micro-socioeconomic environment of nation states. For instance, nearly all of the included studies investigated the impact of economic recession on the macro-socioeconomic environment, apart from the two studies that were performed at the individual level^[12,13]. Generally, national unemployment rates and GDP acted as the main signifiers of the macro-socioeconomic environment within included

studies (See "economic indicators used" column in Tables 1 and 2). As a major signifier of the macro-socioeconomic environment and a modifier of suicide rates, unemployment is arguably the main mediating factor that must be considered^[51-57]. Another key factor may be indebtedness, which is related to unemployment since those who have become unemployed may take out loans to compensate for their loss of earnings^[58]. Indebtedness has also been independently associated with suicide in certain studies^[59,60], although this particular association may have been distorted due to the retrospective design of these studies. However, the interaction between recession, the macro-socioeconomic and micro-socioeconomic environments, may not have been sufficiently examined. For example, many of the studies in this review have explored the relationship between unemployment or GDP and aggregated suicide rates. However, these studies have not investigated the interaction between recession, individual level behaviours and the individual level environment-as signified by divorce rates, family structure, substance misuse and many other factors. This gap in the literature seems to be due to the lack of multi-level analyses in this area. These studies are indeed needed to gain a more in-depth understanding of the mediating factors at the individual level and the interactions between themselves.

In addition, the interaction between mediating

factors may also be liable to significant differences across cultures. For example, the role of employment and the subsequent potential mental health consequences in high income Western countries may not have the same effects in low income countries where unemployment could be more or less stigmatised. Such potential differences across countries highlight the complexity of the interaction between mediating factors with regard to the complex relationship between economic recession and suicide rates.

Mitigating the impact of economic recession on suicide

The role of unemployment and indebtedness in linking economic recession with suicide rates would provide some support for increased government spending on social protection (e.g., unemployment benefits, healthcare and debt relief programmes) to act as a counterbalance against the increased financial stress which tends to occur in unemployed and heavily indebted populations during recessions. For example, one of the included studies identified a link between increased per capita spending on active labour market programmes^[11] (which attempt to increase employment) and a reduction in suicide rates. This study also argued that the reason underlying suicide rates decreased in Sweden and Finland in the 1990s, when both countries suffered from economic recession, was their robust social protection programmes as well as active labour market programmes which assisted the unemployed in finding work. Such programmes may also explain why there was a clear overall negative association between economic recession and suicide in a study based in Finland^[37].

Periods of economic recession may also highlight deficiencies in mental health services which may be put under extra strain during these periods. This could provide an opportunity to invest and improve mental health services, although this may be challenging in an environment where fiscal policies focused on reducing the overall size of the budget for health services are implemented. In other words, mental health services may face stiff competition for a declining pool of resources.

Social protection may potentially act as a buffer against the negative socioeconomic effects of recession. Therefore, developing social protection interventions would require a better understanding of the groups who are likely to be more exposed to the negative effects of an economic recession. For example, if increased unemployment was clearly demonstrated to mediate the relationship between economic recession and suicide rather than indebtedness, active return-to-work schemes may play a more relevant role in social protection spending than debt relief programmes.

Evidence for the effects of the great recession on suicide rates

Twelve studies investigated the impact of the Great Recession on suicide rates^[17,23-27,30-33,38,41]. Ten studies^[17,23-27,30-33]

found evidence for an association between the recession and suicide rates, one study did not replicate such an association^[41] and another study reported mixed results^[38]. Europe and the United States were unsurprisingly the focus of this research effort and overall there does seem to be compelling country-level and international evidence from the studies included in this review that the Great Recession has had a significant impact on suicide rates in multiple countries. However, the findings from some studies have received different interpretations. For instance, the preliminary analysis of European suicide data by Stuckler *et al.*^[17] has been criticised for drawing premature spurious conclusions^[61,62]. The results of Barr *et al.*'s study from England^[23] have been partially contradicted by another study on suicide trends in England after the Great Recession^[41], which failed to find a statistically significant association between the onset of recession and suicide rates. These criticisms do not undermine the weight of the evidence in this area. Rather, they operate as a reminder that research in this area is highly complex and that the ecological study designs favoured by most of the included studies do not permit causal associations to be made.

In the light of this review, there are grounds to consider an association between economic recessions and increased suicide rates. However, various methodological differences between the study designs suggest caution in interpreting this finding. Moreover, the association between economic recession and suicide rates at a population level (as investigated by most of the included studies) provides little insight into the impact of economic recession on assessing suicide risk at an individual level. Since these studies have mostly been carried out in high and middle income Western and South-East Asian countries, future research in low income countries is needed, the recent 2007 recession period providing a good opportunity to conduct these studies. Also, multiple economic indicators should be used in order to better understand the underpinning of such a complex association. Overall, economic recession appears to lead to major socioeconomic changes at national levels which also may have an impact on suicide rates. In particular, these findings should become a focus of concern for researchers and policymakers in order to develop and implement specific suicide prevention strategies over these high-risk periods.

COMMENTS

Background

There exists a large body of literature that has investigated the relationship between economic recession and suicide across many different countries and time periods. Such studies have often proposed a sociological or economic framework for understanding how economic recession can influence suicide rates. In the years 2007 and 2008, the "Great Recession" occurred which was an economic recession of global proportions and was the most severe of its kind since the Great Depression of the 1930s. In light of this most recent recession, this review article seeks to provide a systematic update of the

research in this area as well as a more in-depth analysis of the strengths and limitations of individual articles.

Research frontiers

The current research hotspot is the synthesis of the academic literature concerning the interaction between the most recent recession of 2007 and suicide rates. This is an expanding area of inquiry. Future research frontiers will most likely include research into the interaction between economic recession and suicide in low and middle income countries, and individual level research into this interaction rather than population level. If more individual level analyses of the relationship between recession and suicide are produced, then future reviews will most likely focus on synthesising the results from these studies. If the heterogeneity across these studies is not an issue and these studies use similar designs and methodologies, it is at least conceivable that meta-analyses of individual level studies will be conducted; thus providing high level evidence of the individual experience of economic recession on suicide risk.

Innovations and breakthroughs

This review provides an up-to-date qualitative synthesis of the most recent published literature relating to the most recent recession as well as literature investigating past recessions. It is hoped that this will allow readers to compare the evidence from previous recessions to evidence pertaining to the most recent recession. The review is focused entirely upon suicide rather than on mental health or mortality more generally. A short critique of all included studies has been provided which highlight notable strengths and limitations as well as providing general insights. Issues concerning the measurement and definition of recession, the methodological issues that arise from this, and sources of bias are discussed in depth in this review. This review discusses the included studies in terms of broad study design categories whose relevance is explained. Crucially, this review surpasses previous reviews which have not taken account of the most recent evidence.

Applications

This review can be used to acquire a basic grounding in the research literature relating to the relationship between economic recession and suicide in the past few decades. It can also be used as a guide to specific published articles in this area as a short synopsis and critique is provided for each included study.

Terminology

Proccyclical variations in suicide mortality refers to increases in suicide mortality as an economy grows. Countercyclical variance reflects an increase in suicide rate when economic recession occurs. Gross Domestic Product refers to the total market value of goods and services produced by a nation state or region. The consumer price index measures the change in value of a specified group or "basket" of goods commonly purchased by consumers. The "Great Recession" refers to the most recent global recession that began in 2007. Active labour market programmes are government programmes which attempt to actively intervene in labour markets to assist the unemployed in finding and acquiring work.

Peer-review

This is a very nice manuscript. There is a thoughtful review of the literature and a balanced overview of the conclusions. It might be useful to have a few short line of critique on each of the 11 individual articles as well.

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