Supplementary Information

Health co-benefits of modelled sustainable dietary transitions towards reduced red and processed meat intake in the United Kingdom

Table of contents

Materials and methods

Handling input data and relative risks

The disease-specific mortality and morbidity data were only available by 5-year age ranges and not in single-year-of-age format. Therefore, the rate for each 1-year age interval was interpolated using monotonic cubic spline interpolation using the programme SRS splines, available as an add-in to Excel (22).

Relative risks from the GBD which were expressed in terms of a harmful risk factor (e.g. "diet high in sodium/salt") were inverted to create relative risks for a positive change in diet. The GBD provides relative risks for females and males combined, by 5-year age ranges, starting from the age of 25. The relative risks for each risk, outcome, and 5-year age range were weighted according to the age distribution in the UK population to create one single relative risk for each risk-outcome pair. Ages from 18-25 were assigned the same relative risk as the 25-29 age group, although the baseline mortality from the included dietary risks was almost non-existent in the UK population aged 18-25. For the analysis, the exposure-response functions were assumed to be log-linear. The change in mortality risk *R* associated with a modelled change in dietary exposure *E* was calculated as:

$$\delta R = exp\left[\frac{log(RR_{\Delta E})}{\Delta E} \times \delta E\right]$$

Where $RR_{\Delta E}$ is the relative risk associated with a fixed change in dietary risk exposure (ΔE) derived from the GBD.

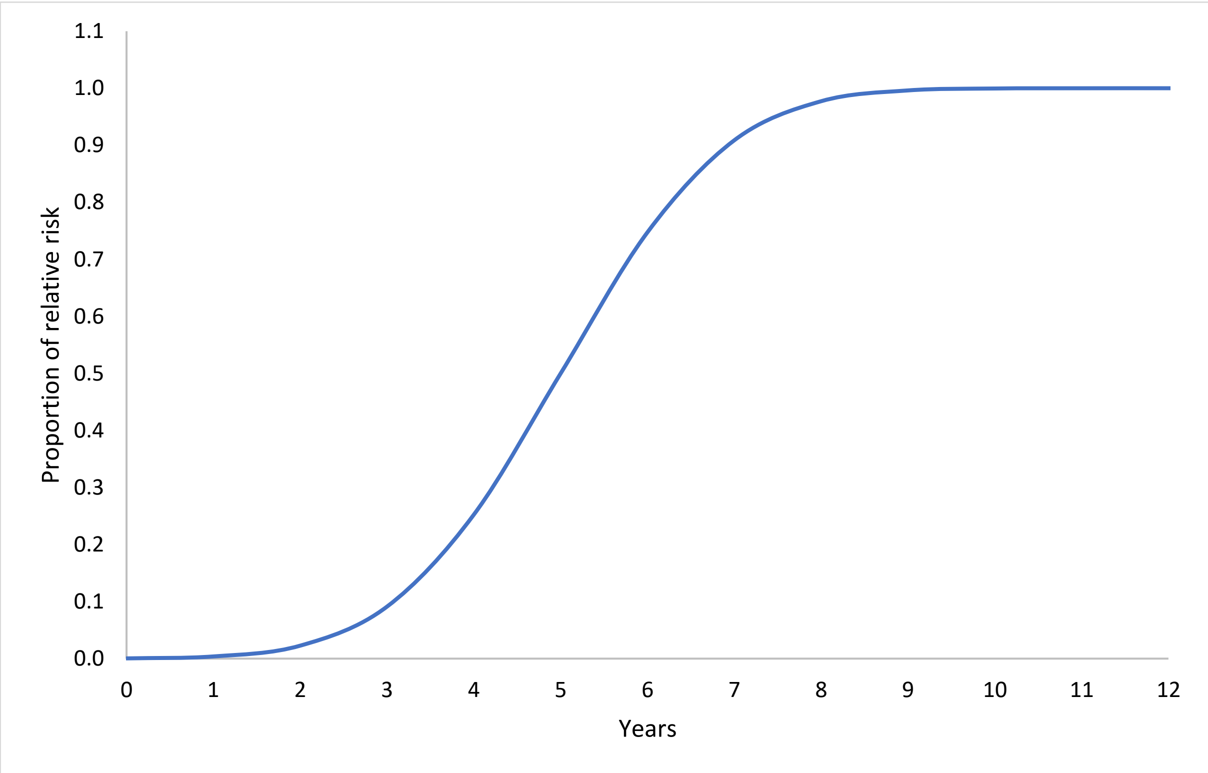
Assumptions and lags implemented in the modelling

A full list of assumptions for the health impact modelling, as well as where to find these in the text, may be found in Supplementary Table 1. We assumed that shifts in consumption patterns were adopted instantaneously, and that underlying mortality and incidence rates remained constant throughout the follow-up period. Furthermore, the model projected a consistent number of new live births into the future. In cases where several dietary exposures affected the same disease, the risks were multiplied together as done previously (23). To account for the time required for dietary changes to manifest as health impacts, we integrated time lags based on established epidemiological evidence (26,27) and a previously applied modelling approach (28). Specifically, we assumed that the time to full effect (TTFE) on ischemic heart disease, stroke, and type 2 diabetes was approximately 10 years in the main analyses. These time lags were implemented using time-varying functions derived from cumulative distribution functions of normally distributed variables, resulting in s-shaped curves (Supplementary Figures 1-3) to represent the gradual onset of health benefits. Further details regarding the precise implementation of these time lags have been previously described (28).

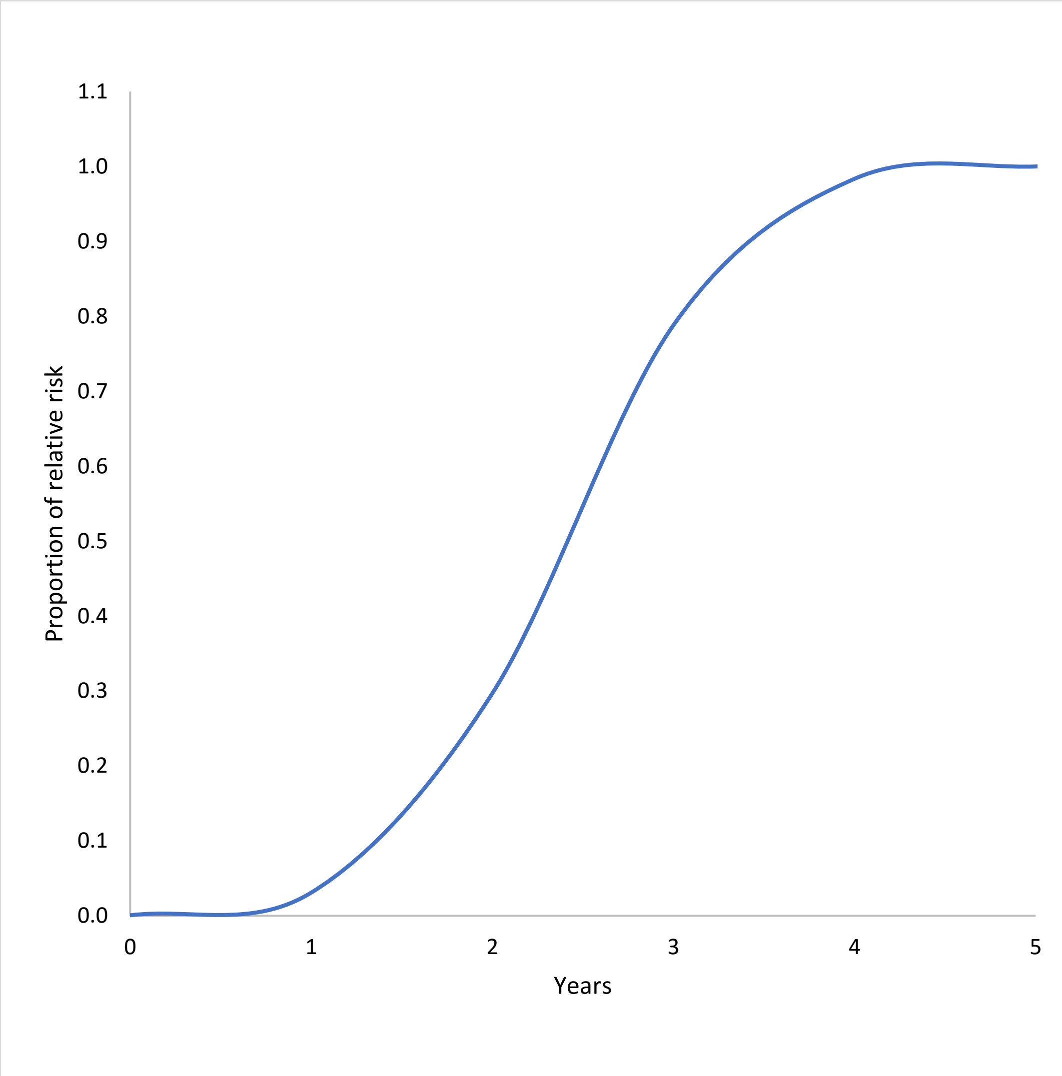
Supplementary Table 1. Main assumptions of the health impact model.

	Main assumptions	Place in text
1	Relative risks for each risk, outcome, and 5-year age range were weighted according to the age distribution in the UK population	Page 3 Supplementary Materials
2	Relative risks from the GBD were inverted to create relative risks for a positive change in diet	Page 5 main text, page 3 Supplementary Materials

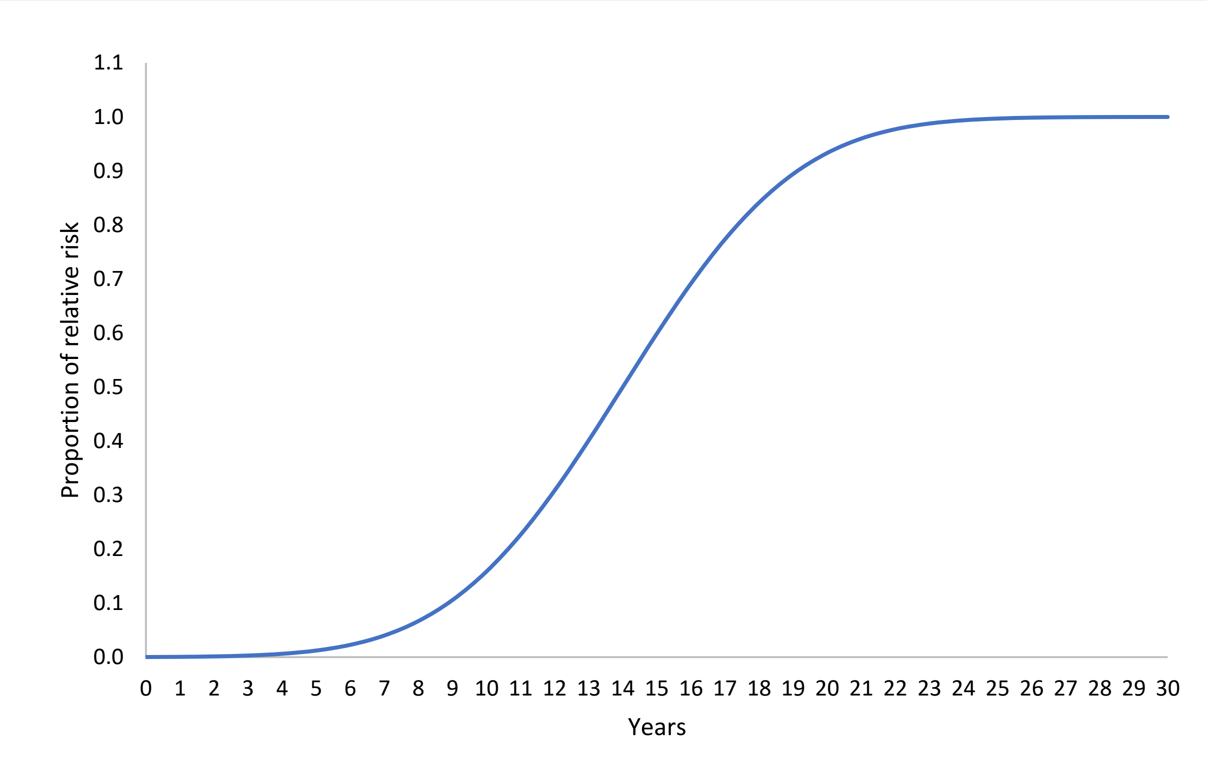
3	Disease-specific mortality and morbidity data was interpolated using monotonic cubic spline interpolation to get the rate for each 1-year age interval	Page 3 Supplementary Materials
4	Changes vegetables, legumes, red meat, and processed meat consumption were assumed to be adopted instantly.	Page 3 Supplementary Materials
5	Underlying mortality and incidence rates remained constant for the duration of follow-up	Page 3 Supplementary Materials
7	The same number of new live births into the future were assumed	Page 3 Supplementary Materials
8	The effects on all disease outcomes were assumed to reach their maximum impact after 10 years in the main analyses, and after 5 and 30 years, respectively, in the sensitivity analyses	Pages 6-7 main text and page 3 Supplementary Materials
9	To account for the time delays between dietary changes and health outcomes, time-varying functions based on cumulative distribution curves were used	Page 3-4 Supplementary Materials
10	In cases where several dietary exposures affected the same disease, the risks were multiplied together to avoid double counting.	Page 9 main text



Supplementary Figure 1. Time lag function used for health outcomes (time to full effect = 10 years).



Supplementary Figure 2. Time lag function used for health outcomes (time to full effect = 5 years).



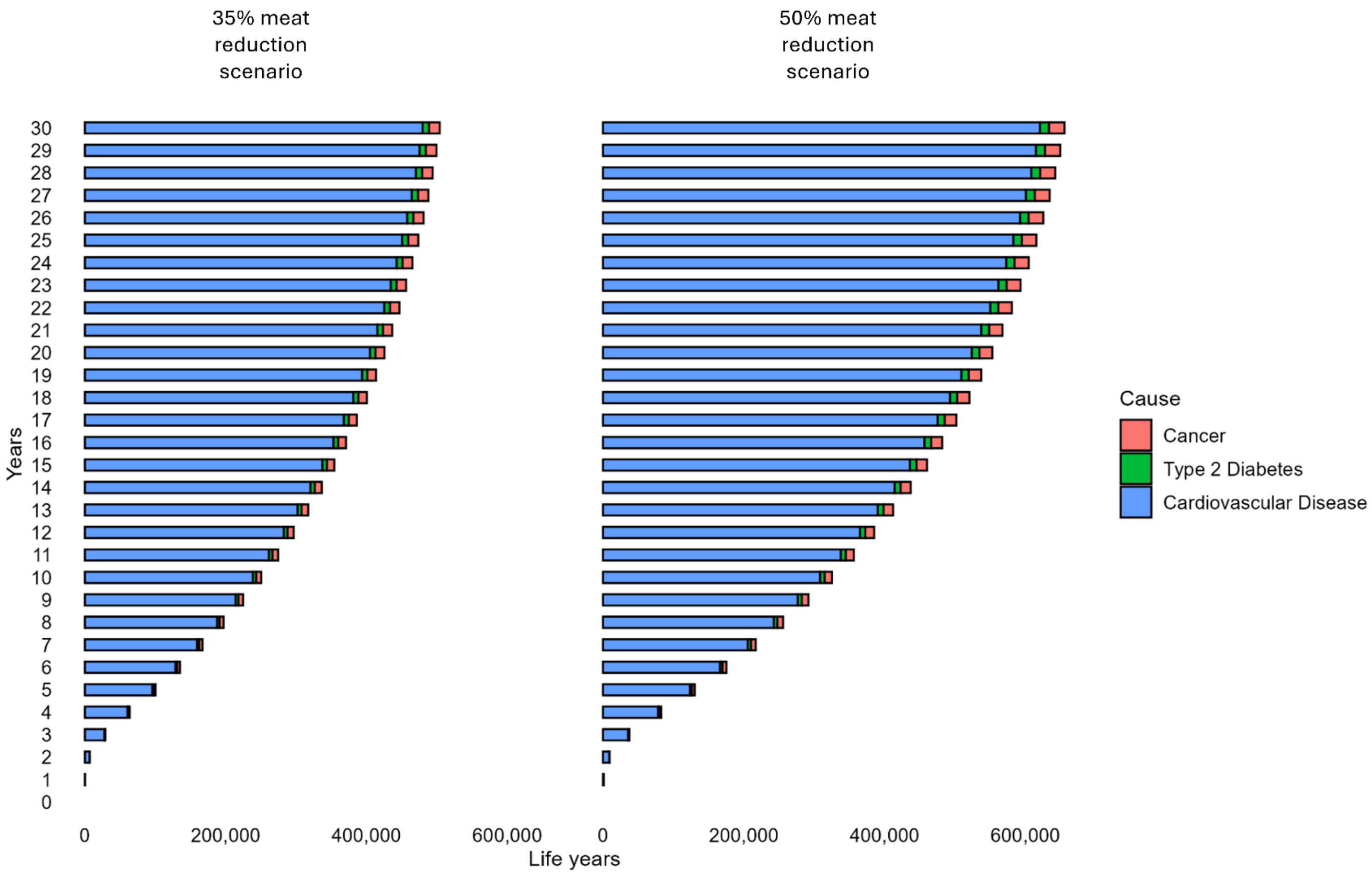
Supplementary Figure 3. Time lag function used for health outcomes (time to full effect = 30 years).

Results

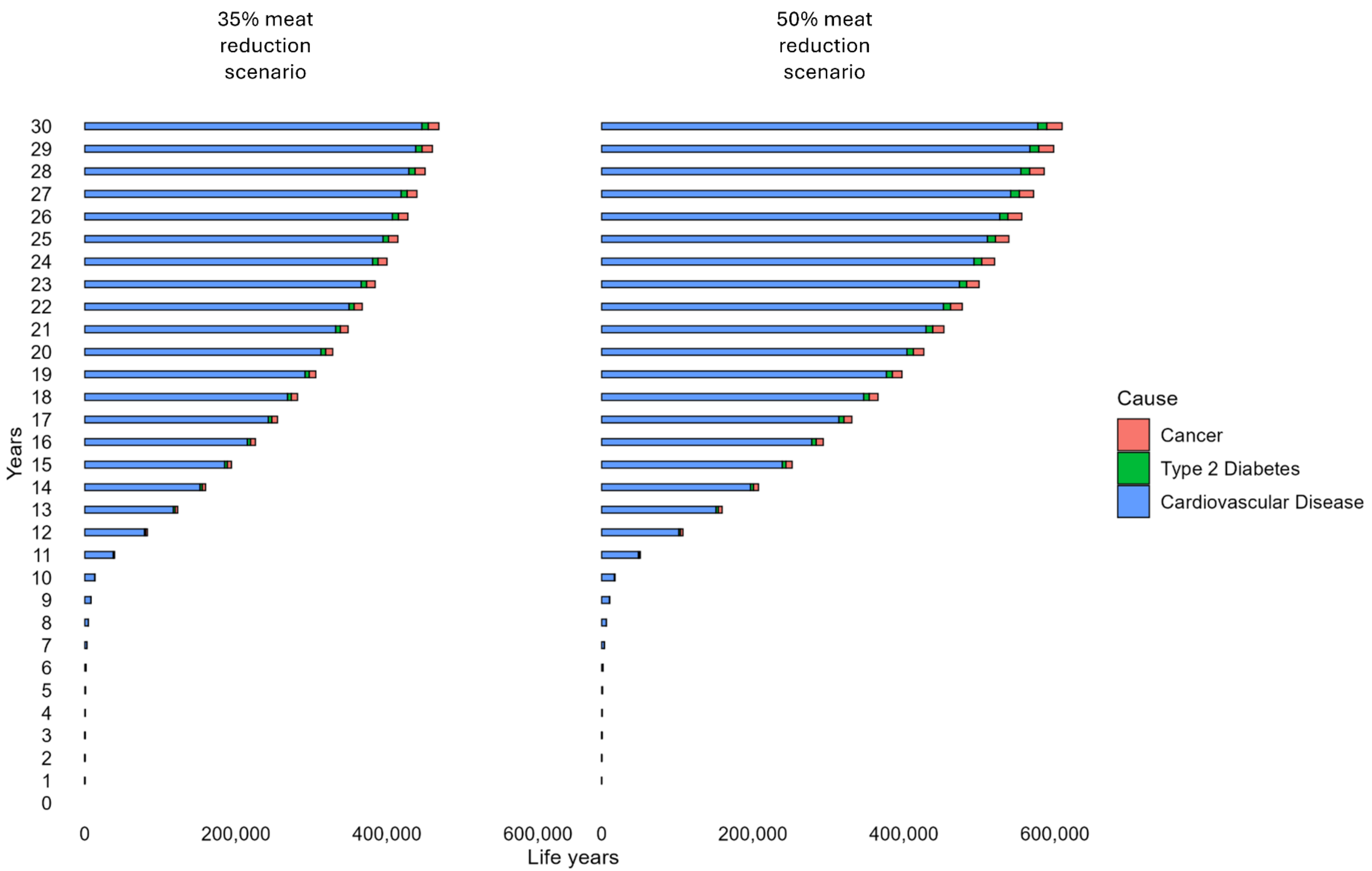
Supplementary Table 2. Changes in life expectancy, years of life gained and incidence of disease, accumulated over 30 years, 10 years into the health impact projection for the 35% and 50% meat reduction scenarios, respectively.

Outcome	35% meat reduction scenario[a]	50% meat reduction scenario[b]	35% meat reduction scenario[a]	50% meat reduction scenario[b]
LE (months)	7·22 (1·08 to 12·9)	9·39 (1·3 to 15·42)	7·22 (1·08 to 12·9)	9·39 (1·3 to 15·42)
YLG[a] (million)	9·5 (1·43 to 16·92)	12·34 (1·71 to 20·22)	6·19 (0·93 to 11·04)	8·04 (1·12 to 13·2)
Disease incidence				
Colorectal dancer	-50,495 (-2,864 to -169,981)	-77,859 (-8,398 to -245,670)	-33,909 (-2,328 to -106,593)	-51,102 (-5,703 to -151,723)
Type-2 diabetes	-879,798 (-86,887 to -2,081,616)	-1,236,212 (-158,794 to -2,725,018)	-518,839 (-51,397 to -1,225,182)	-728,526 (-93,699 to -1,602,879)
CVD[a]	-2,799,015 (-399,282 to -4,995,682)	-3,629,187 (-470,374 to -5,953,242)	-1,659,300 (-238,227 to -2,945,476)	-2,147,166 (-280,672 to -3,502,116)

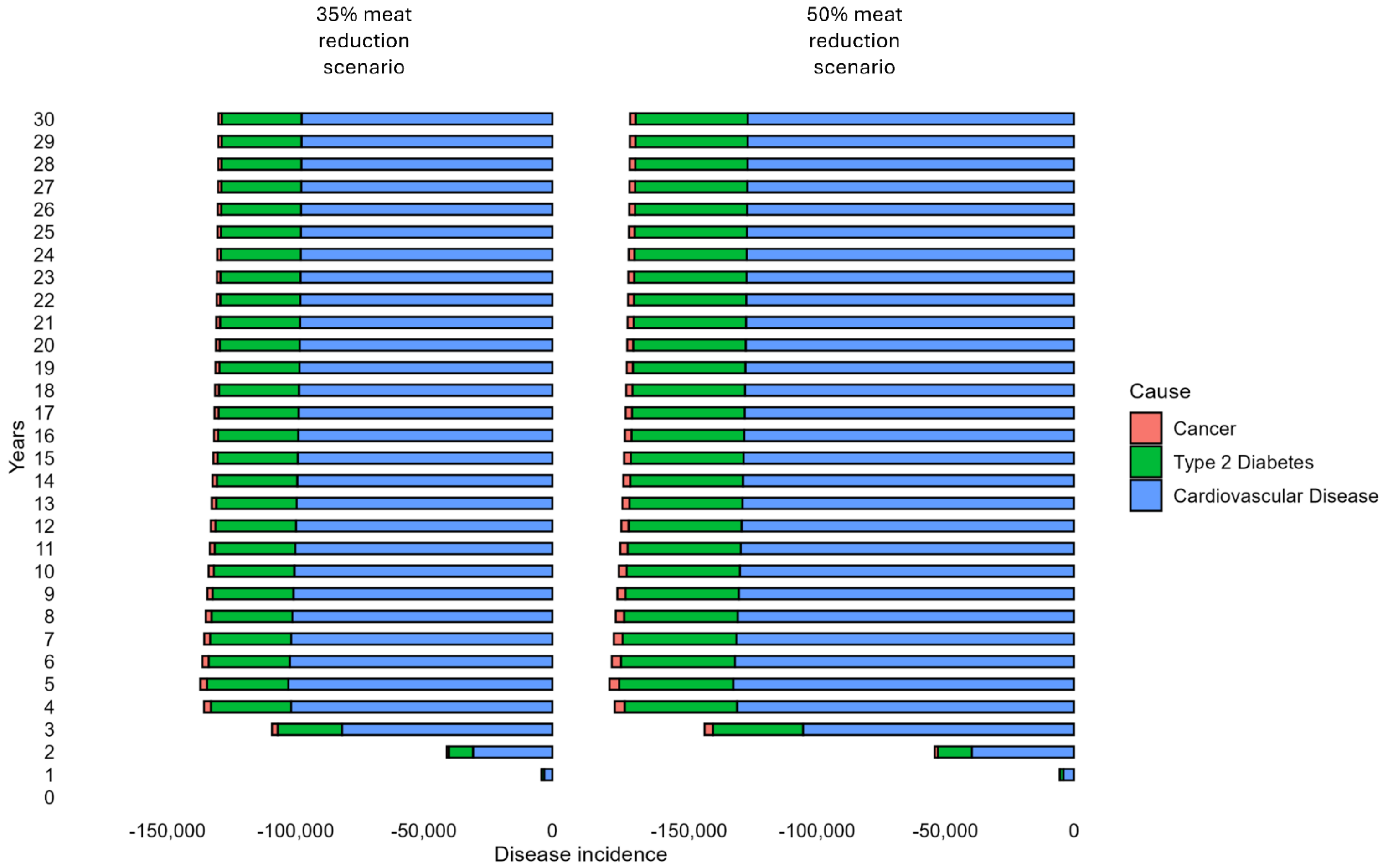
[a]Time to full effect of 5 years.
[b]Time to full effect of 30 years.
LE = Life expectancy.
YLG = Years of Life Gained.
CVD = Cardiovascular disease.
[a]Ischemic heart disease, ischemic stroke, subarachnoid haemorrhage and intracerebral haemorrhage, combined



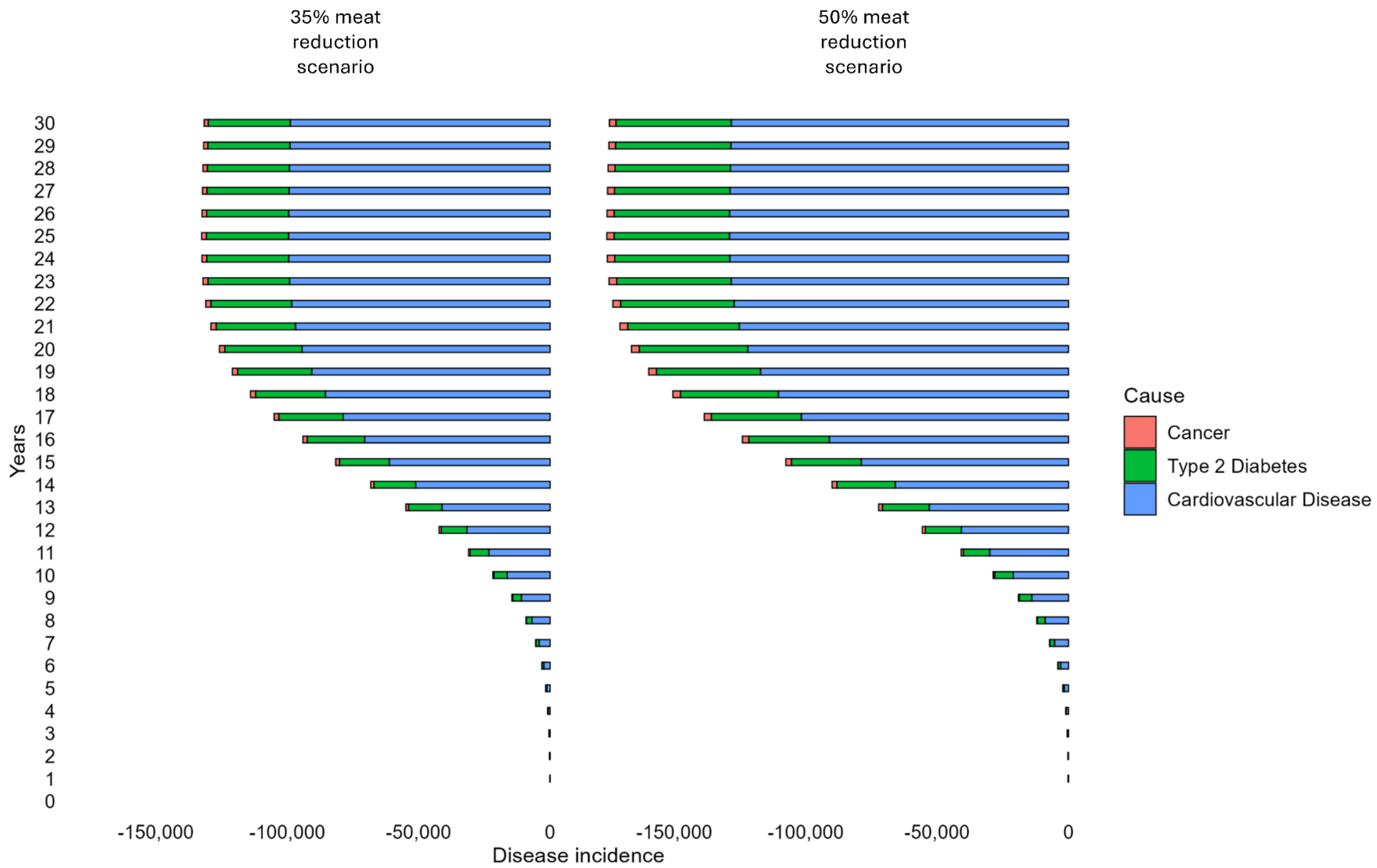
Supplementary Figure 4. Share of changes in years of life gained by disease outcome 5 years into the health impact projection for the 35% and 50% meat reduction scenarios, respectively.



Supplementary Figure 5. Share of changes in years of life gained by disease outcome 30 years into the health impact projection for the 35% and 50% meat reduction scenarios, respectively.



Supplementary Figure 6. Share of changes in disease incidence by disease outcome 5 years into the health impact projection for the 35% and 50% meat reduction scenarios, respectively.



Supplementary Figure 7. Share of changes in disease incidence by disease outcome 30 years into the health impact projection for the 35% and 50% meat reduction scenarios, respectively.

References

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