

Cardiovascular mortality in Northern Ireland during the 2008-2014 financial crisis years: who got the worst hit?

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ABSTRACT

Background: Internationally, the relationship between cardiovascular mortality and economic recessions was quite established. Northern Ireland was badly affected by the global financial crisis in 2008-2014 but little is known about how cardiovascular mortality was affected.

Objective: The aim of the present study was to investigate the potential impact of the 2008 economic crisis on the annual cerebrovascular accidents CVA and ischaemic heart disease IHD mortality in Northern Ireland.

Method: Mortality data were extracted from Northern Ireland Statistics and Research Agency database. We utilized generalized linear regression Poisson modelling to estimate the impact of economic crisis on the annual IHD and CVA mortality.

Results: We found a significant rise in IHD-deaths during the financial crisis years in males over the age of 65 ($\beta = 49.466$, p value = 0.003) and females over the age of 65 ($\beta = 57.721$, p value = 0.001). However, CVA-mortality in the post-crisis years rose significantly for females who were 65 years or older ($\beta = 56.010$, p value = 0.005) but not for males. The rest of the age groups were not significantly affected in terms of either CVA or IHD mortality.

Conclusion: For the total population, over 65 was the only age category with significant increase in both IHD and CVA mortality in the post-2008 era (p values < 0.001 and = 0.012, respectively)

Key words: IHD, CVA, Northern Ireland, economic recession, working-age, socio-economic changes

INTRODUCTION

The 2008-2014 economic recession was one of the worst crises the post-WW2 world has experienced. Recent research confirmed its established negative effect on many mental and physical health parameters [1]. Evidence emerged to support a substantial increase in prevalence and incidence of cardiovascular and respiratory problems

during the periods of economic hardships [2]. However, data at the level of individual countries were occasionally not in agreement with the international literature [3,4]. The financial crisis effects on health parameters tend to vary geographically. This makes it hard to draw reliable conclusions about individual states or provinces. In Northern Ireland, to the best of our knowledge, little research explored the cardiovascular health effects of the

2008-2014 financial downturn.

A number of theories were proposed to explain this positive association between economic recession and cardiovascular mortality. During financial downturns jobs are lost, lifestyle behaviour worsens, and health system becomes less able to manage acute and chronic disorders [5]. Healthy diet consumption decreases during economic crisis [6]. Some studies indicated that a rise in unemployment can significantly affect cardiovascular mortality, specifically in males [5]. However, a recent investigation of the effects of short term unemployment on mortality across the EU indicated the contrary [7]. Such mixed findings were highlighted in earlier reviews [8]. Stress per se can considerably increase the risk of cardiovascular and respiratory conditions [9]. Reduction in governmental spending on health-care services can also cause a significant rise in mortality across all age groups [10]. Worse, cardiovascular disease costs tend to increase during recession periods [11]. Prescription costs are likely to escalate during the financial crisis, which hinders the ability of patients to adhere to health advice and recommendations [12].

Northern Ireland has endured substantial economic recession in the post-2008 period. The fiscal deficit has jumped to reach a peak of 35% of Gross domestic product GDP exceeding the Republic of Ireland and Greece's fiscal deficits. Although the GDP per capita has increased to reach almost £25000 in 2007, it dropped acutely over the following two years to plummet at £20000 [13]. Prior to 2008-2014 economic recession, the unemployment rate for males was falling consistently following the Good Friday agreement in 1996; a record low of 23500 persons unemployed was reported in August 2007. However, because of the economic crisis, unemployment in Northern Ireland soared again, to triple in 2012 (with 64800 persons unemployed) [13].

The aim of the present study was to investigate the potential impact of the 2008 economic crisis on the annual cerebrovascular accidents CVA and ischaemic heart disease IHD mortality in Northern Ireland. We hypothesize that CVA and IHD mortality rates did not change significantly during the 2008-2014 economic crisis years in Northern Ireland

METHODS

The Northern Ireland Statistics and Research Agency NISRA provides mortality data in Northern Ireland between 2001 and 2014 inclusive, to the public, on its website [14]. We contrasted the count of IHD and CVA deaths before and after the year 2008, taking into account any possible pre-existing trend of cardiac deaths, using a generalized linear Poisson regression approach. We adjusted for the population count by including an offset

term in the model representing the annual population estimate. Time in years was used as an explanatory variable, and the annual IHD or CVA deaths count as a response variable. The population was further divided according to gender and the same Poisson regression analysis was performed on each gender-related data. We further subdivided the population into working-age class (20 to 64 years old) and post-retirement age class (65 years and above) intervals to estimate the effect of the economic crisis on each age category. An indicator function that equals 0 before 2008 and 1 thereafter was included in the model in order to quantify the effect of the economic crisis. We also included an interaction term between the year and the crisis period. The statistical models we adopted were:

$$\ln(IHDdeaths_t) = \beta_0 + \beta_1 \times Year_t + \beta_2 \times Crisis + \beta_3 \times Year_t \times Crisis + \ln(Population_t) + \varepsilon_t$$

$$\ln(CVAdeaths_t) = \beta_0 + \beta_1 \times Year_t + \beta_2 \times Crisis + \beta_3 \times Year_t \times Crisis + \ln(Population_t) + \varepsilon_t$$

Here t is an index for the year, $Crisis$ is the dummy indicator that takes the value 1 during the 2008-2014 period and the value 0 otherwise, $Population$ is the specific population count during the specific year, β_0 , β_1 , β_2 , and β_3 are the coefficients to be estimated and ε_t is the error term. Ln is the natural logarithm.

We applied the Bonferroni correction penalty for multiple modelling; for the standard 5% level statistical significance a $P < 0.016$ is needed. Statistical investigation was accomplished using the R statistical package version 3.1.2.

RESULTS

Annual IHD death rates in Northern Ireland were falling consistently during the period 2001-2014 (Figures 1 and 2). A total of 31,060 deaths were caused by IHD during the 16-year study period. The average annual IHD deaths were 2,782 deaths/year prior to the economic crisis and 2,084 deaths/year afterwards.

Total population effect

The economic crisis coefficient in the model for total IHD mortality was $\beta = 23.686$ (SE = 11.0193); statistically not significant (p value = 0.032) (see table. 1). This suggests no evidence to support an effect for the economic crisis on the total rate of IHD deaths in the post-2008 period. In terms of the IHD mortality in the working class group (aged between 20 and 64 years), the coefficient for the effect of the economic crisis was also

FIGURE 1. The 2001-2014 annual IHD deaths in Northern Ireland

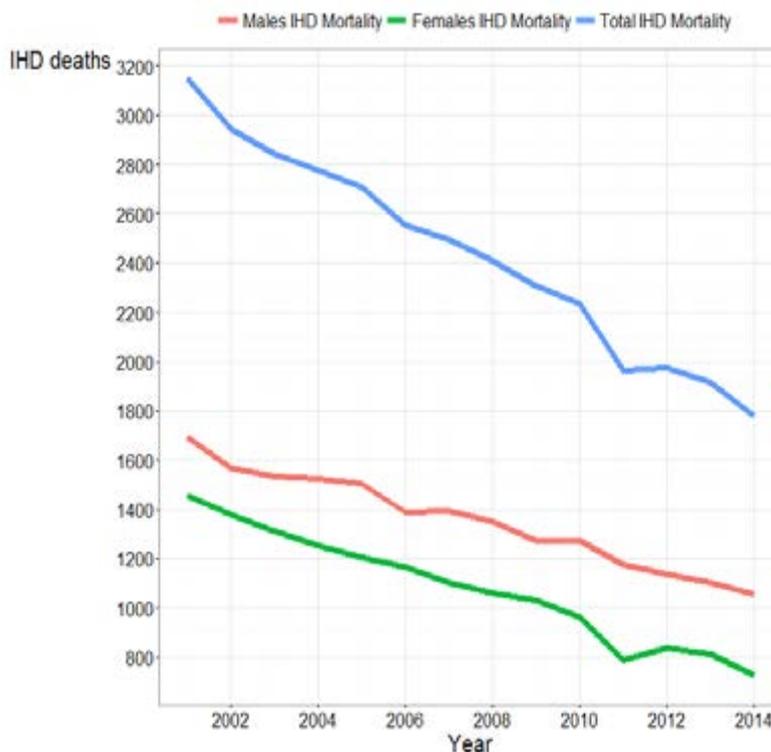


FIGURE 2. The 2001-2014 annual CVA deaths in Northern Ireland

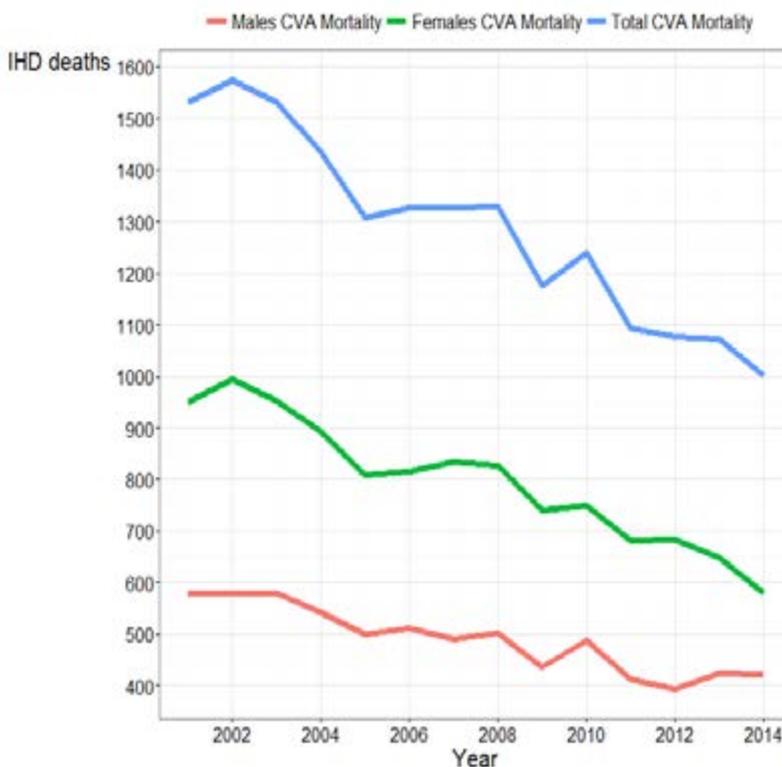


TABLE 1. The estimates for the effect of the 2008-2014 economic crisis on IHD and CVA mortality in Northern Ireland

IHD in the total population						
Age Group	Economic Crisis	Standard Error	P value	Year*Crisis Interaction	Standard Error	P value
Age 20-64	-6.964	28.156	0.805	0.003	0.014	0.809
Age 65+	52.494	11.977	< 0.001	-0.026	0.0045	< 0.001
All ages	23.686	11.019	0.032	-0.012	0.0055	0.032

CVA in the total population						
Age Group	Economic Crisis	Standard Error	P value	Year*Crisis Interaction	Standard Error	P value
Age 20-64	22.928	54.5295	0.74	-0.011	0.0272	0.676
Age 65+	39.642	15.700	0.012	-0.020	0.0078	0.012
All ages	15.273	15.081	0.311	0.008	0.0075	0.312

TABLE 2. The estimates for the effect of the 2008-2014 economic crisis on IHD and CVA mortality in Northern Ireland

IHD in the male population						
Age Group	Economic Crisis	Standard Error	P value	Year*Crisis Interaction	Standard Error	P value
Age 20-64	-16.224	31.662	0.608	0.008	0.0158	0.612
Age 65+	49.466	16.603	0.003	-0.025	0.0083	0.003
All ages	17.164	14.701	0.243	-0.009	0.007	0.243

CVA in the male population						
Age Group	Economic Crisis	Standard Error	P value	Year*Crisis Interaction	Standard Error	P value
Age 20-64	27.884	73.486	0.704	-0.014	0.037	0.705
Age 65+	10.249	25.880	0.692	-0.005	0.0129	0.692
All ages	-10.569	24.396	0.0665	0.005	0.0122	0.665

not significant ($\beta = -16.224$, p value = 0.608). However, a different picture emerged for the post-retirement group (aged 65 years and above). The estimate for the impact of the financial crisis was ($\beta = 52.494$, $SE = 11.977$). This was statistically significant (p value < 0.001).

In terms of the CVA-related mortality (see Table.1), the crisis coefficient in the model was $\beta = 15.273$ ($SE = 15.081$); also statistically not significant (p value = 0.312). No evidence in Northern Ireland data to support an effect for the economic crisis on the total rate of CVA deaths in the post-2008 period. In the working class group (aged between 20 and 64 years), the coefficient for the effect of the economic crisis was also not significant ($\beta = 22.928$, $SE = 54.5295$, p value = 0.674). For the post-retirement group (aged 65 years and above), however, the estimate for the impact of the financial crisis on CVA mortality was ($\beta = 39.642$, $SE = 15.6995$) and was statistically significant (p value = 0.012).

Male population effect

The crisis coefficient in the model for male IHD mortality (see table. 2) was $\beta = 17.164$ ($SE = 14.701$) obviously statistically not significant (p value = 0.243). In

terms of the IHD mortality in the working class group (aged between 20 and 64 years), the coefficient for the effect of the economic crisis was not significant ($\beta = -16.224$, p value = 0.608). However, for the post-retirement group (over 65), the estimate for the impact of the financial crisis was ($\beta = 49.466$, $SE = 16.603$). This was statistically significant (p value = 0.003).

The crisis coefficient in the model for male CVA mortality was $\beta = -10.569$ ($SE = 24.396$); statistically not significant (p value = 0.665). In terms of the CVA mortality in the working class group (aged between 20 and 64 years), the coefficient for the effect of the economic crisis was not significant ($\beta = 27.884$, $SE = 73.486$, p value = 0.704). For the post-retirement group (aged 65 years and above), also, the estimate for the impact of the financial crisis on CVA mortality was ($\beta = 10.249$, $SE = 25.880$). This was statistically not significant (p value = 0.692).

Female population effect

The crisis coefficient in the model for female IHD mortality (see table. 3) was $\beta = 34.344$ ($SE = 16.669$); statistically not significant (p value = 0.039). In terms of the IHD mortality in the working class group (aged

TABLE 3. The estimates for the effect of the 2008-2014 economic crisis on IHD and CVA mortality in Northern Ireland

IHD in the female population

Age Group	Economic Crisis	Standard Error	P value	Year* Crisis Interaction	Standard Error	P value
Age 20-64	25.506	61.621	0.679	-0.013	0.0235	0.677
Age 65+	57.721	17.316	0.001	-0.029	0.0086	0.001
All ages	34.344	16.669	0.039	-0.017	0.0083	0.039

CVA in the female population

Age Group	Economic Crisis	Standard Error	P value	Year* Crisis Interaction	Standard Error	P value
Age 20-64	26.498	81.683	0.746	-0.013	0.0407	0.747
Age 65+	56.010	19.752	0.005	0.068	0.0098	0.005
All ages	31.693	19.189	0.099	-0.016	0.0096	0.099

between 20 and 64 years), the coefficient for the effect of the economic crisis was not significant ($\beta = 25.506$, SE = 61.621, p value = 0.679). However, for the post-retirement group (over 65), the estimate for the impact of the financial crisis was ($\beta = 57.721$, SE = 17.316). This was statistically significant (p value = 0.001).

The crisis coefficient in the model for female CVA mortality was $\beta = -10.569$ (SE = 19.189); statistically not significant (p value = 0.099). In terms of the CVA mortality in the working class group (aged between 20 and 64 years), the coefficient for the effect of the economic crisis was not significant ($\beta = 26.498$, SE = 81.683, p value = 0.746). For the post-retirement group (aged 65 years and above), on the contrary, the estimate for the impact of the financial crisis on CVA mortality was ($\beta = 56.010$, SE = 19.752). This was statistically significant (p value = 0.005).

DISCUSSION

The results of our analysis indicated an overall, yet statistically insignificant, rise in the IHD and CVA mortality rates following the 2008 economic recession in Northern Ireland. This agreed with the research findings available from other countries [2]. Our findings may support the proposed link between psychosocial stress and risk of IHD and CVA [15,16]. This increase in mortality, however, was only statistically significant in the over 65 age group, specifically in females. As for males, the IHD mortality in the post-retirement age group was statistically significant, unlike the CVA mortality. In females, despite being statistically insignificant, the working-age group experienced an increase in both IHD and CVA mortality, whereas the same age group in males experienced a rise in CVA mortality, but a reduction in IHD mortality.

This differential effect in terms of IHD and CVA mortality amongst the over 65s could be explained by two major factors. First, it could be argued that the IHD and CVA mortality in older adults have been accelerated due to the effect of poorer health-care standards forced by the cuts in funding. Because of the frailty of this age

group any worsening in health standards would have a more detrimental effect. Frailty is a geriatric syndrome of muscle weakness, slowed performance, poor physical activity, fatigue and weight loss; commonly associated with old age [17]. Significant austerity measures were put in place in Northern Ireland in the post-2008 period, with inevitable substantial impact on health-care system. Day-to-day expenditure reductions were estimated to be around 8% in Northern Ireland [13]. This clearly opposes the recent recommendations that more spending on health could alleviate the recession-related adverse health effects [18,19]. Even in the absence of any economic downturns, older adults seem not to be in parallel with the overall noticeable baseline fall in terms of IHD mortality, compared to the working age group, even in high-income countries [20].

Second, the interplay of latent health variables and the observed poor health outcomes in the elderly has been complex and, hence, difficult to evaluate [21]. Older age as such was shown to be an independent risk factor for IHD [22]. It is also linked to the severity of the IHD condition [23]. Older adults, as per the findings of a recent UK-based study, were less likely to engage in physical activity; therefore they place themselves at an increased risk of cardiovascular disease [24]. It could also be argued that the significant increase in the over 65 mortality during the financial recession is an artefact of the higher sample size in this age group compared to the working age group.

It was clear that not only geographical location could explain the variability in such effect, but also the demographic class in terms of individual age-groups.

The findings of our study in connection with older adults in Northern Ireland provide further support to the significant impact the financial crisis could have on IHD and CVA mortality as established in past research.

A very important socio-economic factor in Northern Ireland is the legacy of the "Troubles" that have affected many public health aspects during the last three decades of the twentieth century. The years 1968 to 1998 witnessed over 35,000 shootings and over 16,000 bombings

occurring in Northern Ireland resulting in about 3,600 deaths and 47,000 people injured [25]. We argue that our results were minimally affected directly by the “troubles” as we have focused the analysis on the 2001-2014 mortality data.

Any interpretation to our findings based on the ecological design and the robust statistical modelling, should take into account one limitation. We relied on the reported and registered causes of death as well as included only mortality data. Further research should explore the incidence of IHD and CVA before and after the financial recession. To the best of our knowledge this is the first study to specifically assess the effect of the 2008-2014 economic recession on IHD and CVA mortality in Northern Ireland.

Authorship

MO and AO qualify for authorship. Both have participated sufficiently in the work and take public responsibility for the content. MO and AO certify that they take public responsibility for the content and provide any relevant data upon request. MO and AO have contributed substantially to conception and design or analysis and interpretation of the data, drafting or revision of content, and approval of the final version. MO and AO had no assistance from any persons who may qualify as author.

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