



BMJ Open Can changes in spending on health and social care explain the recent mortality trends in Scotland? A protocol for an observational study

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ABSTRACT

Introduction There have been steady reductions in mortality rates in the majority of high-income countries, including Scotland, since 1945. However, reductions in mortality rates have slowed down since 2012–2014 in these nations; and have reversed in some cases. Deaths among those aged 55+ explain a large amount of these changing mortality trends in Scotland. Increased pressures on health and social care services have been suggested as one factor explaining these changes. This paper outlines a protocol for the approach to testing the extent to which health and social care pressures can explain recent mortality trends in Scotland. Although a slower rate of mortality improvements have affected people of all ages, certain ages have been more negatively affected than the others. The current analyses will be run by age-band to test if the service pressure-mortality link varies across age-group.

Methods and analysis This will be an observational ecological study based on the Scottish population. The exposures of interest will be the absolute (primary outcome) and percentage (secondary outcome) change in real terms per capita spending on social and healthcare services between 2011 and 2017. The outcome of interest will be the absolute (primary outcome) and percentage (secondary outcome) change in age-standardised mortality rate between 2012 and 2018 for men and women separately. The units of analysis will be the 32 local authorities and the 14 territorial health boards. The analyses will be run for both all age-groups combined and for the following age bands: <1, 1–15, 16–44, 45–64, 65–74, 75–84 and 85+.

A series of descriptive analyses will summarise the distribution of health and social care expenditure and mortality trends between 2011 and 2018. Linear regression analysis will be used to investigate the direct association between health care spending and mortality rates.

Ethics and dissemination The data used in this study will be publicly available and aggregated and will not be individually identifiable; therefore, ethical committee approval is not needed. This work will not result in the creation of a new data set. On completion, the study will be stored within the National Health Service research governance system. All of the results will be published once they have been shared with partner agencies.

Strengths and limitations of this study

- The focus on a single healthcare system (ie, NHS Scotland) reduces the risk that factors other than spending explain differences in mortality change.
- The study is of substantial size and includes a large number of geographical units with different spending patterns and mortality trends.
- Information on spending and on mortality is complete and consistent across study areas.
- Because of its ecological design the study will not be able to provide strong causal evidence.
- Since the analyses are based on data between 2011 and 2018, the study will only generate information on short-term mortality responses to spending changes.

INTRODUCTION

Mortality trends

There have been steady reductions in mortality rates in high-income nations since 1945.^{1–3} However, from around 2012 these trends changed such that the reductions in mortality rates have slowed down and in some cases reversed. Among high-income nations, the USA and the UK were found to have experienced the smallest gains in life expectancy between 2010 and 2016 for both males and females.^{4,5}

Reduced rates of improvements in mortality rates were observed in all of the UK's nations between 2011 and 2016 (relative to 2006 and 2011).^{1,6} In Scotland, life expectancy gains began to slow down after 2012–2014. Between 2014–2016 and 2015–2017 Scottish life expectancy declined by 0.05 years for males and 0.06 years for females.⁷

Although the observed changes in mortality rates have affected the entire Scottish population these changes have not been experienced equally. Certain geographical areas and age groups experienced more dramatic

changes in mortality rates. First, regarding geographical areas, between 2014–2016 and 2015–2017 changes in life expectancy ranged by territorial Health Board from –0.8 to 0.3 years for males and from –1.0 to 1.2 years for females.⁸ Similarly, in 2015–2017 there was a gap in life expectancy across Local Authorities of 7.2 years for males and 5.0 years for females.⁸ This study will look at links between service pressures and mortality trends by both Scottish local authority and territorial health board.

Second, although all age groups have had a slower rate of mortality improvement since 2012 than in the previous period, certain age groups were more negatively affected than others. In Scotland, the greatest drop in the rate of improvement between (2012–2014 and 2015–2017) was found among those aged 55 to 84 years and mortality rates started to increase for both younger adults (35 to 50 years) and for those aged 90+ years.⁹ This was largely explained by an increase in mortality from drug-related deaths and dementia, respectively.⁹ Similar trends were observed overall for the UK where mortality rates for those aged 15 to 54 years increased and the rate of improvement for those aged 55 to 89 years slowed.⁶ Furthermore, the health and social care needs are high among older adults 65+ and are the highest for those aged 85+ as the prevalence of chronic and long-term health conditions increases with age.¹⁰ To compound this issue, more people in Scotland are projected to reach old age. For example, based on 2017 estimates those aged 65 to 74 and 75 and over will increase by 13% and 27%, respectively, by 2026.¹¹ Given these trends, this study will also investigate whether or not the associations between health and social care service pressures and mortality rates tend to increase at those ages that have greater health service needs and the most concerning mortality trends.

Many hypotheses have been suggested to explain the recent mortality trends. These include influenza, austerity and pressures on health and social care services. This paper describes our approach to investigating how financial pressures on health and social care services might explain the slowed rate of improvements in mortality rates in Scotland.

Increased health and social care pressures

In response to the financial crash of 2007 and the subsequent recession, many high-income countries including the UK responded with austerity policies; leading to cut-backs in many areas of public spending.^{12–14} Between 2010/2011 and 2014/2015 UK departmental spending was cut by 9.1%.¹⁵

Healthcare

While healthcare spending was relatively protected, one of the lowest periods of financial growth for the National Health Service (NHS) in the UK was between 2010/2011 and 2014/2015, with an annual growth of 1.1% per year; compared with the highest rate of growth at 8.9% between 2001/2002 and 2004/2005.¹⁶ Health spending trends varied across the UK. After adjusting for population

change, real per-capita spending across the UK nations between 2009/2010 and 2014/2015 increased the most in England (+2.7%) and decreased the most in Scotland (–2.1%).¹⁷

In order to appreciate the impact that funding cuts have on healthcare delivery they must be considered alongside other factors. For example, between 2010 and 2016, the NHS received an average of an additional 1.3% funding while demand pressures (ie, demographic changes and increased operational costs) are estimated to be increasing by about 3% annually.¹⁸ A further pressure to consider is that the annual cost of operating the NHS between 1985/1986 and 2010 increased by 4.7% which is above the economy-wide inflation rate of 3.1% per year, over this same period.¹⁸

Social care

Constraints were also placed on local authority (LA) spending on social work and social care services in the UK following the 2007 financial crash.¹⁵ Out of the four UK nations, the greatest cuts were made in England between 2012/2013 and 2014/2015; where per capita spending fell from approximately £320 to £295.^{16 19} Between 2009/2010 and 2014/2015 the amount of money spent by local authorities in England on adult social care was reduced from £16.3 to £14.6 billion.²⁰ There were smaller changes in per head spending in the other nations during this time, for example, from approximately £420 in 2012/2013 to £435 in 2014/2015 in Scotland.¹⁶ Further financial pressures have resulted from the introduction of the national living wage of £7.20 in April 2016, which increased annually and reached £8.21 in April 2019. The national living wage is estimated to result in costing the social care system an additional £1.6 billion by 2020.²¹

In addition to financial constraints, social care services across the UK are facing a number of other challenges. For example, significant demographic change is occurring in Scotland. It is estimated that between 2012 and 2037 the population of Scotland that is retired will increase by 27% compared with an increase of the working age population by 4%.²² This suggests a growing proportion of the population will be reliant on adult social care services while a decreasing proportion of the population will be of working age.

When financial pressures are coupled with an ageing population and associated increased demands, even an increase in social spending can result in a constrained social care system when it is surpassed by an increase in service demand.

Privatisation

Privatisation of health and social care services in the UK increased after the introduction of the Health and Social Care Act 2012.²³ This act altered how NHS provisions were regulated and purchased. Competition was considered to be positive as it could result in improved quality of care. Encouraging competition resulted in increased privatisation of services.²³

There are differences in the extent to which the NHS has privatised across the UK nations, with the English system being more exposed to private provision than the other nations. In 2018/2019, 7.3% (£9.2 billion) of the English health budget was spent on private health-care providers.²⁴ This may have increased costs without commensurate improvements in services.^{25 26}

Much of adult social care is privately funded. Privatisation of adult social care services has increased over the past four decades. In 1979, the percentage of nursing home beds that were provided by the local authority in England went from 64% in 1979 to 6% in 2012.^{8 27} In 2014/2015, 41% of elderly in England paid for all of their social care on their own.²⁰ A large proportion of adult social care is informally provided. The National Audit Office (NAO) estimated that the cost for informal care on adult social care services could be up to the equivalent of six times the public spending. In 2015/2016, public spending by LA on social care was £24.4 billion, with two-thirds (£16.4 billion) of this going to adult social care services.¹⁷ Based on the estimates from the NAO, informal care could be costing the public approximately £98.4 billion a year.

There is some evidence that increased privatisation of healthcare services is linked with reduced service provisions by NHS boards and increased inequalities by age and socioeconomic deprivation.²⁸ Increased privatisation of social care service provision has been linked with reduced social care service quality.^{29 30}

Health and social care financial pressures and mortality rates

Although this protocol is based on an analysis of Scottish data, it is worth highlighting that trends in healthcare expenditure vary by country. For example, in the WHO Europe region public-sector expenditure on health (as a percentage of GDP (grossdomestic product)) increased the most in the EU15 nations (European Union), followed by EU2004 countries, with the commonwealth of independent states (CIS) experiencing little to no increase between 1995 and 2014.³¹

A recent historical example that highlights the links between healthcare expenditure and health outcomes can be drawn from the former socialist's countries of Central and Eastern Europe. These states experienced substantial socioeconomic reforms following the collapse of the Soviet Union between 1989 and 1991, one of the many marked transformations resulted in a reformation of their healthcare systems.³² The majority of these post-soviet nations experienced growth in national healthcare expenditure. EU2004 accession nations experienced the greatest gains in healthcare expenditure between 1989 and 2012 (\$66 (PPP (purchasing power parity) per capita)) followed by the South-Eastern Europe (SEE) states (\$31) which was followed by the CIS (\$11). The EU2004 and the SEE states consequently benefitted from comparable gains in life expectancy at birth, at 0.22 and 0.21 years, respectively; despite the expenditure growth being greater in the former. On the other hand, the

CIS experienced a smaller increase in life expectancy (0.07 years). This is thought to be due to a combination of a lower increases in healthcare expenditure and the Russian mortality crisis.^{31–33}

There is more recent evidence that cuts to health and social care spending along with increased service demands and unmet need may partly explain the recent mortality trends in England.^{34–38} There was a notable spike in mortality rates in January of 2015. These coincided with a range of markers used to monitor NHS performance (calls to NHS 111, ambulance call out times, wait times, operation cancellations, staff absence rates, unfilled posts and delayed discharges) noticeably underperforming and falling below targets.³⁸ Further statistical analysis are required in order to infer any causal relationship between health and social care pressures and mortality rates as it is possible that a third factor (such as influenza) could have created both the increase in demand for services and the increase in mortality, without service pressures being a contributory factor.

The impact that cuts to public expenditure on health and public expenditure on social care had on mortality in England were estimated in a recent study.³⁶ The combined constraints on public spending on social and healthcare between 2010 and 2014 were found to be associated with just over 45 000 excess deaths compared with the 2010 estimates. These excess deaths were concentrated in the 60+ years age-group and in those living in care homes.³⁶

Further evidence for a link between healthcare spending and mortality rates comes from two studies which looked at the impact that differential healthcare spending had on inequalities in (amenable) mortality rates in England.^{34 35} These studies show that the observed periods of increased healthcare spending was associated with greater reductions in amenable mortality over time.

A few studies have investigated the health impact of social spending relative to healthcare spending. A larger ratio of social services to healthcare spending has been linked with better population health outcomes including life expectancy in a number of OECD (Organisation for Economic Co-operation and Development) countries.^{39–41} This suggests that social care funding has a relatively bigger impact on life expectancy than healthcare funding. This may be because social services help to address the social determinants of health.⁴¹ These studies also looked at the direct effect of social and healthcare spending on health outcomes. Higher social service expenditure was linked with a range of better population health outcomes including life expectancy, potentially avoidable mortality, cancer mortality and potential years of life lost.^{39–41} An increase in healthcare expenditure was linked with higher life expectancy and lower maternal mortality.⁴⁰

There are a number of limitations to these studies:^{39–41} they did not examine the association between trends in spending and mortality in Scotland and there was no consideration of the impact on mortality rates across different age groups. A composite measure of social

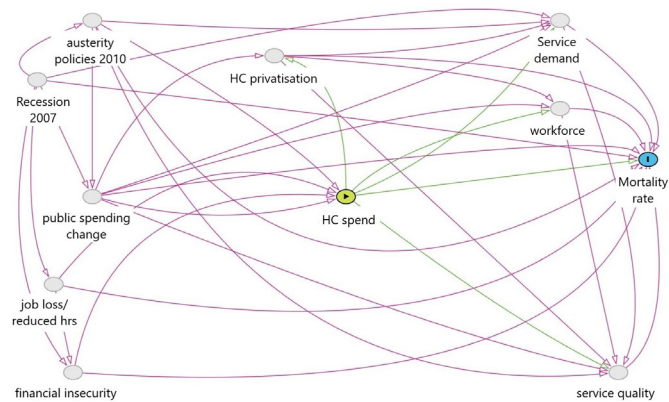


Figure 1 DAG depicting the theory of the associations between changes to healthcare spending and mortality rates along with potential mediators. DAG, directed acyclic graph; HC, healthcare; hrs, hours.

services was included in the studies by Dutton *et al* (2018) and Bradley *et al* (2011; 2016) which included a range of social services such as education, income support, public health and transportation in addition to social support services. The latter is the only social service of interest in the present study. An additional limitation of the cited studies is that they included countries which have models of health and social care funding which are different to the respective funding models that are used in Scotland, which is the country that is being investigated in this protocol.

Description of the theory to be tested

The proposed study will test the relationships between health and social care pressures and mortality rates that are mapped out in [figure 1](#) (healthcare) and [figure 2](#) (social care). The direct links between changes to spending on health services, by Health Board, and social care services, by Local Authority, and mortality rates will be tested. Since the trends of reduced improvements—and in some cases—increases in mortality rates in Scotland vary by sex⁹ the analyses will be run separately for males and females.

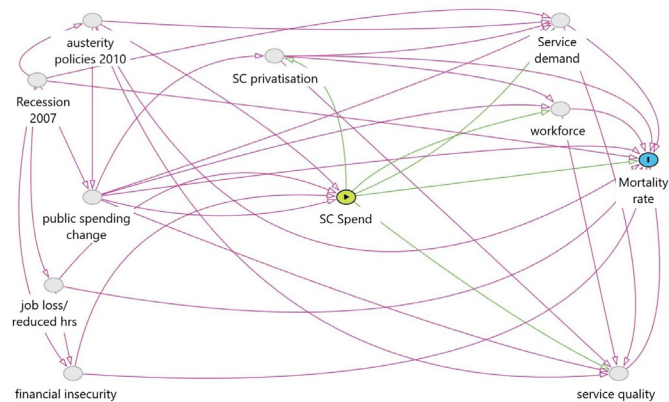


Figure 2 DAG depicting the theory of the associations between changes to social care spending and mortality rates along with potential mediators. DAG, directed acyclic graph; SC, social care; hrs, hours.

The analyses will test for these associations for both all age groups combined and by age band.

Between (2012–2014 and 2015–2017) the greatest falls in Scottish mortality rates were observed for the 55 to 84 age group. Increase in mortality rates were also witnessed during this period for the 30 to 54 and the 90+ age groups. To test if these respective changes in mortality trends coincide with a stronger association with health and social care service expenditure, the current analyses will be based around the following age groups: <1, 1–15, 16–44, 45–64, 65–74, 75–84 and 85+.

There are a number of factors that potentially—either wholly or partially—mediate the association between spending and mortality rates (ie, whole time equivalent workforce, service demand, service quality and privatisation) included in the directed acyclic graphs (DAGs) in [figures 1 and 2](#) which will not be tested in the present study. Adjusting for potential mediators introduces the risk of a range of statistical biases. One such bias is the collider bias. This bias occurs when adjustment is made for a mediator that is caused by an unobserved factor which also influences the outcome of interest, these are referred to as mediator-outcome confounders. A collider bias could obscure the estimated effect of the exposure on the outcome by artefactually modifying the size and/or direction of the estimated association.⁴² Future studies could investigate causal links between these factors and mortality rates. It would be particularly valuable to include measures of health and social care privatisation in any future study that investigates the links between health and social care funding and mortality in England due to its high rate of privatisation.²⁴

These hypotheses could be closely linked to the other hypotheses which have not been included in the DAG to avoid further complexity within the DAG. For example, influenza, obesity and mental illness could also increase the demand for the services to create additional pressures.

Aim

To measure the impact that health and social care service pressures have on the changes in trends in mortality rates across health boards and local authorities in Scotland.

Research questions

The following research questions will be answered:

1. Is a lower rate of increase in healthcare spending across health board associated with more adverse mortality trends in Scotland?
 - a. Does the size of this association increase at those ages which experienced both the greatest reduction and increases in mortality rates and have greater healthcare needs?
 - b. Is the association different for males and females?
2. Is a lower rate of increase in social care spending across local authority associated with more adverse mortality trends in Scotland?
 - a. Does the size of this association increase at those ages which experienced both the greatest reduction

and increases in mortality rates and have greater social care needs?

b. Is the association different for males and females?

These research questions will be stated as the following hypotheses, which will be tested with single-tailed t-tests.

1. A lower rate of increase in healthcare spending across health board is associated with poorer subsequent mortality outcomes in Scotland.
 - a. The size of this association increases at those ages which experienced both the greatest reductions and increases in mortality rates and have greater healthcare needs.
 - b. This association varies by sex.
2. A lower rate of increase in social care spending across local authority is associated with poorer mortality outcomes in Scotland
 - a. The size of this association increases at those ages which experienced both the greatest reductions and increases in mortality rates and have greater social care needs.
 - b. This association varies by sex.

METHODS AND ANALYSIS

Design

An observational ecological study design will be used.

Populations and settings

The study will include the population of Scotland. The unit of analysis will be either local authority or health board, depending on whether the focus is on social care or healthcare pressures, respectively.^{34 35} There are 14 territorial NHS Health Boards in Scotland. The size of health boards range from a population of 22 000 to 1 169 000. Territorial health boards are responsible for protecting and improving their population's health and for the provision of frontline medical services. There are 32 Local Authorities in Scotland which range in size from 22 000 to 621 020 people. Local authorities provide a range of public services including social care, education, housing, transportation and economic development.

Measures

Exposure variables: service pressures

The indicators of health and social care pressures that will be included in this study to test the above hypotheses are outlined below.

Healthcare

The indicators of healthcare service pressures will be the absolute (primary) and percentage (secondary) change in real terms total per capita net expenditure by NHS territorial Health Board. This information is available in ISD's (Information Services Division) R300 Cost Book. The absolute and percentage change in healthcare spending by health board from 2011 to 2017 will be calculated and included as a predictor variable. Population estimates for the territorial health boards are available from ISD.

Social care

The indicators of social care service pressures will be the absolute (primary) and percentage (secondary) change in real terms per capita net revenue expenditure on social care services by Local Authority.⁴³ This data is available from the Scottish Government in the LFR03 (Local Financial Return) file. The LFR only includes social care expenditure by local authority and does not include expenditure via NHS resource transfers. Consistent with the Integrated Resource Framework—which has been developed by the Scottish Government, NHS and the Convention of Scottish Local Authorities to help monitor the cost of local decision-making about health and social care—the expenditure summaries included in this study will exclude the following LFR columns: service strategy, children's panel, children and families and criminal justice social work services. The change in spending on social care services between 2011 and 2017 will be included. Population estimates for local authorities are available from ISD.

To calculate the absolute difference in real terms health and social care expenditure between 2010/2011 and 2016/2017, the GDP deflator factor of 1.10 from the latter was applied to the former. The GDP deflation factor for the financial year are produced by the Treasury at the UK government with data provided by the office for National Statistics and the Office for Budget Responsibility.⁴⁴ Consistent with ISD methodology the June deflator value will be used.

Outcome variable: mortality

Mortality data will be derived from National Records of Scotland. Mortality estimates from 2012, which was the break point for mortality trends in Scotland,¹ up until the most recently available mortality estimates will be analysed across health board and local authority, were appropriate. Age-standardised mortality rates (ASMRs) as well as age-sex-standardised mortality will be calculated using the 2013 European Standard Population. Mortality data will be available for males and females separately. The outcome data will be annualised.

1. The absolute (primary outcome) and percentage (secondary outcome) change in ASMR will be estimated for each of the 14 territorial NHS Health Boards in Scotland between 2012 and 2018.
 - a. One analysis will look at the whole population and another analysis will group the population into the following age groups: <1, 1–15, 16–29, 30–54, 55–69, 70–84 and 85+.
2. The absolute (primary outcome) and percentage (secondary outcome) change in ASMR will be estimated for each of the 32 Local Authorities in Scotland between 2012 and 2018.
 - a. One analysis will look at the whole population and another analysis will group the population into the following age groups: <1, 1–15, 16–29, 30–54, 55–69, 70–84 and 85+.



Patient and public involvement

No patient involved.

Analytical approach

Exposure data are financial year and outcome data are calendar year. Our primary analyses will use a 9-month lag such that change in exposure between 2011/2012 and 2016/2017 will be compared with change in outcome between 2012 and 2018. A sensitivity analysis will then be performed with a shorter and longer lag time period, for the whole population.

Descriptive

A series of descriptive analyses will summarise the distribution of health and social care expenditure and mortality trends, between 2011 and 2018 for each health board and local authority, respectively.

Statistical

Population-weighted linear regression analysis will be used to investigate the direct association between a change in healthcare spending and mortality rates by health board and between a change in social care spending and mortality rates by Local Authority between 2011 and 2018.

ETHICS AND DISSEMINATION

The data used in this study will be publicly available and aggregated and will not be individually identifiable; therefore, ethical committee approval is not needed. This work will not result in the creation of a new data set. On completion, the study will be stored within the NHS research governance system. All of the results will be published once they have been shared with partner agencies.

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Contributors CW: substantial contributions to the conception and design of the work; drafting the work; contributed to the final approval of the version to be published; agreed to be accountable for all aspects of their work. JM: substantial contributions to the conception and design of the work; revising the work critically for important intellectual content; contributed to the final approval of the version to be published; agreed to be accountable for all aspects of their work. RM: substantial contributions to the conception and design of the work; revising the work critically for important intellectual content; contributed to the final approval of the version to be published; agreed to be accountable for all aspects of their work. GMAW: substantial contributions to the conception and design of the work; revising the work critically for important intellectual content; contributed to the final approval of the version to be published; agreed to be accountable for all aspects of their work. CC: substantial contributions to the acquisition of data; revising the work critically for important intellectual content; contributed to the final approval of the version to be published; agreed to be accountable for all aspects of their work. GM: substantial contributions to the conception and design of the work; revising the work critically for important intellectual content; contributed to the final approval of the version to be published; agreed to be accountable for all aspects of their work.

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