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The effect of income-based policies on mortality inequalities in Scotland: a modelling study

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Abstract

The unequal distribution of income is a fundamental determinant of health inequalities. Decision making around economic policies could be enhanced by showing their potential health effects. We used scenario modelling to assess the effects of 12 income-based policies on Years of Life Lost (YLL) and inequalities in YLL in Scotland. EUROMOD, a tax-benefit microsimulation model, was used to estimate the effects of hypothetical fiscal policies on income for Scottish households (n=2871; 2014/15 Family Resources Survey). Income change was estimated for each quintile of the 2016 Scottish Index of Multiple Deprivation. 'Triple I', a health inequalities scenario modelling tool, was used to estimate policy effects on YLL and government spending after 5 years. The best policy for improving health and narrowing health inequalities was a 50% increase to means-tested benefits rates (approximately 105,177 or 4·7% YLL fewer than the baseline scenario, and a 7·9% reduction in relative index of inequality (RII)). Citizen's Basic Income (CBI) schemes also substantially narrowed inequalities (3·7% RII for basic scheme, 5·9% for CBI with additional payments for disabled individuals), and modestly reduced YLL (0·7% and 1·4%, respectively). The most effective policies for reducing health inequalities appeared to be those that disproportionately increased incomes in the most deprived areas.

JEL: D31, I14, I38

Keywords: income distribution; health inequalities; multiple deprivation; Scotland

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The results presented here are based on EUROMOD version H1.0+. EUROMOD is maintained, developed and managed jointly by the Institute for Social and Economic Research (ISER) at the University of Essex and the Joint Research Centre of the European Commission, in collaboration with national teams from the EU member states. We are indebted to the many people who have contributed to the development of EUROMOD. The process of extending and updating EUROMOD is financially supported by the European Union Programme for Employment and Social Innovation 'Easi' (2014-2020). We make use of microdata from the Family Resources Survey for the UK made available by the Department of Work and Pensions via the UK Data Service. The results and their interpretation are the authors' responsibility.

INTRODUCTION

Health inequalities (or health inequities in the North American literature) are the unjust and avoidable differences in people's health across the population and between specific population groups.[1] Whilst there have been substantial improvements in health over the past 30 years across Europe, these gains have been unequally distributed across society, leading to a widening in relative health inequalities in many European countries.[2] Within the UK, Scotland experiences both higher rates of mortality, and higher levels of absolute and relative health inequality, than other constituent countries.[3]

The pathways that contribute to health inequalities are complex. The fundamental causes, however, are the unequal distribution of power, income, and wealth across society.[4] Income is strongly associated with health outcomes at national, neighbourhood, and household level.[5] A range of material, social, and psychological mechanisms have been proposed to explain how absolute and relative income levels affect health. Income provides the means to access goods and services that support healthy living, such as diet, good housing, and leisure activities.[6] Income is also an expression of socioeconomic position more generally. Inequality in income is well recognised as a determinant of health inequality at population level, with stress incurred through relative social position and reduced social cohesion a proposed causal mechanism.[7]

Reducing health inequalities is recognised by the Scottish Government as a critical part of achieving their aim to make Scotland a better, healthier place for everyone.[8] The importance of social and economic factors as drivers of health inequality has been increasingly incorporated in UK policies.[9] The actions pursued to improve health and tackle inequality have, however, frequently focused on interventions which seek to alter behaviour at the individual level.[9,10] This 'lifestyle drift'[11] in policy to narrow health inequalities – from structural to individual/behavioural interventions – has been, in part, attributed to the desire to demonstrate that policies are evidence-based, and the wider availability of evaluation evidence for individual-level interventions than for more complex structural interventions.[10] However, various taxation and welfare powers have recently been devolved from the UK to Scotland, under the Scotland Act 2016, providing new opportunities to influence more 'upstream' determinants of health.

Modelling offers the opportunity to explore the effects of policy interventions without implementation. This approach therefore offers one mechanism by which to address the evidence gap when considering 'upstream' policies to address health inequalities. Furthermore, research has found that policy-makers find such modelling evidence particularly powerful in opening discussions and guiding decision-making.[12] Communicating such evidence through modelled outcomes provides a means by which to move discussion of the social determinants health from abstract ideas within policy documents, towards concrete decisions for political and societal discussion.

The Informing Interventions to reduce health Inequalities ('Triple I') scenario modelling approach estimates the impacts on health and health inequalities of a range of interventions.[13] In consulting with stakeholders ahead of updating and extending the earlier Triple I work we found strong and consistent demand for including interventions that influence the social determinants of health, to counter lifestyle drift in evidence and policy. This is in keeping with the desire expressed in the public health priorities for Scotland to "venture upstream and fix them [health inequalities] at source".[14]

In this paper we compare the effects of different policy approaches to altering household income in Scotland on Years of Life Lost (YLL) (a population-level sum of the estimated number of years a person would have lived if they had not died) and inequalities in YLL. YLL is a measure of premature mortality that gives greater weight to deaths at younger ages. Our aim is to provide decision-makers with comparative information about the effectiveness of different policies.

METHODS

The income-based policies

We considered a range of fiscal policies that would affect household income and categorised them as either taxation-based, benefits-based, or 'novel' (Table 1). These were selected to represent a range of existing and potential future options, with varying levels of current practical and political feasibility. The 50% increase in means-tested benefits policy, for example, was designed to bring the incomes of recipient households up to a minimum level for healthy living.[15] Some of the policies could be introduced in Scotland within existing devolved powers, whereas others would require UK-wide implementation.

Policy effects on household incomes

We modelled the effect of each policy on the incomes (before housing costs) of a sample of Scottish households (n = 2,871) in the 2014/15 Family Resources Survey (FRS).[16] The FRS is a cross-sectional household survey based on a two-stage stratified clustered probability sample of private households. We used EUROMOD version H1.0+,[17] a detailed tax-benefit microsimulation model developed by the Institute for Social and Economic Research at the University of Essex that enables researchers and policy analysts to estimate the effects of taxes and benefits on household income and work incentives. We ran the models for the year 2016, with monetary values uprated accordingly, and benefit uptake rates from the Department for Work and Pensions (DWP) and Her Majesty's Revenue and Customs (HMRC). How EUROMOD models the UK economy is described fully by de Agostini (2017).[18] We equivalised the household incomes using the Organisation for Economic Co-operation and Development (OECD) modified equivalence scale,[19] so that they could be compared between households of differing sizes and compositions.

Table 1. Description of the income-based policies.

	Policy description
Taxation-based policies	
Income Tax[a] +1p†	Income Tax rates increased by 1p (to 21p basic rate, 41p higher rate, and 46p additional rate).
Income Tax -1p†	Income Tax rates decreased by 1p (to 19p basic rate, 39p higher rate, and 44p additional rate).
Personal Allowance +£1,000	Income Tax tax-free Personal Allowance (PA) increased from £11,000 to £12,000.
Personal Allowance -£1,000	PA decreased from £11,000 to £10,000.
Council Tax[b] increase†	Council Tax increased for mid- to high-value properties: band E +7·5%, band F +12·5%, band G +17·5%, and band H +22·5%.
Benefits-based policies	
Means-tested benefits +50%	50% increase in benefits paid to those who pass an income test. See Supplementary Appendix A for the benefits and increased rates.
Devolved benefits +50%†	50% increase in six benefits devolved to the Scottish Government. See Supplementary Appendix B for the benefits and increased rates.
Novel policies	
Citizen's Basic Income	Introduction of Citizen's Basic Income (CBI): an income from the state received by every citizen, not dependent on need. Most benefits would be removed, as well as the PA. Income Tax rates and National Insurance Contributions modified to recoup most of the cost. See Supplementary Appendix C for further details.
Citizen's Basic Income Plus	Introduction of CBI with additional payments for disabled adults. See Supplementary Appendix C for further details.
Local Income Tax†	Council Tax removed, and all Income Tax rates increased by 3p.
Real Living Wage	Mandatory payment of the 'real' living wage to all employees (calculated as £8·25 per hour for 2016/17 by the Living Wage Foundation based on living costs).
Benefit uptake +1%†	A 1% increase in the number of claimants of means-tested benefits, which may arise from wider availability of income-maximisation advice services, for example. The increased uptake rates are given in Supplementary Appendix D.

[a] Income Tax is a tax levied directly on personal income. The 2016 Income Tax structure was used in the analysis.

[b] Council Tax is a tax levied on households by local authorities, based on the estimated value of a property and the number of people living in it. The 2016 Council Tax rates were used in the analysis.

† These policies could be introduced in Scotland with existing devolved powers.

National-level results for Scotland were produced using weights that accounted for differential non-response to the FRS.[18] Lower than average response rates were observed for single occupants, lone parents, couples with non-dependent children, households in purpose-built flats or maisonettes, household who owned their house outright and households with self-employed or unemployed heads. For each policy we estimated average household income change from baseline (no policy) for each quintile of the 2016 Scottish Index of Multiple Deprivation (SIMD), using FRS data that were linked to SIMD quintiles for us by the DWP. All data processing was conducted using Stata/SE version 13.1.

Effect of household income change on mortality

To estimate how each policy would affect mortality rates we sought evidence for the relationship between income change and all-cause mortality. There is good evidence that a change in income is associated with a change in self-reported health in the same direction, but currently an absence of evidence of the impact of income change on mortality.[20] The existence of a strong cross-sectional relationship between income and mortality has been established,[5] and has been used in studies to estimate the effects of policies that would change household incomes.[21]

We therefore used a regression analysis of cross-sectional data to estimate the relationship for Scotland. We used logarithmic transformations to linearize the relationship, on the assumption that a proportional change in income is likely to have a proportional effect on mortality. Log_2 transformation was chosen for income for ease of interpretation, such that the exponentiated coefficient would give the change in mortality for a doubling of income. We regressed log_e-transformed all-cause mortality rates (European age-standardised rates (EASRs), calculated using 2016 data from National Records of Scotland (NRS) and the European Standard Population 2013) on log_2-transformed mean equivalised household income (before housing costs, values uprated to 2016 from FRS 2014/15), for SIMD 2016 quintiles (Supplementary Appendix E). A plot of the transformed values approximated a linear trend. For a doubling of household income the regression predicted a mortality rate ratio of 0·454. We applied this estimated effect to the income changes estimated for each SIMD quintile in EUROMOD to predict each policy's effect on mortality rates for that quintile. The greatest uncertainties in our models relate to the assumptions in the effect sizes rather than due to any sampling issues. We therefore tested the sensitivity of the results to the strength of this relationship by reducing the effect size by 25% and 50% (mortality rate ratios of 0.590 and 0.727, respectively).

Policy effects on YLL

Effects of the policies on YLL were estimated using the Triple I modelling spreadsheet tool (Microsoft Excel-based) that we developed for these and other interventions (http://www.healthscotland.scot/triplei). The Triple I model is described in detail elsewhere,[22] but in short it models policy effects on a closed cohort (Scottish adult population in 2016), and policy effects are assumed to be immediate and constant over time. Population estimates for the closed cohort – by sex, five-year age group, and SIMD quintile – were obtained from NRS. All-cause mortality rates for the subgroups were estimated using NRS mortality data

(2002-2016) and a parametric survival model (exponential distribution), giving the following formula:

$$\text{Rate} = e^{(38{\cdot}37 + 0{\cdot}09*\text{age} + 1{\cdot}05*\text{male} - 0{\cdot}01*\text{age}*\text{male} - 0{\cdot}02*\text{year} + 0{\cdot}57*\text{Q1} + 0{\cdot}21*\text{Q2} - 0{\cdot}23*\text{Q4} - 0{\cdot}54*\text{Q5})}$$

where Q1-5 were SIMD quintiles, age was mean age of the age group in years, and SIMD Q3 and female were reference categories. For each year of follow up, deaths in the absence of the policy (baseline scenario) were estimated using the rate predicted by the formula. For the policy scenario the predicted effect of the policy on the mortality rate, by SIMD quintile, was used to adjust the baseline rate before estimating numbers of deaths. For each scenario YLL were calculated for each age group as the difference between their age at death and their age- and sex-specific life expectancy, multiplied by the number of deaths. We estimated the difference in YLL and inequalities in YLL between each policy and the baseline scenario, after five years of implementation. Five years was selected as this corresponds approximately to local and national planning cycles. Inequalities were measured using the Relative Index of Inequality (RII): a linear regression-based index that takes into account differences across the whole gradient of inequality, not just the gap in health outcome between the most and least deprived.[23]

Policy costs

The implications for government expenditure were estimated from the EUROMOD output for each policy. The net cost of each policy was calculated relative to the baseline (no policy) scenario. The calculation accounted for changes in revenue from taxes and National Insurance contributions, and balanced these against changes in expenditure on benefits. However, the calculation excluded health-related costs such as lost productivity and associated tax revenue, as well as healthcare costs. In the absence of data required to perform a more comprehensive health economics analysis these figures are intended to provide a comparative guide for policymakers about the policy options.

Role of the funding source

All authors are employees of the NHS and carried this work out as part of their normal working duties, forming part of the ongoing work programme to investigate recent mortality trends. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

RESULTS

We estimated that the taxation-based policies considered could result in small changes to household incomes that differed little between the most and least deprived areas (Figure 1, and Supplementary Appendix F). Indeed, policies involving lower levels of taxation could benefit those in less deprived areas more than those in more deprived areas. The benefits-based policies could have disproportionate effects across the deprivation gradient, resulting in large

income increases for the most deprived areas and modest increases for the least deprived. Of the novel policies, Local Income Tax could have the most even effect across the quintiles. The other novel policies disproportionately increased incomes for those in more deprived areas, and the two CBI policies reduced incomes in less deprived areas.

In the baseline scenario, with no changes to taxation or benefits, we estimated 2·2 million YLL over the 5 years. YLL would be 66% lower in the least deprived areas (5,905 YLL per 100,000 per year) than in the most deprived areas (17,236 YLL per 100,000 per year). The RII for the baseline scenario would be 1·25, meaning that the range between the most and least deprived is approximately 1·25 times the population average YLL rate (10,673 YLL per 100,000 per year), or 13,341, and the rate increases by 13,341/5 = 2,668 YLL per 100,000 per year with each increasing deprivation quintile.

Increasing means-tested benefits by 50% was estimated to have the biggest effect on reducing YLL (by approximately 105,177 or some 4·7% prevented) and inequalities in YLL (by approximately 0·099, or 7·9%) (Figure 2 and Table 2). Sizeable reductions in YLL were also estimated for the real Living Wage (53,179 or 2·4% fewer), Local Income Tax (49,581 or 2·2%), and increasing devolved benefits by 50% (38,959 or 1·7%). The two CBI policies would also be effective at narrowing inequalities in YLL, reducing them by 0.05 (3·7%) for CBI, and 0.07 (5·9%) for CBI Plus.

Any changes to taxation policy (shown by triangles in Figure 2) either reduced YLL but widened inequalities (if taxes were decreased, and hence incomes increased), or increased YLL while narrowing inequalities (if taxes were increased).

We performed sensitivity analyses by assessing the impact of the relationship being attenuated by 25% or 50%, and found that the effects on YLL would be reduced by 33% and 60%, respectively. Effects of the policies on premature mortality (commonly defined in the UK as deaths under the age of 75 years) were also calculated (Supplementary Appendix G), and mirrored the trends described for YLL.

The implications of the policies for annual government spending ranged from £541 m increased revenue (reducing PA by £1,000) to £2,173 increased spend (increasing means-tested benefits by 50%) (Table 3). Estimated impacts on YLL were related to these costs: more expensive policies resulted in greater reductions in YLL, while cost-saving policies were estimated to increase YLL. In contrast, the cost of a policy was not closely related to its effect on health inequalities. In particular the CBI policies appeared to exhibit good potential for reducing inequalities at less than a quarter of the cost of increasing means-tested benefits by 50%.

Figure 1. Percentage change in equivalised household income (before housing costs) for each policy, by SIMD 2016 quintile.

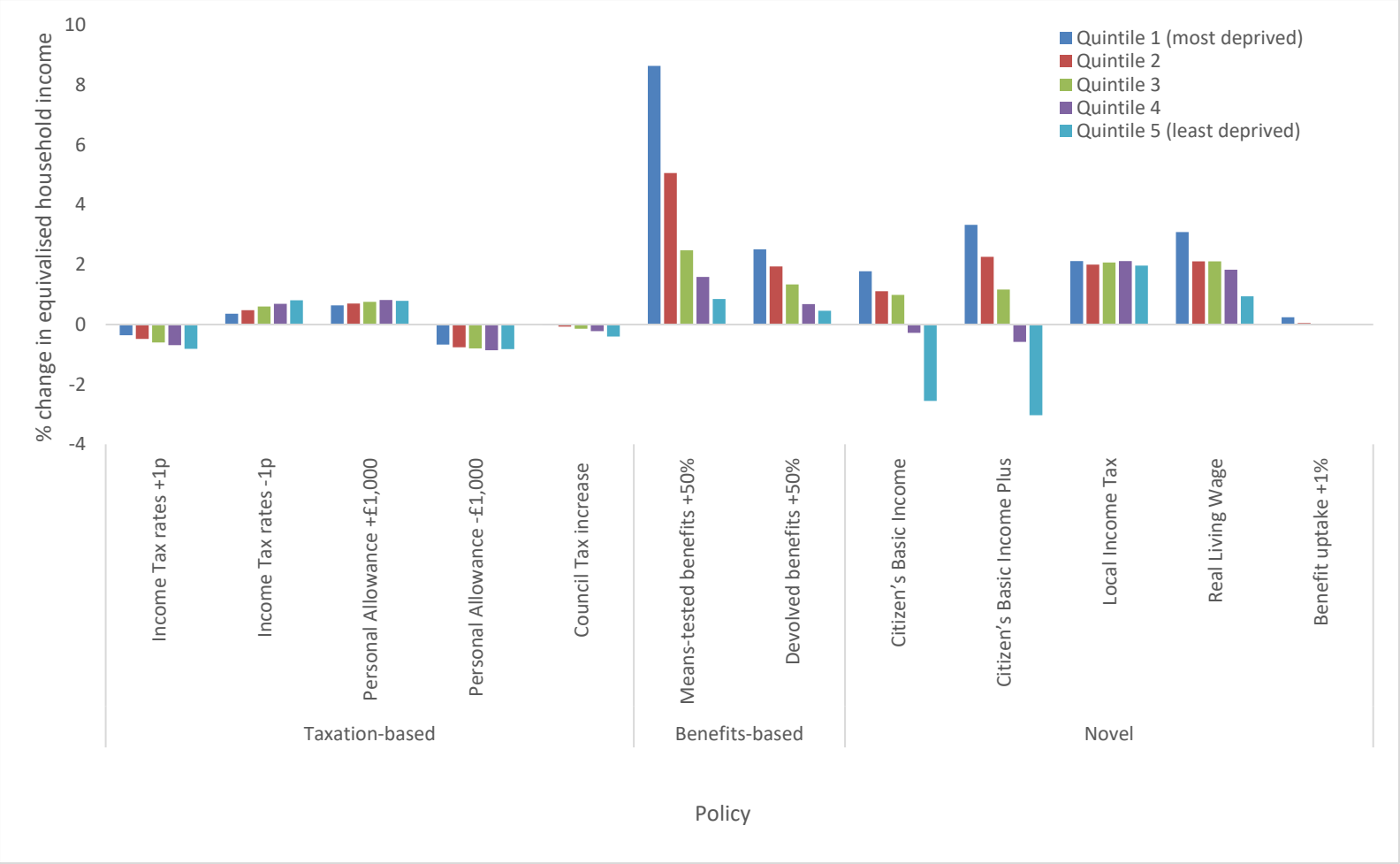

Table 2. Estimated effects of each policy on Years of Life Lost (YLL) and inequalities in YLL, for the population and by SIMD 2016 quintile, after five years.

	Absolute difference* from baseline scenario (% difference)						
	SIMD Q1 (most deprived)	SIMD Q2	SIMD Q3	SIMD Q4	SIMD Q5 (least deprived)	Whole population sum	Relative Index of Inequality (RII)
Income Tax rates +1p	2607 (0·4%)	2750 (0·5%)	2928 (0·7%)	2734 (0·8%)	2304 (0·9%)	13322 (0·6%)	-0·006 (-0·5%)
Income Tax rates -1p	-2587 (-0·4%)	-2725 (-0·5%)	-2892 (-0·7%)	-2694 (-0·8%)	-2264 (-0·9%)	-13164 (-0·6%)	0·006 (0·5%)
Personal Allowance +£1,000	-4602 (-0·7%)	-3911 (-0·8%)	-3662 (-0·8%)	-3170 (-0·9%)	-2226 (-0·9%)	-17573 (-0·8%)	0·003 (0·2%)
Personal Allowance -£1,000	4891 (0·7%)	4353 (0·8%)	3916 (0·9%)	3397 (1·0%)	2333 (0·9%)	18889 (0·8%)	-0·003 (-0·2%)
Council Tax increase	121 (0·0%)	407 (0·1%)	701 (0·2%)	871 (0·2%)	1141 (0·5%)	3241 (0·1%)	-0·004 (-0·4%)
Means-tested benefits +50%	-57614 (-8·6%)	-27274 (-5·3%)	-11779 (-2·7%)	-6123 (-1·7%)	-2385 (-0·9%)	-105177 (-4·7%)	-0·099 (-7·9%)
Devolved benefits +50%	-17770 (-2·7%)	-10791 (-2·1%)	-6449 (-1·5%)	-2649 (-0·8%)	-1299 (-0·5%)	-38959 (-1·7%)	-0·027 (-2·1%)
Citizen's Basic Income	-12668 (-1·9%)	-6223 (-1·2%)	-4774 (-1·1%)	1107 (0·3%)	7420 (2·9%)	-15140 (-0·7%)	-0·046 (-3·7%)
Citizen's Basic Income Plus	-23373 (-3·5%)	-12546 (-2·4%)	-5603 (-1·3%)	2280 (0·6%)	8856 (3·5%)	-30388 (-1·4%)	-0·074 (-5·9%)
Local Income Tax	-15062 (-2·2%)	-11100 (-2·1%)	-9836 (-2·2%)	-8123 (-2·3%)	-5460 (-2·2%)	-49581 (-2·2%)	0·000 (0·0%)
Living Wage	-21735 (-3·2%)	-11727 (-2·3%)	-10050 (-2·3%)	-7022 (-2·0%)	-2644 (-1·0%)	-53179 (-2·4%)	-0·022 (-1·7%)
Benefit uptake +1%	-1712 (-0·3%)	-288 (-0·1%)	0 (0·0%)	-70 (0·0%)	0 (0·0%)	-2070 (-0·1%)	-0·003 (-0·2%)

***** Positive difference = increase in YLL compared to baseline scenario.

Figure 2. Effects of income-based policies on YLL and inequalities in YLL after 5 years, relative to baseline scenario. Symbols represent the policy type: triangles for Taxation-based, circles for Benefits-based, and squares for Novel.

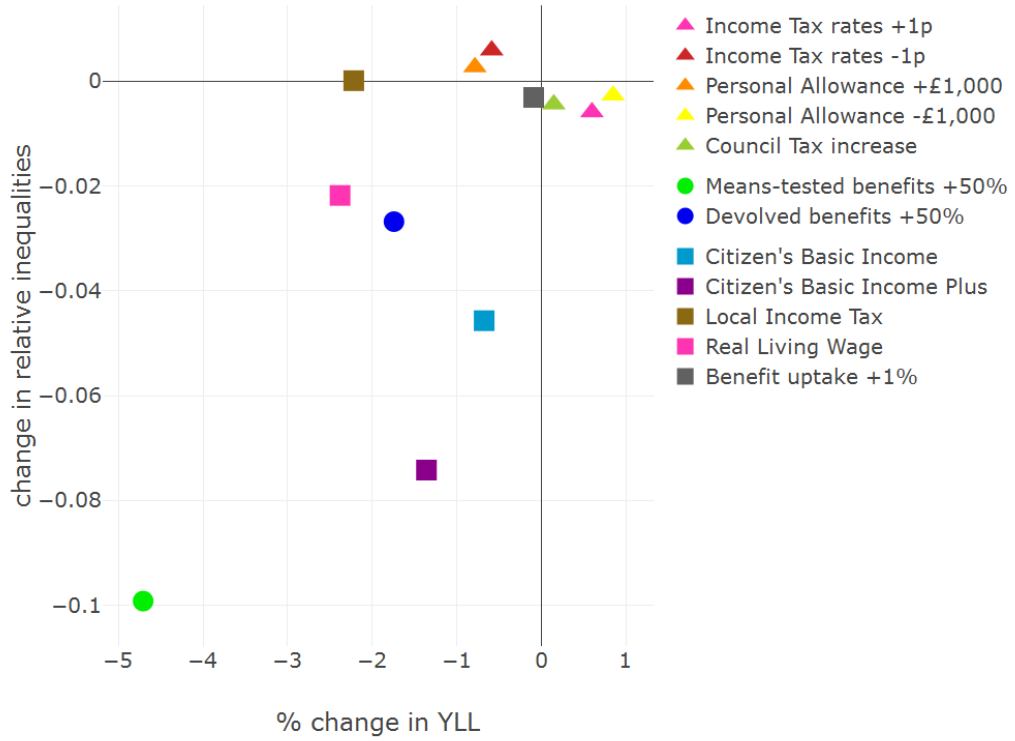

Table 3. Direct fiscal cost for each income-based policy[a].

Intervention	Net cost[b] (£m) per annum
Income Tax rates +1p	-429
Income Tax rates -1p	429
Personal Allowance +£1,000	513
Personal Allowance -£1,000	-541
Council Tax increase	-135
Means-tested benefits +50%	2,173
Devolved benefits +50%	773
Citizen's Basic Income	442
Citizen's Basic Income Plus	535
Local Income Tax	1,288
Real Living Wage[c]	1,264

[a] Increasing benefit uptake by 1% has been excluded because we were unable to reliably estimate the implementation investment required to achieve the 1% increase.
[b] Negative costs indicate revenue to government.
[c] Cost for the Real Living Wage includes £2,148 m increased wage bill that is likely to be borne between the government and employers, minus the government's net savings arising from increased tax and National Insurance contributions, and reduced benefit expenditure.

DISCUSSION

In this study we have used scenario modelling to compare how twelve income-based policies might affect household incomes, YLL, and inequalities in YLL in Scotland. We found the biggest apparent reductions in YLL for policies that increased household incomes most, and consequently cost the most. In contrast, the cost of a policy was not closely related to its effect on health inequalities, suggesting that the design of the policy was more important than its cost. Progressive policies that disproportionately increased incomes in the most deprived areas compared with the least deprived areas were best at reducing inequalities.

Modelling different policies as we have done provides a flexible, cost-effective, and evidence-based way of estimating their effects without implementing them.[10] We used a detailed model, incorporating a representative sample of Scottish households, so our findings are applicable to Scotland as a whole. As such, this work can inform decision makers about resource allocation and policy formulation. The Triple I modelling tools, in spreadsheet and online results browser formats, are available from our website: http://www.healthscotland.scot/triplei. In addition to YLL, effects can be estimated for premature mortality and hospital admissions. It should be noted, however, that we have not considered all possible income-based policies, so our findings should not divert attention from other potential approaches.

There are limitations to the work that should also be acknowledged. As with all modelling work the findings should be interpreted in the context of the model specifications and assumptions. A key assumption was that an increase in income would result in a reduction in mortality that could be adequately predicted from a regression analysis of cross-sectional income and health data. There is good evidence that change in income is likely to be causally related to changing health, as income and health are strongly related,[5] and reverse causality (change in health status leading to change in income) has been broadly rejected at the population level.[24] Nonetheless, the relationship could feasibly be weaker than we estimated, which would affect the absolute results (although not the relative effect of each policy in relation to the others). The sensitivity analysis showed that the strength of the relationship between income and health is an important factor in the estimated policy effect sizes, and our results are likely to represent the upper limit of the effects.

The modelling incorporates some simplifications that should also be borne in mind. We modelled each policy in isolation, although in reality multiple policies could be implemented concurrently. Looking at policies in isolation permits estimation of the impacts of changing only that policy, while keeping everything else constant. Only a policy's direct costs/savings and impacts are included in the modelling. If a policy proposal is to be revenue neutral the impacts of changes in taxation need to also be considered. These secondary effects must be considered in the decision-making process; this could be achieved by combining policies at the EUROMOD modelling stage, and repeating the assessment of estimated health effects using Triple I (akin to the CBI policy modelling described in

Supplementary Appendix C). However, neither the Triple I nor EUROMOD models can account for how a change in income might affect behavioural responses within a household that could also change their income, and health, such as deciding whether to work or not, or to work more or fewer hours. Tax and benefit fraud could not be accounted for in the modelling, which may have led to slight overestimation of the proportional income change for each policy.

Our work demonstrates how scenario modelling can be used to address the lack of effectiveness evidence concerning upstream interventions, and the potential value of some income-based policies for the Scottish Government's desire to fix inequalities "at source".[14] Modelling studies such as ours can inform policy-makers about likely effects of policies on health and health inequalities before they are implemented. Earlier studies focussed on the effects of single income-based policies on mortality,[21,25] whereas we have compared multiple policies with differing approaches to income redistribution.

Health impact modelling has been used to predict the health effects of the UK soft drinks industry levy,[26] and of minimum unit pricing for alcohol in Scotland.[27] Due to their focus on specific ('downstream') health behaviours these studies adopted more advanced modelling techniques than we were able to, and incorporated behavioural responses to some extent. Nonetheless, our more generalised modelling approach allows disparate policies, with multiple potential pathways between the exposure and the health outcome, to be included and compared.

Our finding that the policies that increased household incomes most might result in the biggest reductions in YLL suggests that the government's aim of making Scotland a healthier place could be advanced by greater investment in policies that increase household income. While this result was expected, given the clear negative relationship between household income and mortality rate, it is supported by quasi-experimental analyses of income change on mortality in the USA.[28]

However, we also found that not all policies that improve health would reduce health inequalities. Policies that increase incomes relatively uniformly across the socioeconomic gradient – such as reducing income tax or increasing the tax-free Personal Allowance for income tax – could increase inequalities while improving health. The more disproportionately a policy can affect incomes across the gradient – even to the extent of increasing them in the most deprived areas and decreasing them in the least deprived – the greater an impact it will make on reducing health inequality. We found only a single study that had assessed how income-based policies would affect health inequalities: Di Novi et al.[29] found that healthcare tax credits in Italy increased inequalities in health status, and that the policy could be redesigned to reduce this effect. Similarly, Griffin et al.[30] found that almost one-third of the health interventions recommended by the National Institute for Health and Care Excellence (NICE) were likely to increase health inequalities. A greater focus on health inequalities impacts of policies and interventions is clearly needed so that they do not have unintended

consequences. Making Scotland a fairer as well as a healthier place will require consideration about how progressive each policy's direct impacts are.

CONCLUSIONS

We used scenario modelling to estimate the health and inequalities effects of income-based policies in Scotland. We found that policies that affect household incomes have the potential for substantial effects on health and health inequalities. Population health may be improved by any policy that increases average household income, but to reduce health inequalities a policy must be progressive, disproportionately increasing incomes in the most deprived areas over those in the least deprived. Our modelling was subject to various assumptions and sources of uncertainty, but nonetheless highlights how the approach can be used to inform decisions around addressing the upstream determinants of health inequalities.

Contributors

GM and MR conceived and led the study. ER conducted the analyses and wrote the paper. All authors provided substantive comments on the paper and approved the final version.

Declaration of interests

We declare no competing interests. All authors are NHS employees and no additional funding was sought or received for the work.

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