

# Forecasting all risk factors for all countries

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**Abstract:** Estimating the future health gain and economic impacts of preventative interventions, robustly and routinely, is within reach. Proportional multi-state lifetable modelling is an established method for achieving this goal (Blakely et al., 2020), but requires baseline risk factor distribution forecasts, such as estimates of future smoking rates or systolic blood pressure. Prospective modelling often involves forecasting risk factors, however this tends to be the most labour-intensive part of model specification, and reliance on disparate data sets hinders comparison across models.

Murray et al. (2003) proposed three goals for comparative risk assessment, with the aim of supporting evidence-based decision making about population health. The first two goals have been achieved: (i) quantifying the current health loss due to any disease or condition, across countries, and (ii) estimating the health loss of risk factors compared to the counterfactual world in which the risk factor was never present. Routine and comparable risk factor forecasts are the final hurdle for the third goal: estimating the avoidable health burden of risk factors into the future. We fill this gap with a new method for forecasting risk factor distributions.

Our risk factor forecasts depend on the summary exposure values produced by the Global Burden of Disease (Global Burden of Disease Collaborative Network, 2020). A summary exposure value is a number between 0 and 1, where 0 indicates a population with no exposure to the risk factor, while 1 indicates a population at the 99<sup>th</sup> percentile of global risk. The Global Burden of Disease reports summary exposure values by age, sex and country, and projects them into the future. However, the Global Burden of Disease does not explicitly produce risk factor forecasts, as the summary exposure value is an aggregated average across the health burden of many disease-risk pairs. We produce risk factor distributions by decomposing the health burden of each risk factor into component diseases, then optimising across candidate distributions to reproduce the aggregate summary exposure value.

Our method scales to all major risk factors and almost every country due to the impressive coverage of the Global Burden of Disease dataset. We use the 2019 dataset as it is the most complete, but will be able to update to use new datasets as they, and their methods, become publicly available. Our forecasting method is quick to run and produces risk factor distributions that are consistent with Global Burden of Disease methods. As well as quantifying the total avoidable health burden into the future, these risk factor forecasts can also be used to model preventative interventions by comparing health and economic outcomes in futures with or without a reduction in risk factor prevalence.

We present our summary exposure value disaggregation method alongside comparisons to independently generated country-level risk factor forecasts, to validate the method. We also present examples of the health interventions that can be modelled using these forecasts, and more can be viewed via the SHINE Health Intervention Impact Calculator (<https://shine-hiic.com/>).

## REFERENCES

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