

# The effect of macroeconomic variables on suicide

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## ABSTRACT

**Background.** There are a large number of factors mediating suicide. Many studies have searched for a direct causal relationship between economic hardship and suicide, however, findings have been varied.

**Method.** Suicide data was obtained from the Australian Bureau of Statistics for the period between January 1968 and August 2002. These were correlated with a suite of macroeconomic data including housing loan interest rates, unemployment rates, days lost to industrial disputes, Consumer Price Index, gross domestic product, and the Consumer Sentiment Index.

**Results.** A total of 51 845 males and 16 327 females committed suicide between these dates. There were significant associations between suicide rates and eleven macroeconomic indicators for both genders in at least one age range. Data was divided into male and female and five age ranges and pooled ages. Analyses were conducted on these 132 datasets resulting in 80 significant findings. The data was generally stronger for indices measuring economic performance than indices measuring consumers' perceptions of the state of the economy. A striking difference between male and female trends was seen. Generally, male suicide rates increased with markers of economic adversity, while the opposite pattern was seen in females. There were significantly different patterns in age-stratified data, with for example higher housing loan interest rates having a positive association with suicide in younger people and a negative association in older age groups.

**Conclusion.** Macroeconomic trends are significantly associated with suicide. The patterns in males and females are very different, and there are further substantial age-related differences.

## INTRODUCTION

The incidence of suicide in Australia, and globally, is an important public health concern. No single risk factors or variable can comprehensively explain trends and patterns in suicide, rather the rate of suicide is determined by an interaction between many factors. Suicide rates differ markedly between nations and also change over time (WHO, 2004). To form an appreciation for changing trends in suicide, temporally and globally, it is necessary to take a multifactorial approach where every suicide is precipitated by the interaction of a mosaic of predisposing and precipitating risk factors.

Certain risk factors are clearly of greater significance than others. In particular the link between suicide and mental illness is of primary importance. However, the prevalence of mental illness and adequacy of treatment, falls short of fully explaining the various trends and fluctuation in the suicide rate (Bertolote *et al.* 2004). Also important are major life events, which include loss traumas, problems at work, legal problems, the breakdown of family or social relationships, substance abuse and personality factors (Heikkinen *et al.* 1992*a,b*; Mehlum, 1992; Marttunen *et al.* 1993; Beautrais *et al.* 1997). Other contributing factors which have been reported to influence the suicide rate have included environmental factors such as seasons (Partonen *et al.* 2004) and even type of government (Mann *et al.* 1999; Page *et al.* 2002*a*).

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The relationship between the economy and suicide has attracted academic interest since Emile Durkheim published *Le suicide* in 1897 (Durkheim, 1897). Social theorists have postulated that this relationship is not necessarily linear (Lester, 2001). Durkheim postulated that the suicide rate would increase during financial crashes and financial booms due to *anomie*, an unlimited and insatiable change in desires associated with the breakdown of the external restraints present during periods of economic stability (Lester & Yang, 1977). A close association between poverty and suicide was not found in a study of suicide in Britain from 1981 to 1992, however, this study did find that suicide was associated with social fragmentation (Whitley et al. 1999). Ferrada-Noli (1997), in a study of the 10 richest and 10 poorest municipalities in Sweden, demonstrated that the relative risk of suicide was 1.6 times greater in the low-income municipalities compared to the high-income municipalities. Turvey et al. (2002), in a rural community sample in Iowa, found that financial loss rather than low income was a significant correlate of suicidal ideation.

Several studies have documented that macroeconomic variables impact on the rate of suicide. A study of Finnish statistics from 1985 to 1995 reported that suicide in both genders increased during a 5-year period of increasing gross domestic product (GDP) and decreased during a period of decreasing GDP (Hintikka et al. 1999). No association was found between suicide and unemployment. In contrast, Blakely et al. (2003) used census information from New Zealand to suggest that unemployment was associated with a 2- to 3-fold increase in the relative risk of suicide. This was qualified by noting that mental illness is also strongly associated with unemployment. Lester (1996) found a strong correlation between *per capita* GDP and suicide rates ( $r=0.54$ ,  $p<0.001$ ) from international 1980 statistics.

Weyerer & Wiedenmann (1995) investigated economic factors and rates of suicide in Germany from 1881 to 1989, excluding the war years. The strongest correlations were increased suicide with increased unemployment and decreased real income. Weaker but significant correlations were found between increased suicide and increased frequency of bankruptcy and decreased economic growth. Suicides by

males and females did not differ in their relation to economic variables. Increased suicide rates followed economic indicators in the direction of increased economic stress.

Rancans et al. (2001) using statistics from Latvia from 1980 to 1998, found that a rapid increase in suicide which peaked in 1993, corresponded with the abrupt collapse in the GDP and rise of unemployment from 1990 to 1993, but while the suicide rate declined from 1993 to 1998 economic variables remained weak.

The economy may also exert an influence on the suicide rate by acting at multiple levels. Not only does economic change cause a change in the burden of the economy on an individual but also affects access to and quality of mental health care (Rogers & Pilgrim, 2003). Economic indices can be objective measures of economic performance or subjective measures where people are surveyed to measure their perception of economic conditions. In contrast to the studies examining objective measures, no association with suicide was found using data from national surveys of the subjective well-being of 55 nations (Lester, 1998). This study, however, did not simultaneously examine objective measures.

The study described here aims to clarify the relationship between suicide and the economy by investigating the relationship between suicide and a broad suite of objective and subjective macroeconomic variables, including the impact of age and gender on these variables. Statistical techniques were used to investigate the null hypotheses; (i) that there is no association between suicide and macroeconomic indices, and (ii) that if an association between suicide and macroeconomic indices does exist, there will be no difference in their association with suicide between subjective and objective indices of economic performance.

## MATERIALS AND METHOD

The date of event and gender of every person in Australia for whom the documented cause of death was suicide, from 1 January 1968 to 31 August 2002, was obtained from the Australian Bureau of Statistics. A total of 51 845 males and 16 327 females committed suicide between these dates. The data were stratified into age groups: 0–19, 20–34, 35–49, 50–64 and  $\geq 65$  years.

Quarterly indices of Australian economic performance were obtained from the Reserve Bank of Australia and included; GDP *per capita*, and Consumer Price Index (CPI). Annual indices were available for industrial disputes (all industries) measured as working days lost per 1000 employees, housing interest rates, and the unemployment rate.

Historical consumer sentiment data for Australia, the Westpac–Melbourne Institute Consumer Sentiment Index, was obtained from the Melbourne Institute of Applied Economic and Social Research, University of Melbourne. The Consumer Sentiment Index (CSI) was constructed as a combination of 10 responses to five questions on householders' views regarding their family finances and the state of the economy administered monthly as a stratified survey of residents across Australia. Responders expressed optimism or pessimism to component questions probing their (i) family finances *versus* 1 year ago, (ii) family finances over the next 12 months, (iii) economic conditions over the next 12 months, (iv) economic conditions over the next 5 years, and (v) whether it is a good or bad time to buy major household items.

The relationship between number of suicides (per 100 000) and economic indicators, calculated monthly, quarterly or annually, was assessed using regression techniques. Best-fitting models were derived by maximizing the coefficient of determination while minimizing the standard deviation and optimizing Mallows Cp. Although the number of suicides was slightly skewed in some cases, the residual analysis using regression techniques did not show any gross violations of assumptions. The coefficient of determination ( $R^2$ ),  $p$  value and slope ( $\beta$ ) were calculated.

## RESULTS

Between 1968 and 2001 male suicide rates have increased over time while female rates have decreased (Fig. 1).

### Economic performance measures

Results are presented for age-stratified and non-age-stratified data. Table 1 summarizes all analyses conducted in this study. All indices studied were reported.

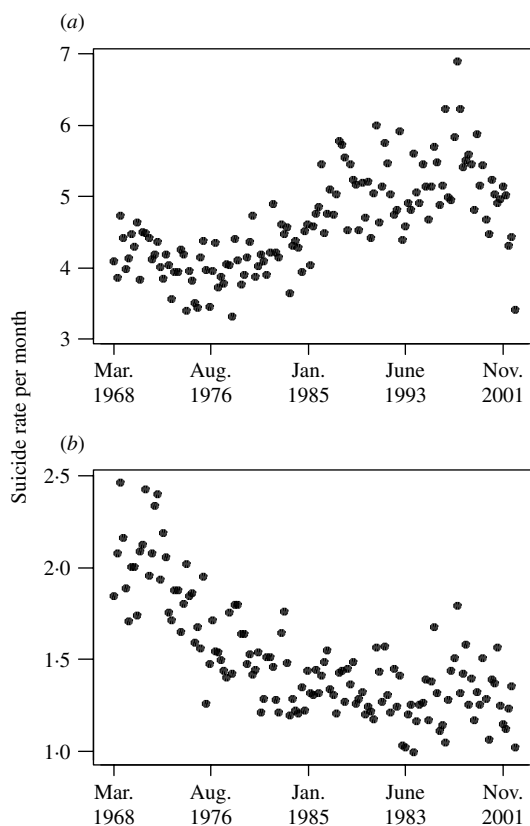


FIG. 1. Suicide rates for (a) males and (b) females from 1968 to 2001.

### Housing loan interest rates (annual)

Across all ages the suicide rate was significantly and positively associated with housing loan interest rates for males ( $R^2=0.17$ ,  $p=0.03$ ,  $\beta=0.30$ ) and significantly and negatively associated with housing loan interest rates for females ( $R^2=0.41$ ,  $p=0.00$ ,  $\beta=-0.25$ ) (Fig. 2).

The suicide rate for males was significantly and positively associated with housing loan interest rates in the age range 0–34 years. The effect size was strongest in the age range 20–34 years ( $R^2=0.26$ ,  $p=0.00$ ,  $\beta=0.95$ ). This association switched from positive to negative for the 35–49 years age group and remained significant. In the  $\geq 50$  years age group the association between suicide and housing interest rates was significant but not linear and displayed the highest suicide rate associated with the lowest level of interest.

Table 1. *The relationship between suicide and economic indices*

Suicide <i>versus</i> :	$R^2$ (0–19 yr)	$R^2$ (20–34 yr)	$R^2$ (35–49 yr)	$R^2$ (50–64 yr)	$R^2$ (≥ 65 yr)	$R^2$ (All ages)
Unemployment rate						
Male	0.45**	0.71**	N.S.	0.44**	0.31**	0.45**
Female	N.S.	0.48**	0.74**	0.72**	0.62**	0.79**
Working days lost						
Male	0.20*	0.42**	N.S.	N.S.	N.S.	0.44**
Female	N.S.	N.S.	0.23*	0.24*	0.22*	0.19*
Housing loan interest rates						
Male	0.38**	0.26**	0.21*	0.52*	0.40**	0.17*
Female	N.S.	0.28**	0.50**	0.43*	0.22*	0.41**
Consumer price index						
Male	0.14**	0.41**	0.10**	N.S.	0.06*	0.36**
Female	0.09**	N.S.	0.16**	0.29**	0.18**	0.11**
Gross domestic product						
Male	0.50**	0.74*	0.12**	0.14**	0.18**	0.64**
Female	0.12**	N.S.	0.59**	0.72**	0.36**	0.60**
Consumer Sentiment Index (CSI)						
Male	0.03**	N.S.	N.S.	N.S.	0.02*	0.02*
Female	N.S.	N.S.	N.S.	N.S.	0.03**	N.S.
CSI – buy major household items						
Male	0.06**	0.02*	N.S.	N.S.	0.01*	0.04**
Female	N.S.	N.S.	0.01*	N.S.	0.02*	N.S.
CSI – Economy next 5 years						
Male	0.06**	0.05**	N.S.	N.S.	0.02*	0.06**
Female	N.S.	N.S.	0.04**	0.02*	0.02*	N.S.
CSI – Economy next 12 months						
Male	N.S.	N.S.	N.S.	N.S.	0.01*	N.S.
Female	N.S.	N.S.	N.S.	0.02*	0.05**	0.03**
CSI – family finances next 12 months						
Male	N.S.	N.S.	N.S.	N.S.	0.03**	N.S.
Female	N.S.	N.S.	N.S.	0.02*	0.03**	0.01*
CSI – family finances <i>versus</i> 1 year ago						
Male	0.04**	0.05**	N.S.	N.S.	N.S.	0.07**
Female	N.S.	N.S.	0.08**	0.03**	N.S.	0.02*

Significance: \*  $p < 0.05$ , \*\*  $p < 0.005$ , N.S., not significant.

For females there was no significant relationship between suicide and housing loan interest rates in the age range 0–19 years. There was a significant and negative association for the 20–49 years age group. In the  $\geq 50$  years age group the association between suicide and housing interest rates was significant but not linear and the suicide rate remained the highest for the lowest level of housing interest.

#### *Unemployment rate (annual)*

Across all ages the suicide rate was significantly and positively associated with the unemployment rate for males ( $R^2 = 0.45$ ,  $p = 0.00$ ,  $\beta = 0.46$ ) and significantly and negatively associated with the unemployment rate for females ( $R^2 = 0.79$ ,  $p = 0.00$ ,  $\beta = -0.46$ ) (Fig. 2).

The suicide rate for males was significantly and positively associated with the unemployment rate in the age range 0–34 years. The effect size was strongest in the age range 20–34 years ( $R^2 = 0.71$ ,  $p = 0.00$ ,  $\beta = 1.49$ ), which may reflect the impact of high levels of youth unemployment in this age group. This association became a negative trend ( $p = 0.09$ ) for the 35–49 years age group. The association between suicide and the unemployment rate was negative and significant for the 50–64 years ( $R^2 = 0.44$ ,  $p = 0.00$ ,  $\beta = -0.61$ ) and  $\geq 65$  years age groups ( $R^2 = 0.31$ ,  $p = 0.00$ ,  $\beta = -0.66$ ).

The suicide rate for females was not significantly associated with the unemployment rate for the 0–19 years age group. There was a significant and negative association for age groups

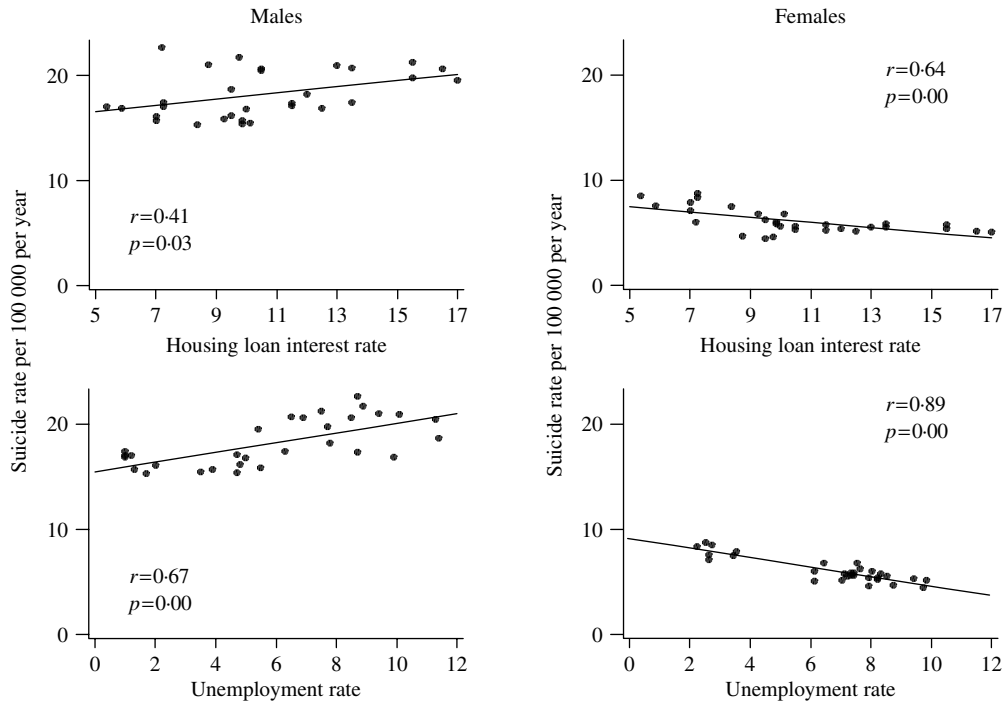


Fig. 2. Selected graphs of the association between the suicide rate and economic indices assessed using regression techniques. ●, Raw data; —, predicted.

20–34 years ( $R^2=0.48$ ,  $p=0.00$ ,  $\beta=-0.33$ ), 35–49 years ( $R^2=0.74$ ,  $p=0.00$ ,  $\beta=-1.12$ ), 50–64 years ( $R^2=0.72$ ,  $p=0.00$ ,  $\beta=-1.37$ ) and  $\geq 65$  years ( $R^2=0.62$ ,  $p=0.00$ ,  $\beta=-0.63$ ), in contrast to the pattern seen in males.

#### *Working days lost to industrial disputes (annual)*

Across all ages the suicide rate was significantly and negatively associated with the number of working days lost due to industrial disputes for males ( $R^2=0.44$ ,  $p=0.00$ ,  $\beta=-0.001$ ) and significantly and positively associated with the number of working days lost due to industrial disputes for females ( $R^2=0.19$ ,  $p=0.02$ ,  $\beta=0.0004$ ).

The suicide rate for males aged 0–34 years was significantly and negatively associated with the number of working days lost due to industrial disputes. The effect size was very small with  $\beta$  values of  $-0.0004$  and  $-0.003$  for males aged 0–19 years and 20–34 years respectively. The suicide rate for males aged  $\geq 35$  years was not significantly related to this variable.

The suicide rate for females aged 0–34 years was not significantly related to the number of working days lost due to industrial disputes. There was a significant and positive association between the suicide rate and the number of working days lost due to industrial disputes for females aged  $\geq 35$  years. The effect size was small with  $\beta$  values of 0.001 and 0.0007 for females aged 35–64 years and  $\geq 65$  years respectively.

#### *CPI (per quarter)*

Across all ages the suicide rate was significantly and negatively associated with an increase in the CPI for males ( $R^2=0.36$ ,  $p=0.00$ ,  $\beta=-0.10$ ) and significantly and positively associated with an increase in the CPI for females ( $R^2=0.11$ ,  $p=0.00$ ,  $\beta=0.02$ ).

The suicide rate for males aged 0–49 years and for females aged 0–19 years was significantly and negatively associated with an increase in the CPI. There was no significant relationship between the suicide rate and the CPI for males aged 50–64 years and for females

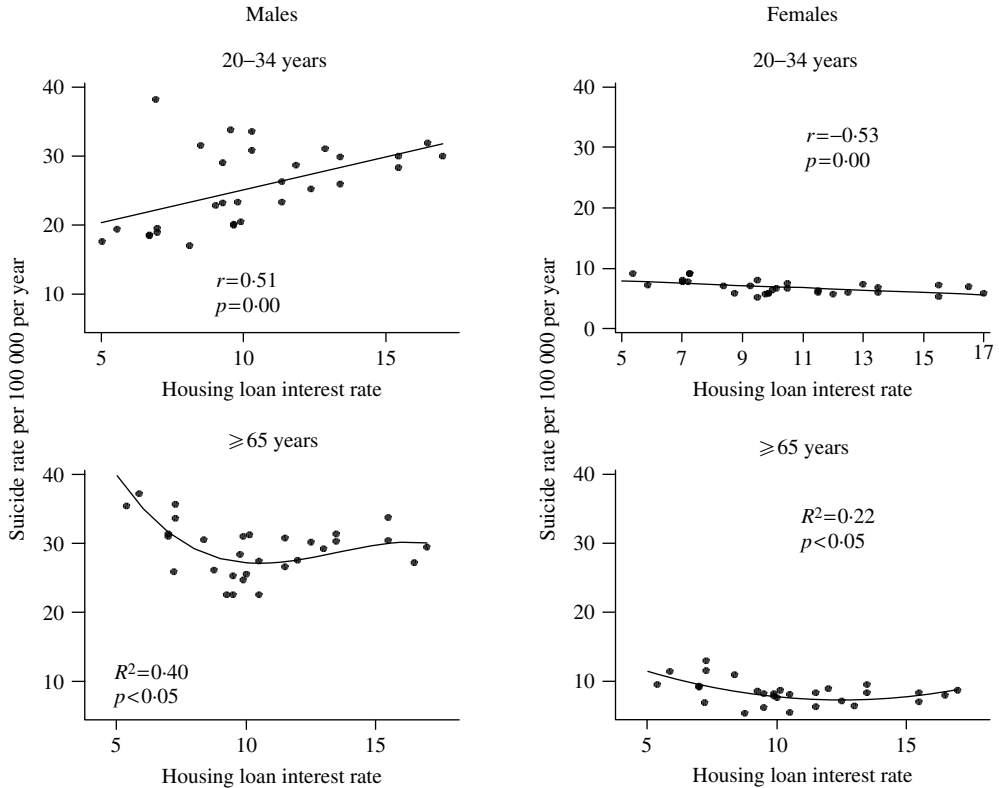


FIG. 3. Selected graphs demonstrating the association between age-stratified annual suicide rates (per 100 000 population) and housing loan interest rates for males and females assessed using regression techniques. ●, Raw data; —, predicted.

aged 20–34 years. The suicide rate for males aged  $\geq 65$  years and for females aged  $\geq 35$  years was significantly and positively associated with an increase in the CPI.

*GDP (per quarter)*

Across all ages the suicide rate was significantly associated with the GDP index for males and females and was nonlinear ( $p < 0.05$ ).

There was a significant nonlinear relationship between the suicide rate for males aged 0–34 years and for females aged 35–64 years and the GDP index. The suicide rate for males aged 35–49 years and for females aged 0–19 years was significantly and positively associated with an increase in the GDP index. The suicide rate for males aged  $\geq 50$  years and for females aged  $\geq 65$  years was significantly and negatively associated with an increase in the GDP index. The effect size in all age and gender ranges was, where significant, very small.

*CSI (per month)*

Across all ages the suicide rate was significantly and negatively associated with an increase in the CSI for males ( $R^2 = 0.02$ ,  $p = 0.01$ ,  $\beta = -0.003$ ) and was not significant for females ( $p = 0.44$ ).

There was a significant and negative association between suicide and an increase in the CSI for males aged 0–19 years and  $\geq 65$  years, for females aged  $\geq 65$  years and a negative trend ( $p = 0.09$ ) for males aged 19–34 years. The effect size in all age and gender ranges was, where significant, very small.

*Individual items of the CSI (per month)*

When analysed for individual items of the CSI significant associations were found for all items for both genders but not for all age ranges. Effect sizes in all age and gender ranges for all items were, where significant, small or very small.



## DISCUSSION

The results from the analyses do not support a null hypothesis of no association between suicide and economic indices. This significant relationship exists for suicides of males and females and for objective and subjective measures of economic performance. There was a significant association between suicide rates and 11 macroeconomic indicators for both genders in at least one age range. Data was divided into male and female and five age ranges and pooled ages. Analyses were conducted on these 132 datasets resulting in 80 significant findings. The effect of economic change is complex and varies considerably between gender and across age ranges.

Interestingly, the CSI, which is a more subjective measure of how people perceive the performance of the national economy, was not associated with the rate of suicide as strongly as the more objective measures of economic performance. Where significance ( $p < 0.05$ ) was achieved effect sizes were always small ( $-0.01 < \beta < 0.01$ ). For individual items of the CSI, effect size ranged from  $\beta = 0.04$ , for males aged  $\geq 65$  years when consumer sentiment suggested it was a good time to buy major household items, to  $\beta = 0.0011$ , for females of all ages when consumer sentiment suggested that family finances were better now than they were 1 year ago. In comparison effect sizes in males aged 20–34 years reached  $\beta = 1.49$  for increases in the unemployment rate and  $\beta = 0.95$  for increases in housing loan interest rates. This suggests that suicide rates may be influenced by economic reality rather than by people's perceptions of the economy.

### Trends in unstratified data

Gender differences are most striking in the data which has not been age stratified. In this data, males and females were often almost mirror opposites of each other. The relationship between an economic index and suicide rates was consistently of a similar level of significance and effect size for both genders. The economic indices that most consistently associated with the suicide rate in males are the unemployment rate, housing loan interest rates and GDP. Qin *et al.* (2000), using data on 811 suicides in a Danish database, found unemployment, low

wealth and low income to be associated with increased suicide risk in males ( $p < 0.05$ ) but not in females. Having a child  $< 2$  years old was associated with decreased suicide risk in women ( $p < 0.01$ ) but not men. Page *et al.* (2002b) analysed suicides in Australia from 1994 to 1998 and found that low socio-economic status was associated with an increased risk for suicide in males, but not in females.

### Age-stratified data

Significant age effects were seen in the data (Fig. 3). An example of this was the impact of the unemployment rate, which showed a positive relationship with suicide in younger males and a negative relationship in younger females and older males. An explanation for this would necessarily be speculative. The impact of higher unemployment on younger males may be operating via traditional role expectations. In females and older males a negative association between suicide and the unemployment rate was an unexpected finding and suggests that females and older males respond to economic hardship differently than younger males. In studies where the association between suicide and unemployment have been investigated using a different methodology, investigating the unemployed as a study cohort, unemployment has previously been associated with an increased risk of suicide (Blakely *et al.* 2003; Voss *et al.* 2004). While unemployed people may be more likely to commit suicide, periods of increased unemployment are only associated with increased suicide risk in young males in these reports. Many factors may possibly be operating in explaining the absence of this trend in females and older males, including differing role expectations, alternate sources of economic support as well as gender and age differences in social cohesion and resilience.

Taylor *et al.* (2004) using epidemiological data from Australia found a strong correlation ( $p < 0.001$ ) between attempting suicide and unemployment amongst both men and women aged 20–64 years. The relationship decreased but remained significant when data was adjusted for mental illness, country of birth and urban or rural residency. Lester (1990), using data from 31 nations, found that the ratio of male to female suicide rates was lower in older adults and higher in youths in nations with a high *per capita* GDP.

Higher housing interest rate was positively associated with suicide in younger individuals and negatively associated with suicide in older groups. Higher interest rates may adversely affect those younger individuals seeking entry to the housing market, while benefiting older individuals with capital delivering an interest-rate-related return. The reduction in the male suicide rate with working days lost due to industrial disputes may reflect empowerment due to industrial action, increased social cohesion during industrial action or, may be a proxy measure of other economic or social factors.

Duberstein *et al.* (2004), using a case-control design to study suicide among people aged  $\geq 50$  years, compared 86 suicides with 86 matched controls. Increased suicide risk was associated with perceived physical illness, family discord and employment change. In a study of suicide trends in England and Wales from 1950 to 1998, Gunnell *et al.* (2003) observed that suicide rates were rising in young men but falling in the elderly. Contributory factors were thought to include increasing divorce and substance misuse in the 25–34 years age group and a lower rise in antidepressant prescribing amongst young males than in older subjects. These observations suggest that differences in suicide trends between age strata can be attributed to age-specific differences in the impact of some factors, including economic variables, as well as differences between strata in the magnitude of some factors themselves.

In age-stratified data the results from the younger age groups suggest that an economic downturn is more precipitative of suicide in men than in women. Women more than men, in several age strata, demonstrated a significantly reduced risk of suicide as unemployment and housing interest rates increased. Speculative interpretations can be made on the finding that women and older men cope better in difficult economic times but are more likely to suicide during times that are associated with decreased economic burden. It is possible that the effect of macroeconomic variables on suicide operates more directly in males and more indirectly in females via proxy variables, such as family and social factors. This cannot be confirmed from the data, however, the data does demonstrate that there are substantial qualitative differences between women and men.

## CONCLUSION

The data in this paper supports the theory that suicide is precipitated by the interaction of a mosaic of factors, primarily ‘seed’ factors such as mental illness, then ‘soil’ factors such as major life events, but also by ‘climate’ factors, which include economic conditions. Low values for  $R^2$  and  $\beta$  for many factors suggest that the relationship between suicide and economic indices is, as expected, only one of many interacting factors. The impact of the economy can contribute towards an individual’s decision to attempt suicide, both positively and negatively. Economic impact varies considerably between genders and across age strata. A high level of significance was obtained for many of the economic indices.

## DECLARATION OF INTEREST

None.

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