

Study protocol: To what extent, and how, do the social determinants of health (SDH) and health inequalities feature in COVID-19 modelling studies?

Contents

- 1 Background..... 1
- 2 Methods..... 2
 - 2.1 Research Question 2
 - 2.2 Aim 2
 - 2.3 Outcomes 5
- 3 References..... 6

1 Background

The capacity of modelling studies to tell policy-relevant stories about the transmission and patterns of infectious diseases has rendered them ‘servants’ (Mansnerus, 2014, p.11) for public health policies. Along with simulation techniques, computer-based modelling has become increasingly important in knowledge production and use processes.

During the COVID-19 pandemic, rapidly constructed mathematical models played a predominant role in shaping national policy responses to infection control (Enserink & Kupferschmidt, 2020; Rhodes & Lancaster, 2020). This is especially the case in the UK where a report relaying a particular set of modelled projections produced by a team at Imperial College (Ferguson et al., 2020) provided the catalyst for the first national lockdown (a combination of policy options to restrict social interaction and flatten the epidemic curve) in March 2020.

The considerable, and unpredictable, social effects of various lockdown measures, referred to as non-pharmaceutical interventions (NPIs) - such as social distancing, and school and university closures are noted in this study. The authors state that if a suppression strategy were to be adopted: ‘no public health intervention with such disruptive effects on society [would have] been previously attempted for such a long duration of time’ (Ferguson et al., 2020, p.16).

When considering the response to the COVID-19 pandemic it is important to understand what kinds of questions were being asked by the research and how the uncertainty of the evidence and inevitable trade-offs of the pandemic were navigated by decision-makers. Mounting evidence of the disproportionate burden of COVID-19 infection, mortality and morbidity, as well as the unequal social and economic impact of control measures on those living in more deprived areas and from black and minority ethnic backgrounds (Bambra et al., 2020; Fenton, Pawson & de Souza-Thomas, 2020; Public Health England, 2020) point to further justification for the need

to consider public health policy through the lens of the social determinants of health. This study will investigate the extent and ways in which modelling studies considered factors relating to social determinants of health and the possible policy implications.

I will present the findings relating to the kinds of variables and outcomes which were prioritised in the modelling studies produced during the first year of the COVID-19 pandemic. If there are models which relate to SDH factors I will describe their characteristics and consider how they are conceptualised in relation to wider literature on health inequalities and SDH. I will then discuss these findings in the context of the wider research landscape and short-term national policy response.

2 Methods

2.1 Research Question

To what extent, and how, have the social determinants of health and health inequalities featured in the modelling studies produced in response to the COVID-19 pandemic?

2.2 Aim

Aim: To explore the conceptual research landscape which unfolded during the first year of the COVID-19 pandemic.

I will analyse three purposefully selected samples of modelling studies which were produced at different time points in the first year of the COVID-19 pandemic to assess if, and how, health inequalities and the social determinants of health featured in the research. Modelling studies will be retrieved from Cochrane COVID-19 Study Register and will cover the following time periods: March-May 2020 (n=186); September-October 2020 (n=186); December-January 2021 (n=186).

The different times stages have been selected for marking the following stages:

March 2020 - May 2020: World Health Organization's declaration of COVID-19 as a pandemic and first national UK lockdown

September 2020 - October 2020: After the initial wave of substantial infections and deaths

December 2020 - January 2021: After the first vaccines were granted regulatory approval.

I will characterize the studies by capturing the following data:

- Status of study:
 - pre-print/
 - rapid communication/
 - journal article

[If studies in the sample appear as both pre-prints and peer-reviewed journal articles, they will

be marked up as linked studies and data will only be extracted from the peer-reviewed study.]

- Aim of the study
- Type of model:
 - Agent Based model
 - Analysis
 - Compartmental model
 - Heuristic tool to guide practice or policy
 - Metapopulation model
 - Statistical model
 - Evaluation of other model(s)

Model Type	Description
Agent-Based model	Dynamics captured at the level of individuals (e.g household, workplace, communal space)
Analysis	Using analytical techniques to assess data (e.g national databases, social media data, questionnaires, surveys etc) to identify correlations (e.g mapping vulnerabilities)
Compartmental model	Focus on a single population which is divided by way of age or health status (e.g Susceptible, Exposed, Infectious, Recovered (SEIR models))
Evaluation of other model(s)	Evaluations or validations of other models. Reflections on the strengths/ weaknesses of other models and how they can be applied
Heuristic tool to guide practice or policy	Model developed and tested to inform practice or policy (e.g diagnosis or capacity planning in healthcare, or
Metapopulation model	Looking at interactions of networks of different subpopulations (e.g through mobility patterns)
Statistical model	Evolution of the epidemic captured through inferring key parameters and behaviours from data

[Note that while some categories overlap and some models could have been applied to more than one category, for ease of analysis I selected just one main category for each model. See table one for description of each type.]

- Country/ countries of author(s)' affiliation (select all that apply)
- Country/countries/geographic area of focus (if applicable)
- Interventions/Variables modelled

- Whether links to COVID-19 are discussed by way of:
 - higher vulnerability
 - higher susceptibility
 - higher levels of exposure
 - higher levels of transmission

Link to COVID-19	Description/ example
Higher vulnerability	Worse outcomes as a result of pre-existing conditions which are socially patterned
Higher susceptibility	Environmental conditions can lead to weakened immune systems by long term exposure to adverse living/ working conditions
Higher levels of exposure	Through working conditions and inability to work from home e.g service sector (food, cleaning, delivery)
Higher rates of transmission	Housing and living conditions (e.g institutionalised, multiple occupation, generational).

Clare Bambra et al.s’ (2020) work focussing on inequalities in COVID-19 will provide a framework to capture factors relating to the SDH, with one extra dimension – ‘Race & Ethnicity’ - added from the [PROGRESS-Plus](#) (Kavanagh, Oliver & Lorenc, 2008) equity framework. In addition to the evidence on significant racial and ethnic inequalities in COVID-19 mortality (Khazanchi, Evans, and Marcelin 2020; Public Health England 2020; Razai, Majeed, and Esmail 2021; Yaya et al. 2020), there is widespread concern over school closures exacerbating pre-existing inequalities among children (Andrew et al., 2020), so ‘early years’, which is a frequent consideration of social determinants of health research and the lifecourse pathway (Marmot & Wilkinson, 1999; Bartley, 2017) will also be added as a category.

- Political environment
- Economic conditions
- Environmental conditions
- Race & Ethnicity
- Early Years
- Housing
- Healthcare
- Access to services
- Work environment/ (un)employment
- Food (access to healthy diet)
- Education
- Social & community networks

- Health related practices
- Age, sex, genetics, NCDs

- Pathways (not mutually exclusive). Whether the links between the SDH and health or well-being are described as:
 - material
 - cultural behavioural
 - selection
 - psychosocial
 - macro social or political economy
 - lifecourse

2.3 Outcomes

A coding framework will be developed to capture variables and outcomes of interest for all models. This will develop in an iterative manner. As there are likely to be a vast array of different variables and outcomes present in the study samples, where possible, similar variables and outcomes will be grouped together into overarching categories to assist with the analysis.

3 References

Andrew, A., Cattan, S., Dias, M.C., Farquharson, C., Kraftman, L., Krutikova, S., Phimister, A. and Sevilla, A. (2020). 'Inequalities in Children's Experiences of Home Learning during the COVID-19 Lockdown in England*'. *Fiscal Studies*, 41 (3), pp.653–683.

Bambra, C., Riordan, R., Ford, J. and Matthews, F. (2020). 'The COVID-19 pandemic and health inequalities'. *J Epidemiol Community Health*, 74 (11), pp.964–968.

Bartley, M. (2017). *Health inequality : an introduction to concepts, theories and methods / Mel Bartley*. Second edition. Cambridge, UK : Polity Press.

Enserink, M. and Kupferschmidt, K. (2020). 'With COVID-19, modeling takes on life and death importance'. *Science*, 367 (6485), pp.1414–1415.

Fenton, K., Pawson, E. and de Souza-Thomas, L. (2020). 'Beyond the data: Understanding the impact of COVID-19 on BAME communities'. *Public Health England*.

Ferguson, N.M., Laydon, D., Nedjati-Gilani, G., Imai, N., Ainslie, K., Baguelin, M., Bhatia, S., Boonyasiri, A., Cucunubá, Z. and Cuomo-Dannenburg, G. (2020). 'Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand. Imperial College COVID-19 Response Team'. *Imperial College COVID-19 Response Team*, p.20.

Kavanagh, J., Oliver, S. and Lorenc, T. (2008). 'Reflections on developing and using PROGRESS-Plus Equity Update'. *Cochrane Health Equity Field and Campbell Equity Methods Group*, pp.1–3.

Khazanchi, R., Evans, C.T. and Marcelin, J.R. (2020). 'Racism, Not Race, Drives Inequity Across the COVID-19 Continuum'. *JAMA Netw Open.*, (9), p.e2019933.

Mansnerus, E. (2014). *Modelling in public health research*. Basingstoke: Basingstoke, Palgrave Pivot.

Marmot, M. and Wilkinson, R. eds. (1999). *Social determinants of health*. OUP Oxford.

Public Health England (2020). *Disparities in the risk and outcomes of COVID-19*. London: Public Health England.

Razai, M.S., Majeed, A. and Esmail, A. (2021). 'Structural racism is a fundamental cause and driver of ethnic disparities in health' [Internet]. Available [Online] at: <https://blogs.bmj.com/bmj/2021/03/31/structural-racism-is-a-fundamental-cause-and-driver-of-ethnic-disparities-in-health/>. [Last accessed 5 April 2021].

Rhodes, T. and Lancaster, K. (2020). 'Mathematical models as public troubles in COVID-19 infection control: following the numbers'. *Health Sociology Review*, 29 (2), pp.177–194.

Yaya, S., Yeboah, H., Charles, C.H., Otu, A. and Labonte, R. (2020). 'Ethnic and racial disparities in COVID-19-related deaths: counting the trees, hiding the forest'. *BMJ Global Health*, 5 (6), p.e002913.