Re-engineering Health Policy Research to Measure Equity Impacts

Tim Doran and
Richard Cookson

Overview

Health inequalities diminish lives and blight communities. Although the determinants of health inequality have become increasingly well understood, policy makers have repeatedly failed to address the issue effectively, and many public health interventions unintentionally worsen inequalities because they disproportionately benefit those with greater resources. This is a policy failure, but it is also a scientific failure. Policy makers often understand that their decisions have differential impacts across society. However, the analytical tools used to inform policy lack a substantial perspective on equity, focusing on averages rather than social distributions, leading to inequitable solutions.

In an age of social division driven by rising inequality, rigorous new methods for precisely measuring the equity impacts of health and social policy interventions are required. By developing these methods, and using them to assess the effectiveness of major public health and healthcare initiatives, researchers can improve understanding of the structural, behavioural and organizational barriers to delivering equitable health outcomes. A fundamental re-orientation of the health policy research endeavour is needed towards helping policy makers reduce health inequalities, with new partnerships between researchers across disciplines, including biostatistics, economics, epidemiology, population-level informatics and ethics. Policy makers will then have the necessary information to judge who gains and who loses from their decisions, and will be enabled to make fairer health policy decisions and to improve health across society.

The scale of the problem

Inequality has been described as our most urgent social problem (Atkinson, 2015), and health inequality as the "scandal of our times" (Dorling, 2013) and "the most shocking and inhumane" of all the forms of inequality (King, 1966). Occupying a lower position in society can cost years of healthy life (Lalonde, 1974; Townsend et al, 1992; CSDH, 2008), and loads pressure onto public services (Barnett et al, 2012; Asaria et al, 2016). The determinants of health inequality are structural (imbalances in wealth, human capital and political power), behavioural (social differences in health-related behaviours, often driven by structural factors) and organizational (inconsistent access to health, education and welfare services) (Townsend et al, 1992). Greater awareness and understanding of these determinants has lifted health equity to prominence on policy agendas across the world, but progress in tackling the problem has been slow, impeded by a lack of effective and coordinated action across all three fronts – structural, behavioural and organizational. Consequently, health inequalities have persisted (Marmot, 2010), continuing to diminish lives and blight communities.

Although the scientific community has made vital contributions in documenting health inequalities and identifying the underlying causes, it has frequently failed to support the development of effective policy solutions because of limitations in approach and methodology. The UK House of Commons health select committee inquiry into health inequalities reported: "One of the major difficulties which has beset this inquiry, and indeed is holding back all those involved in trying to tackle health inequalities, is that it is nearly impossible to know what to do given the scarcity of good evidence and good evaluation of current policy." (House of Commons Health Committee, 2009).

In: Evans J, Ruane S, Southall H. *Data in Society: Challenging Statistics in an Age of Globalisation*. Bristol: The Policy Press, 2019.

Addressing this problem requires action by those who commission and use research, to improve infrastructure for rigorous and independent policy research on health inequalities and implement its findings. However, it also requires action by scientists themselves to address four main limitations to existing research. First, academic discourse has tended to focus on structural and behavioural determinants. Whilst tackling these determinants is of vital importance, attention must also be paid to the contribution that public, private and third sector services could make if they were re-oriented to meet the differing needs, preferences, and constraints of different social groups (Whitehead & Doran, 2011). Second, the evidence informed decision making movement in healthcare has concentrated on safety and effectiveness, rather than equity (Institute of Medicine, 2001). Third, whilst the social epidemiology paradigm has provided profound insights into the determinants of health, it has focused on identifying risk factors and causal pathways, rather than finding effective means of changing risk factors by combining insights from epidemiology, economics and behavioural science (World Health Organization, 2010).

Finally, traditional health policy research focuses on a mythical 'average' citizen, producing evidence of limited usefulness for policy makers. Performance monitoring, trials, natural experiments and economic evaluations tend to focus on averages rather than social distributions. This provides valuable information on effectiveness and efficiency but skews decision-making away from tackling health inequalities, because policy makers are not provided with comprehensive analyses of who gains and who loses from their decisions. For the task of improving health equity these are incomplete approaches, using the wrong tools, leading to ineffective solutions. Attempts to change the behaviour of citizens and service providers have often failed to address differences in the context of the targeted populations, and many well-intentioned public health interventions have worsened inequalities because they have not effectively addressed the structural, behavioural and organisational barriers to equitable implementation. For example, rates of smoking remain stubbornly high within deprived segments of wealthy populations despite substantial long-term reductions among less deprived citizens (Health & Social Care Information Centre, 2015). Newer approaches, including social marketing, acknowledge the need for targeted approaches to behaviour change that take account of individual context, but the methods for measuring distributional effects across populations and identifying target groups remain underdeveloped.

Quantifying who gains and who loses from health policy decisions

Most health policy decisions are informed by analytical methods that focus on the average person. For example, the NICE approach to health care priority setting focuses on overall cost-effectiveness rather than distributional impacts, and recent studies of the outcomes of hospital reforms including choice and competition, payment by results, and pay for quality have been based on averages. As a result, potential trade-offs between cost-effectiveness and health inequality have not been explicitly articulated. This is partly due to the dominant methodological approaches used in health services and policy research, but also because the necessary raw material (in terms of appropriate data) and the necessary tools (in terms of computing power) have been lacking. With the increasing availability of large linked datasets and the computational power to analyse them, these shortcomings can now be addressed. These new resources can be applied to assess policy interventions – ideally implemented as 'controlled' policy experiments, but as these are uncommon, analysis of natural experiments is more likely. For example, over the next few years the English NHS will be an exceptionally rich laboratory for policy learning, as local NHS areas respond to financial pressures by experimenting with diverse new models of care. This experimentation can be exploited in a series of natural experiments to improve understanding of the effectiveness of local NHS commissioning organizations in reducing health inequalities, using methods such as those described below to provide information about the health equity impacts of alternative delivery models.

The ultimate aim is to strengthen the evidence base for tackling health inequalities by quantifying the 'equity impact' of health policy decisions, measuring who gains and who loses from decisions by modelling differences in health risks, behaviours and incentives by socioeconomic group, and

In: Evans J, Ruane S, Southall H. *Data in Society: Challenging Statistics in an Age of Globalisation*. Bristol: The Policy Press, 2019.

corresponding differences in the use, quality and outcomes of services. This requires re-engineering both the common approaches used to assess natural experiments and the standard methods of economic evaluation. It also requires a steadfast knowledge translation campaign to ensure widespread use of equity-informative methods by research producers, commissioners and users, with widespread stakeholder involvement to ensure the methods are user-friendly and relevant to stakeholder needs.

Providing decision makers with more useful information about health equity impacts and trade-offs demands two conceptually distinct types of analysis:

- Equity IMPACT analysis – disaggregating the outcomes of interventions by socioeconomic status and other aspects of social disadvantage, and producing summary measures of health equity impact.
- Equity TRADE-OFF analysis – articulating and quantifying the trade-offs between equity objectives and other policy objectives, such as improving total health.

Choosing equity measures

Policy analyses only rarely examine equity impacts, and when they do, they tend to use a single equity metric and do not explore how metrics based on different value judgements might lead to different conclusions (Kjellsson et al, 2015). Assessing equity impacts requires not only methodological approaches that can measure differential impacts for different population groups, but also a framework for choosing equity measures. This framework is essential, because different measures can lead to different conclusions about the equity impact of an intervention.

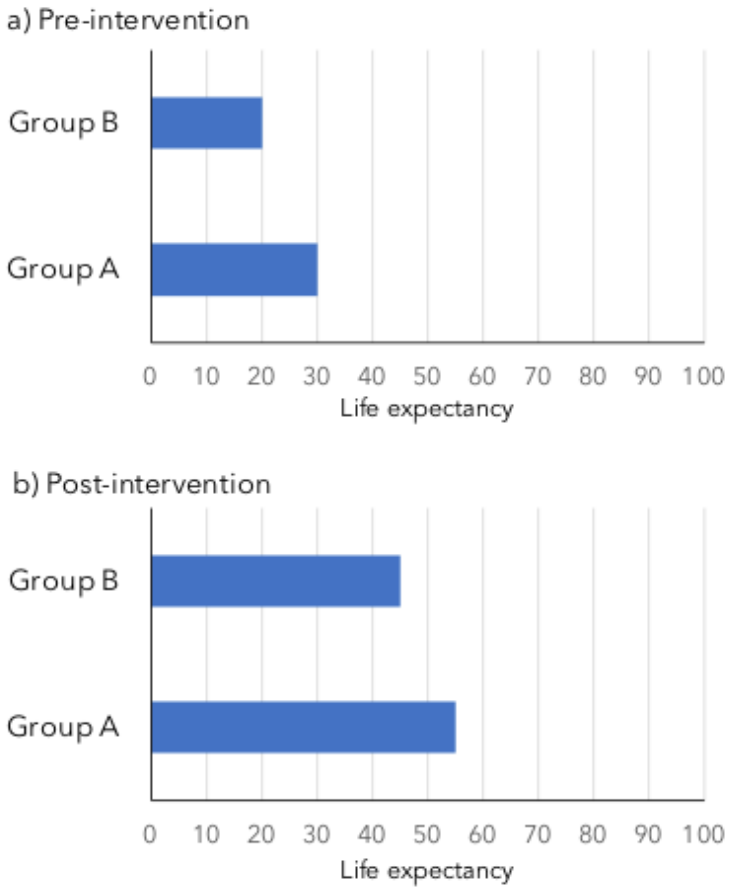
For example, an intervention that increases life expectancy by the same amount in two groups will appear to be equity neutral if the impact is measured in absolute terms (i.e. the size of the gap between the groups) but will appear to be equity improving if the impact is measured in relative terms (i.e. the ratio of life expectancies between groups – see **Figure 1**). In this hypothetical example, we measure the impact of a public health intervention on two population subgroups – Group A and Group B. Prior to the intervention, Group A has a life expectancy of 30 years and B has a life expectancy of 20 years (Figure 1a). Following the intervention life expectancy in both groups increases by 25 years, to 55 years for Group A and to 45 years for Group B (Figure 1b).

Prior to the intervention, the ABSOLUTE INEQUALITY between the groups (i.e. the gap in life expectancy) was 10 years. After the intervention the gap remained at 10 years, so in absolute terms the intervention was EQUITY NEUTRAL (i.e. inequalities neither increased nor decreased). In terms of RELATIVE INEQUALITY (i.e. the ratio of life expectancies for the two groups), prior to the intervention life expectancy for Group A was 50% higher than for Group B. After the intervention life expectancy for Group A was only 22% higher than for Group B, so in relative terms the intervention was EQUITY IMPROVING (i.e. inequalities decreased).

Furthermore, how a health outcome is conceptualised also affects conclusions about equity. Outcomes with both upper and lower limits can be measured in terms of attainments from the lower limit or shortfalls from the upper limit. The choice is often influenced by how well defined each limit is, for example: life expectancy is usually presented in terms of attainments above zero. However, life expectancy has a theoretical upper limit, and changes in life expectancy could also be measured in terms of shortfalls from this maximum level (**Figure 2**). An alternative way of measuring the impacts of the intervention from Figure 1 is to consider how far short of this maximum level each population falls. If we set maximum life expectancy at 100, then prior to the intervention Group A has a shortfall of 70 years (100-30), and Group B has a shortfall of 80 years (100-20) as shown in Figure 2a. After the intervention, life expectancy increases by 25 years in both groups, so that Group A has a shortfall of 45 years and Group B has a shortfall of 55 years (Figure 2b).

In: Evans J, Ruane S, Southall H. *Data in Society: Challenging Statistics in an Age of Globalisation*. Bristol: The Policy Press, 2019.

Figure 1: How different methods of measuring gains in population outcomes affect judgements of equity impacts.



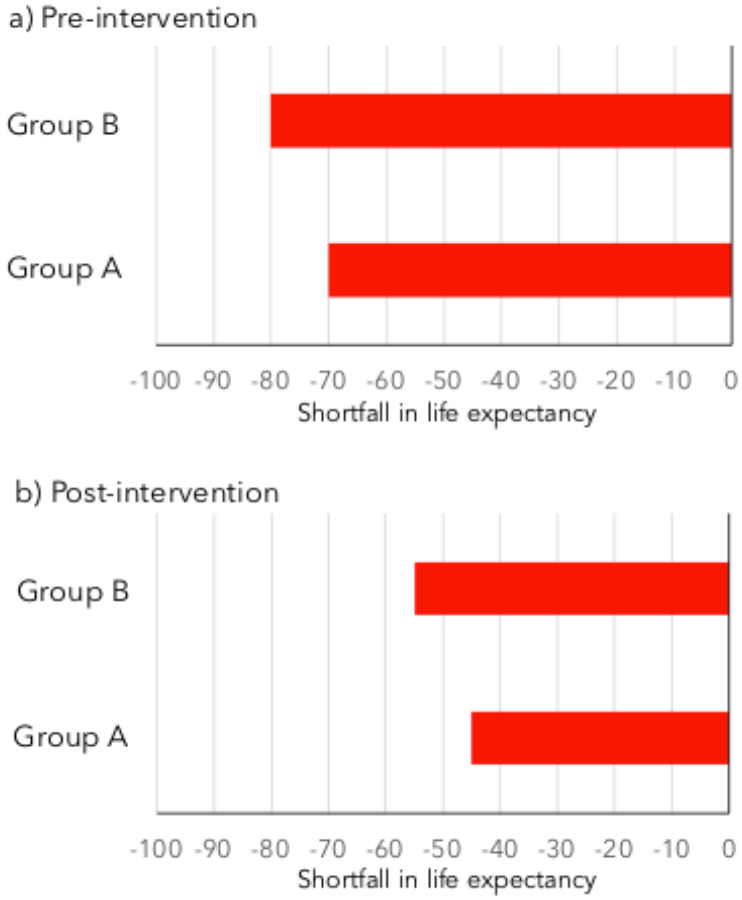
Adapted from Asada, 2010 and Kjellsson et al, 2015.

As was the case when measuring gains, the ABSOLUTE INEQUALITY between the groups is 10 years both before and after the intervention, and so the intervention again appears to be EQUITY NEUTRAL. However, in terms of RELATIVE INEQUALITY, the ratio in shortfalls is 1.14 (a 14% 'gap') prior to the intervention and 1.22 (a 22% 'gap') after. The intervention appears to be EQUITY DECREASING (i.e. inequalities increase). Crucially, the decision to measure outcomes in terms of attainments or shortfalls is not arbitrary or inconsequential; the same intervention could appear to be equity improving or equity decreasing depending on the choice (compare **Figures 1** and **2**).

To avoid researchers and policy makers simply choosing the metric most favourable for their purposes, an analytical framework for selecting, computing and presenting an appropriate suite of equity impact metrics, facilitating comparison between different settings, is required. Developing such a framework should involve exploration and analysis the ethical foundations and implications of the methods, since equity is a complex and contestable ethical concept and human behaviour is partly motivated by ethical norms and values, as well as rational self-interest. This can only be achieved by integrating ethical and economic analysis in ways that help to enrich both disciplines (Sen, 1999).

In: Evans J, Ruane S, Southall H. *Data in Society: Challenging Statistics in an Age of Globalisation*. Bristol: The Policy Press, 2019.

Figure 2: How different methods of measuring shortfalls in population outcomes affect judgements of equity impacts.



Adapted from Asada, 2010 and Kjellsson et al, 2015.

Quantifying equity impacts

The methods commonly used in epidemiological and health services research to quantify the population impacts of interventions, for example ordinary least squares regression (OLS), are not always well suited to measuring equity impacts. OLS approaches effectively measure the relationship between the average of the 'explanatory' variables and the average of the outcome of interest. In most cases the results are heavily influenced by the mid-range of distributions. However, in epidemiological research we are often interested in the tails of outcome distributions – for example, high values of blood glucose – as these extreme values represent states of clinical disease with heightened risk of adverse outcomes. OLS approaches also assume that the relationship between the explanatory variable and the outcome is constant for all values of both sets of variables – for example, that the relationship between income and blood glucose is the same for people with low values of blood glucose as it is for people with high values. However, for equity impact research we want to know if the relationship varies. Standard methods for addressing these problems introduce new problems. For example, dividing the population into groups with different values of the explanatory variable involves discarding most of the available data for each sub-analysis.

New approaches for going beyond averages (measuring 'heterogeneous treatment effects' and 'counterfactual distributions') seek to address these problems. Many new methods of this kind have been developed by statisticians and econometricians, and are now starting to find applications in the health

field. For example, unconditional quantile regression does not discard data, rather it repeats the modelling analysis for different values ('quantiles') of the outcome using all the individual observations in every iteration. Rather than calculating one relationship for all values of the outcome, this approach thereby allows the association between explanatory factors and outcomes to vary as the outcome changes.

Using this approach, Carrieri and Jones explored the relationship between income and values of glycated haemoglobin (HbA1C – a measure of long-term blood glucose levels, and hence an indicator of diabetes) (Carrieri & Jones, 2017). Using standard OLS regression they found a moderately negative association between income and HbA1C values, i.e. lower incomes were associated with higher values of HbA1C (representing poorer control of blood glucose), but the relationship was not strong. In contrast, when using quantile regression, they found that the association varied from weakly negatively for low HbA1C values to strongly negative at high values. Therefore, whilst OLS regression imposes the constraint (through the model of specification itself) that the relationship between income and HbA1C is constant - and quite weak - for all values of the outcome, quantile regression finds that the income coefficient is much greater at high values of HbA1C (values in the diabetic range) than at low values. In other words, at the diabetic end of the spectrum of glycated haemoglobin values, lower incomes are more strongly associated with high values of glycated haemoglobin, which is in turn associated with increased risk of complications and death. So, whereas the OLS approach over-simplifies relationships, for example underestimating the increased risks faced by lower income groups within the hazardous range of biomarkers such as glycated haemoglobin, quantile regression is much more sensitive to differential impacts, and can provide more accurate information on the impact of interventions on health inequalities.

Informing decisions

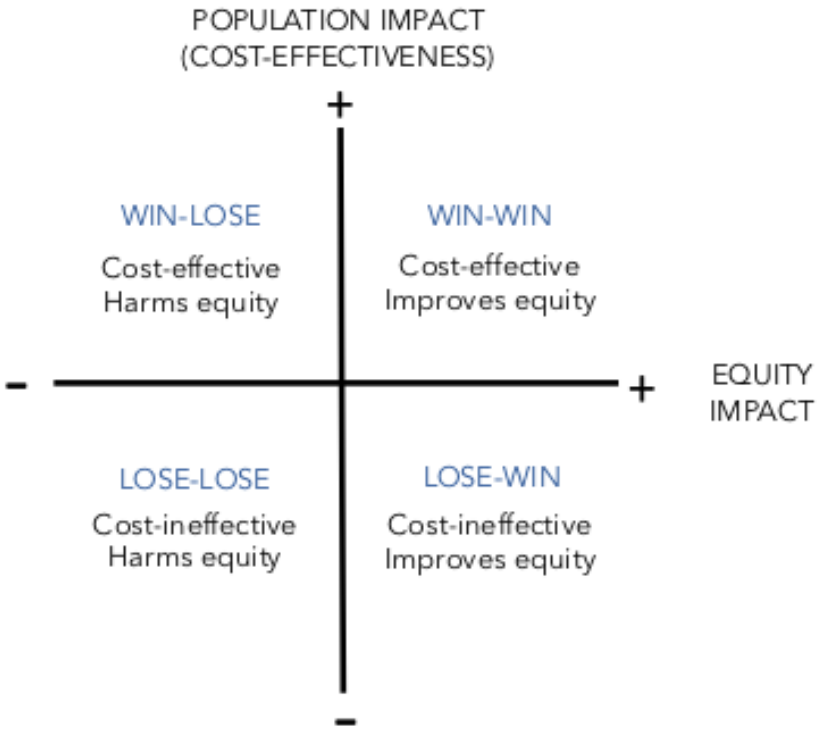
Once calculated, information on equity impacts can be combined with other measurements of impact to inform policy decisions. For example, in the UK, health related interventions are subject to cost-effectiveness analysis by the National Institute for Health and Care Excellence (NICE). Interventions that exceed a set threshold and are deemed cost-effective are recommended for funding by organisations such as the NHS. However, these judgements are generally based on average population impacts and do not directly address equity (Cookson et al, 2016). Recommended interventions can increase health inequalities if they have different impacts on different population groups, for example where the intervention is beneficial for the majority of the population, but less beneficial – or even harmful – for the minority.

Equity impact analysis adds a second dimension to policy evaluation, creating four possible outcomes on an equity impact plane (see **Figure 3**). To allow policies and interventions with different population impacts to be directly compared, their health outcomes can be converted into a single summary index of health, such as the quality-adjusted life-year (QALY). This is represented in Figure 3 by the vertical line; interventions that exceed a set threshold are located towards the top (positive) pole and are considered to be cost-effective. Equity impact assessment adds a second dimension to conventional cost effectiveness analysis, represented by the horizontal line. Interventions that improve equity are located towards the right (positive) pole, and interventions that harm equity are located towards the left (negative) pole. Combining measures of population and equity impact therefore creates four quadrants on an 'equity plane'. This allows identification of: i) interventions that are cost-effective but which harm equity; and ii) interventions that are cost-ineffective but which improve equity.

Decisions about interventions in the top-right (cost-effective, equity improving) or bottom-left (cost-ineffective, equity reducing) quadrants are relatively straightforward; the former should be funded, whereas the latter should not. However, interventions in the top-left (cost-effective, equity reducing) and bottom-right (cost-ineffective, equity-improving) quadrant raise more difficult decisions about how far policy makers are willing to trade-off overall population impact against equity impact. For example, a cost-ineffective intervention might be supported if improving equity in this area is deemed a priority. If

reducing inequality in lifetime health more generally is an overall policy aim, then several interventions falling into the bottom-right quadrant, which would previously have been rejected, may be adopted.

Figure 3: The equity impact plane



Adapted from: Cookson et al, 2017.

To demonstrate the plane in use, if we assume that the hypothetical intervention from **Figures 1** and **2** is cost-effective overall, then the intervention would be located in one of the top two quadrants. Its placement on the equity axis would then depend on which measure of equity was used. If the metric was based on absolute inequality, then the intervention would be located at the mid-point, falling into neither of the top two quadrants; i.e. it would be judged to be equity neutral. If the metric was a relative measure based on attainment, the intervention would fall into the top-right quadrant; i.e. it would be judged to be both cost-effective and equity improving. However, if the metric was a relative measure based on shortfalls, the intervention would fall into the top-left quadrant; i.e. cost-effective but harmful in terms of equity. This demonstrates again the importance of choosing the measure of equity carefully.

In summary

Acceptance of the existence of health inequalities, and of the need for governments to be actively involved in addressing them, has become widespread over the last four decades. However, even when the political will to address health inequalities is in place, policy makers often lack robust evidence on effective interventions, and must rely instead on faith-based solutions. Without proper evaluation, scarce resources will continue to be focused on interventions that are proven to be efficient, but which may be damaging in terms of equity.

In: Evans J, Ruane S, Southall H. *Data in Society: Challenging Statistics in an Age of Globalisation*. Bristol: The Policy Press, 2019.

The current movement to develop rigorous methods for measuring equity impacts echoes the movement to develop methods for evidence-based medicine and policy making in the 1970s. By re-engineering health policy research methods we will be able to assess the effectiveness of major public health initiatives and to improve our understanding of the structural, behavioural and organizational barriers to delivering equitable health outcomes. If we can achieve this, the scientific community will finally be able to provide policy makers with vital information on who gains and who loses from their decisions.

References

- Asada, Y. (2010). On the choice of absolute or relative inequality measures. Milbank Q. 2010;88:616–622; discussion 623.
- Asaria, M., Doran, T., & Cookson, R. (2016). The costs of inequality: whole-population modelling study of lifetime inpatient hospital costs in the English National Health Service by level of neighbourhood deprivation. *J. Epidemiol. Community Health.,* 16,10.1136/jech-2016-207447.
- Atkinson, A. (2015). *Inequality. What can be Done?* Cambridge MA: Harvard University Press.
- Barnett, K., Mercer, S., Norbury, M., Watt, G., Wyke, S., & Guthrie, B. (2012). Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. *Lancet*, *380*(9836), 37–43.
- Carrieri, V., & Jones, A. (2017). The income-health relationship "beyond the mean": new evidence from biomarkers. *Health Econ.*, 26, 937-956.
- Commission on the Social Determinants of Health (CSDH). (2008). *Closing The Gap in a*
- *Generation. Health Equity Through Action on the Social Determinants of Health.* Geneva: World Health Organization.
- Cookson, R., Asaria, M., Ali, S., Ferguson, B., Fleetcroft, R., Goddard, M., Goldblatt, P.,
- Laudicella, M., & Raine, R. (2016). Health Equity Indicators for the English NHS: Longitudinal whole-population study at small area level, *Revised Final Report to NIHR Health Services and Delivery Research Programme Project Number 11/2004/39*.
- Cookson, R., Mirelman, A., Griffin, S., Asaria, M., Dawkins, B., Norheim, O., et al. (2017) Using cost-effectiveness analysis to address health equity concerns. *Value in Health.*, 20, 206-212.
- Dorling, D. (2103). *Unequal Health – The Scandal of Our Times*. Bristol: The Policy Press.
- Gov.UK. (2016). Statement from the new Prime Minister Theresa May. Retrieved from
- https://www.gov.uk/government/speeches/statement-from-the-new-prime-minister-theresa-may
- Health & Social Care Information Centre. (2015). *Statistics on Smoking – England 2015*. Leeds: HSCIC.
- House of Commons Health Committee. (2009). *Health Inequalities - Third Report of Session 2008-2009*. London, The Stationery Office Limited.
- Institute of Medicine, Committee on Quality of Health Care in America. (2001) *Crossing the*
- *Quality Chasm: A New Health System for the 21st Century.* Washington, DC,: National Academies Press.
- King, ML. (1966). *Speech to the Medical Committee for Human Rights.* Chicago, March 25,
- 1966.
- Kjellsson, G., Gerdtham, U., & Petrie, D. (2015). Lies, Damned Lies, and Health Inequality Measurements: Understanding the Value Judgments. *Epidemiology.*, *26*, 673–680.
- Lalonde, M. (1974). *A New Perspective on the Health of Canadians.* Ottawa: Minister of Supply and Services.

In: Evans J, Ruane S, Southall H. *Data in Society: Challenging Statistics in an Age of Globalisation*. Bristol: The Policy Press, 2019.

- Marmot, M. (2010). *Fair Society, Healthy Lives. The Marmot Review*. London: The Marmot Review. http://www.ucl.ac.uk/gheg/ marmotreview/FairSocietyHealthyLivesExecSummary.
- Sargent, G. (2013). Inequality is 'the defining issue of our time'. *Washington Post* December 14, 2013.
- Sen, A. (1999). *On Ethics and Economics.* Oxford: Oxford.
- Townsend, P., Davidson, N., Whitehead, M. (eds.). (1992). *Inequalities in Health: The Black Report*. London: Penguin.
- Whitehead, M., & Doran, T. (2011). The north-south health divide. *Brit. Med. J*., 342, d584.
- World Health Organization. (2010). *Priorities for Research On Equity and Health.* Geneva: World Health Organization.

In: Evans J, Ruane S, Southall H. *Data in Society: Challenging Statistics in an Age of Globalisation*. Bristol: The Policy Press, 2019.