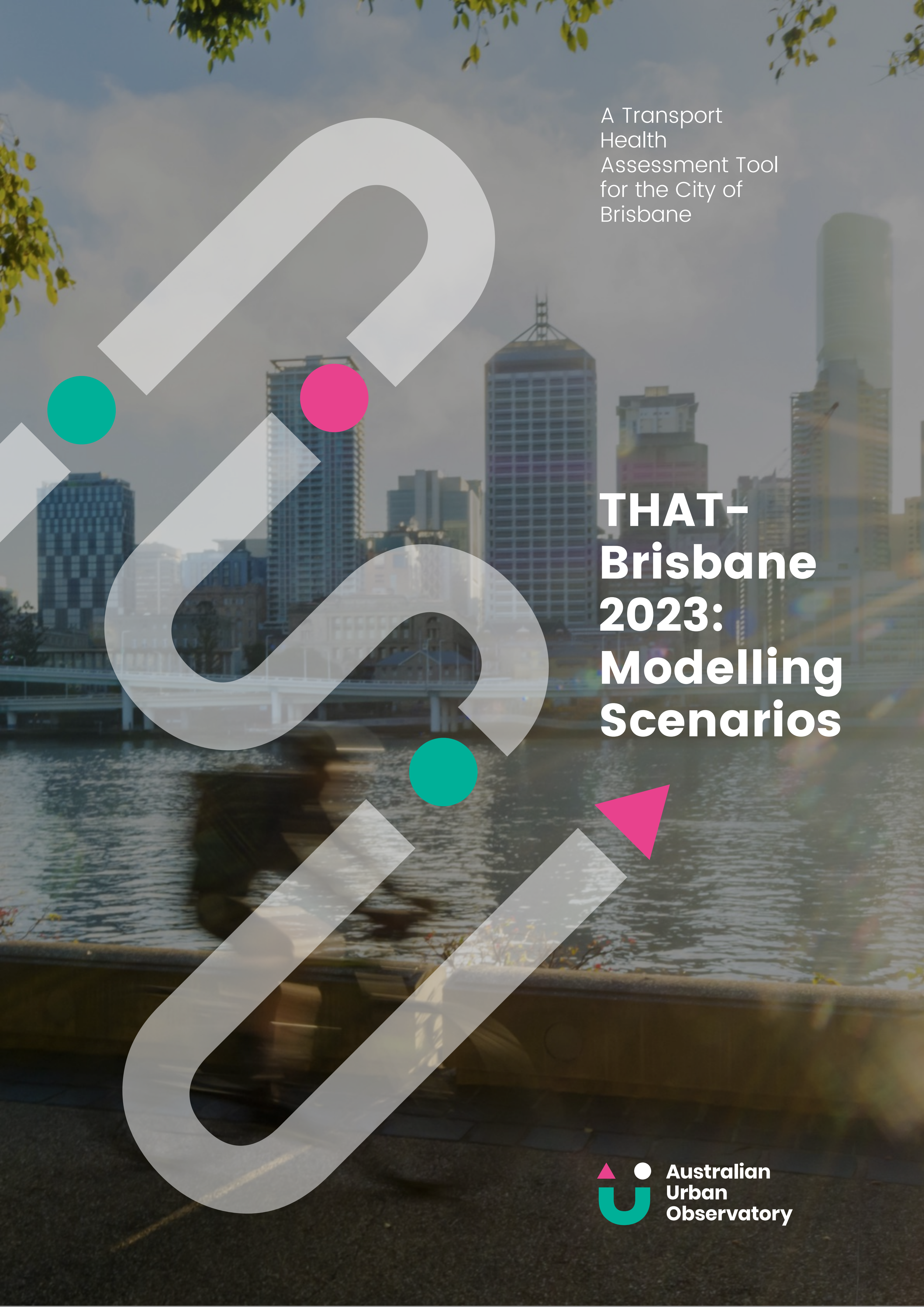

A Transport Health Assessment Tool for the City of Brisbane

THAT-Brisbane 2023: Modelling Scenarios

Australian Urban Observatory

Acknowledgements

The team gratefully acknowledges the funding from the Australian Prevention Partnership Centre with support from RMIT University. The project was co-led by Dr Lucy Gunn and Associate Professor Melanie Davern, with modelling development under the leadership of Dr Belen Zapata-Diomedi and modelling from Mr Steve Pemberton with modelling and web development by Dr Alan Both. The team would like to thank those who participated in the project workshops supporting the development of this tool and accompanying material.

We further acknowledge additional technical contributions from the Public Health Modelling Team at the MRC Epidemiology Unit at the University of Cambridge for the development of THAT-Melbourne as the precursor to THAT-Brisbane. The contributions of Dr Ali Abbas were funded by the European Research Council under the Horizon 2020 research and innovation programme (grant agreement No 817754) under the GLASST: Global and local health impact assessment of transport project. Dr Belen Zapata-Diomedi was funded by a RMIT University Vice-Chancellor's Postdoctoral Fellowship and the JIBE project (APP1192788) with some components of the code development completed during her placement at the MRC Epidemiology Unit, University of Cambridge under the supervision of Dr James Woodcock.

THAT-Brisbane and THAT-Melbourne build on the original model[1] further developed by Zapata-Diomedi et al (2019)[2], with additional development and chronic diseases [3].

This report provides active transport modelling scenario outcomes produced online in the THAT-Brisbane tool available at: auo.org.au/that-brisbane.

Additional detailed scenario modelling and visualisations can be accessed through the Australian Urban Observatory (auo.org.au).

Suggested citation

Gunn, L., Davern M., Zapata-Diomedi, B., Pemberton, S. and Both A. (2023). Transport Health Assessment Tool for Brisbane (THAT-Brisbane). RMIT University: Melbourne.

DOI 10.25439/rmt.24598212.

Enquiries regarding this report may be directed to:

auo@rmit.edu.au
RMIT University City campus
124 La Trobe Street
Melbourne VIC, 3000
Australia

W auo.org.au.

The Australian Prevention Partnership Centre
Systems and solutions for better health

RMIT UNIVERSITY | Centre for Urban Research

Contents

Scenario: replacing car trips under 1km with walking for all trip purposes

This scenario shows the results of replacing car trips under 1km for leisure, shopping, work, education or other purposes with walking trips for all adults of all ages.

This implies that the selected scenario results in a mode shift in walking from 16.8% to 20.2% and from 74.7% to 71.3% for car trips taken as either a driver or passenger.

Increases in walking translate into a shift from 47.9% to 49.6% of the population accumulating the required minutes spent being moderately (150 – 300 mins) or vigorously physically active (75 – 150 mins) or an equivalent combination of both contributing to recommended levels as detailed in the Physical Activity Guidelines.

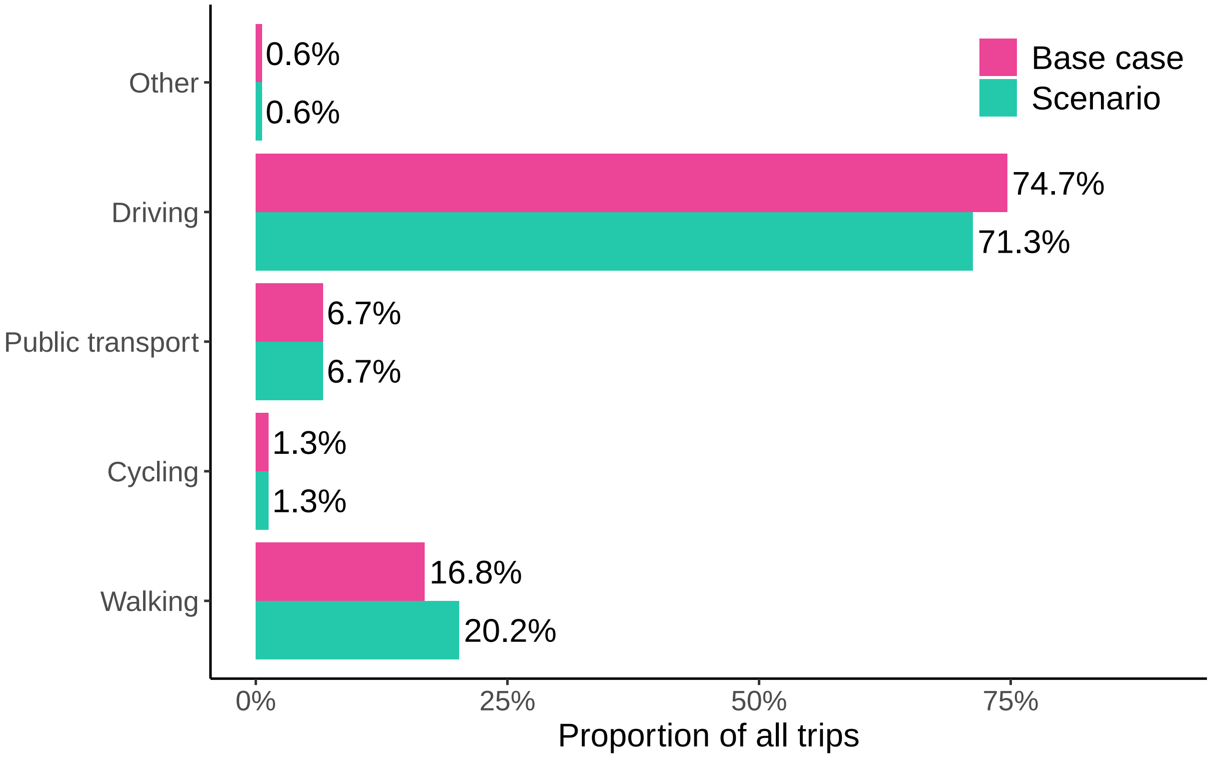

Figure 1: Distribution of base case and scenario trips.

Incidence

Incidence describes the rate of occurrence of new cases of a disease over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of disease prevented, due to increases in physical activity associated with the scenario. Figure 2 presents the change (%) in the disease incidence across the life course. Figure 3 presents how the difference in disease incidence changes over time, by year, using a snapshot of the population from 2019.

Table 1 shows how the scenario impacts the incidence of chronic diseases as both as a percentage and total number of prevented cases.

Table 1. Chronic disease incidence reduction and total number of prevented cases of disease measured across the years of the simulation

Disease*	Incidence of disease is reduced by	Total number of prevented cases of disease aggregated across the simulation
Alzheimer's disease and other dementias	0.10%	644
Breast cancer	0.08%	58
All cancers	0.26%	1,014
Colon cancer	0.10%	130
Chronic myeloid leukemia	0.56%	15
Diabetes type 2	0.68%	2,255
Depression	0.21%	3,442
Head and neck cancer	0.91%	40
Ischemic heart disease	0.37%	3,275
Liver cancer	0.41%	72
Multiple myeloma	0.62%	120
Stomach cancer	0.52%	125
Stroke	0.45%	1,162
Lung cancer	0.38%	437
Uterine cancer	0.20%	17

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

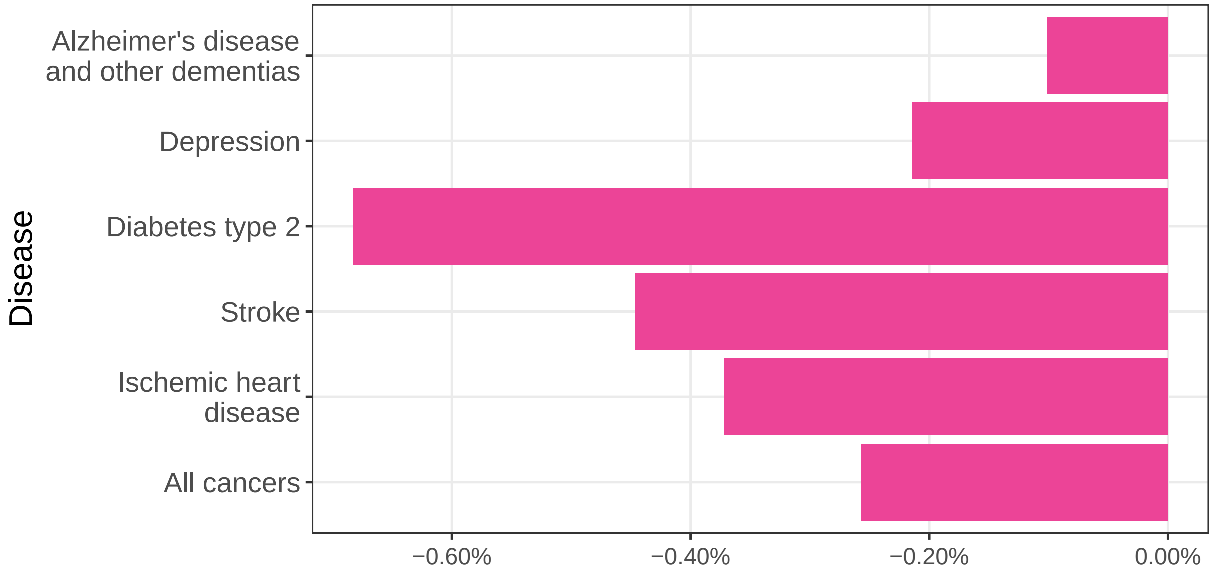

Figure 2.a: Percentage change in incidence by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

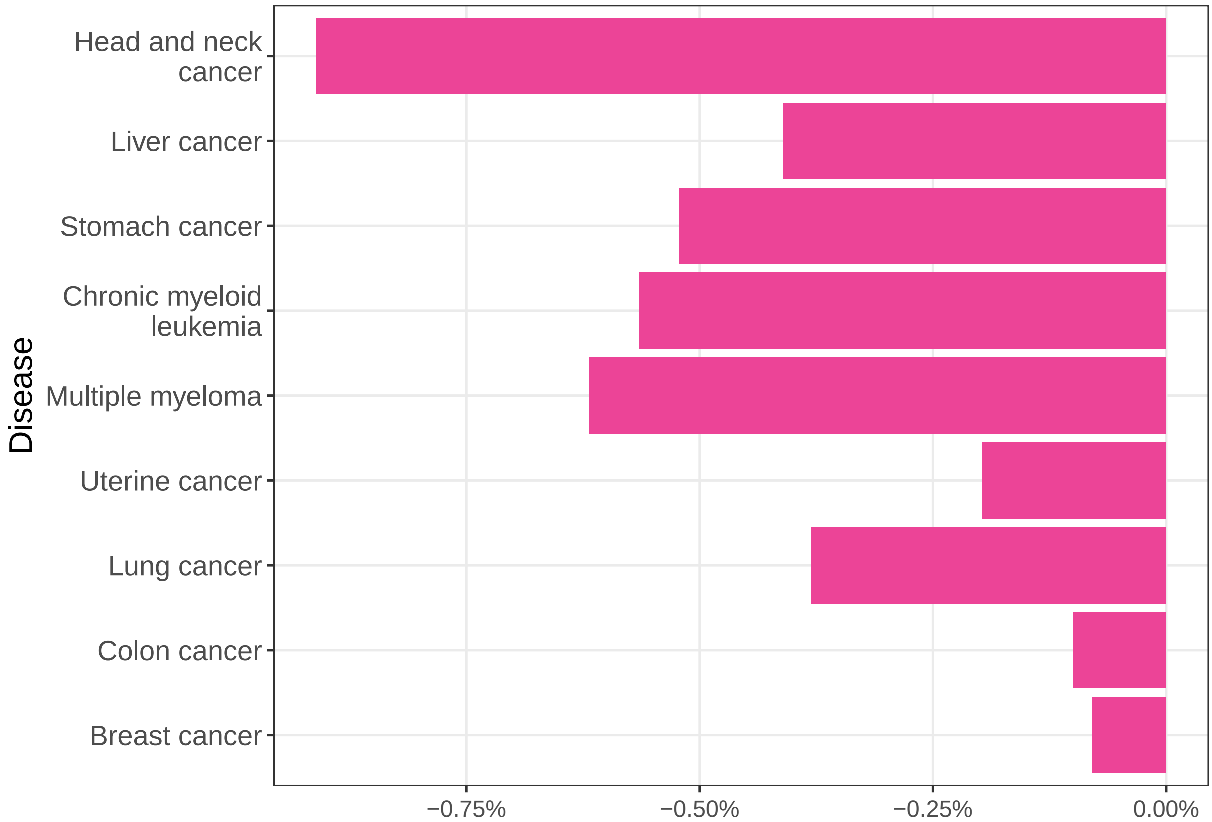

Figure 2.b: Percentage change in incidence for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

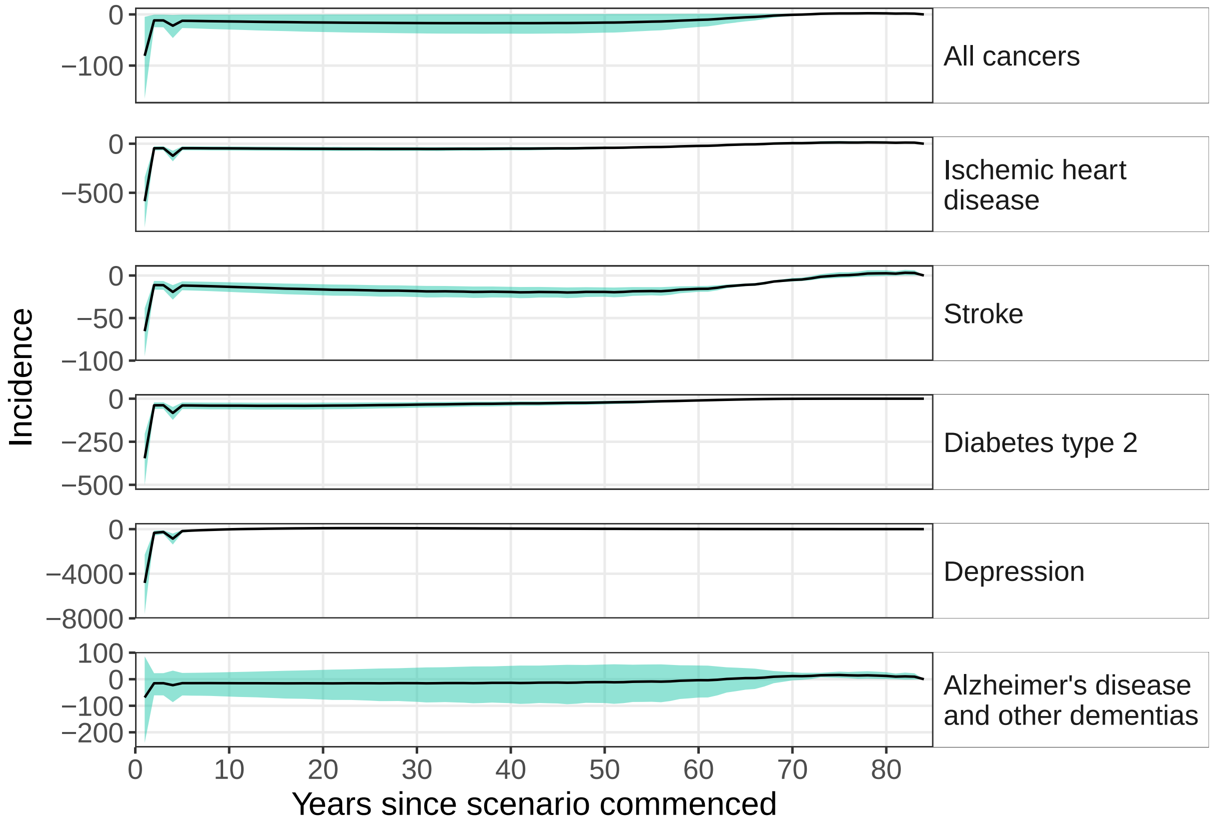

Figure 3.a: The change in incidence over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

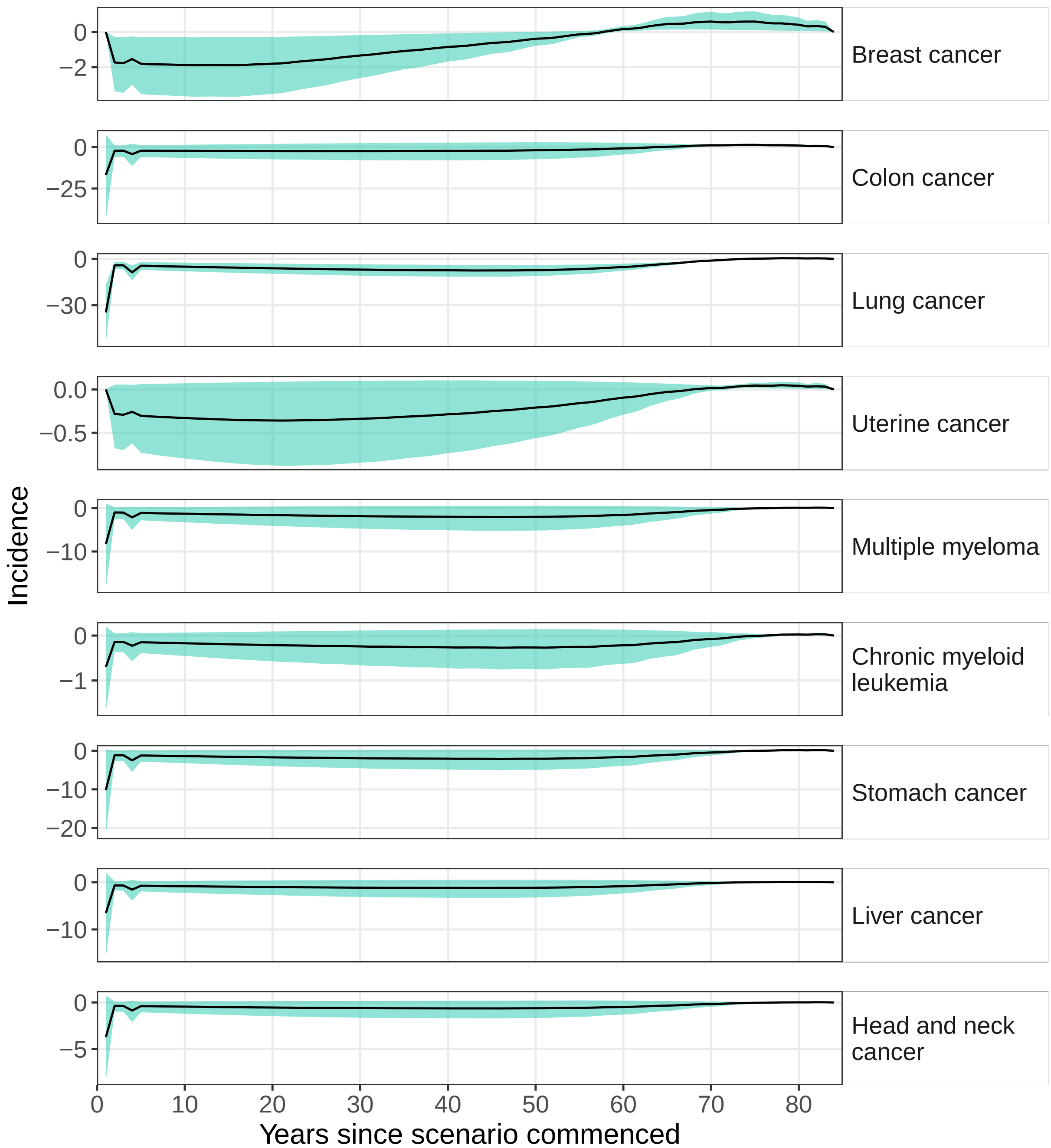

Figure 3.b: Percentage change in incidence for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Mortality

Mortality is the number of deaths due to a given disease over over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of prevented deaths due to increases in physical activity associated with the scenario. Figure 4 presents the total change in mortality over the life course. Figure 5 presents the difference in the number of deaths by year using a snapshot of the population from 2019.

Table 2 shows how the scenario impacts reductions in mortality presented as a percentage and total number of prevented deaths caused by chronic diseases.

Table 2. Percentage reduction in mortality and total number of prevented deaths by chronic disease measured across the years of the simulation.

Disease*	Mortality is reduced by	Total number of prevented deaths aggregated across the simulation
Alzheimer's disease and other dementias	0.00%	-11
Breast cancer	0.00%	1
All cancers	0.30%	771
Colon cancer	0.05%	20
Chronic myeloid leukemia	0.52%	11
Diabetes type 2	0.47%	235
Depression	0.00%	0
Head and neck cancer	0.92%	37
Ischemic heart disease	0.34%	1,265
Liver cancer	0.41%	70
Multiple myeloma	0.60%	105
Stomach cancer	0.51%	107
Stroke	0.41%	713
Lung cancer	0.38%	409
Uterine cancer	0.15%	11

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

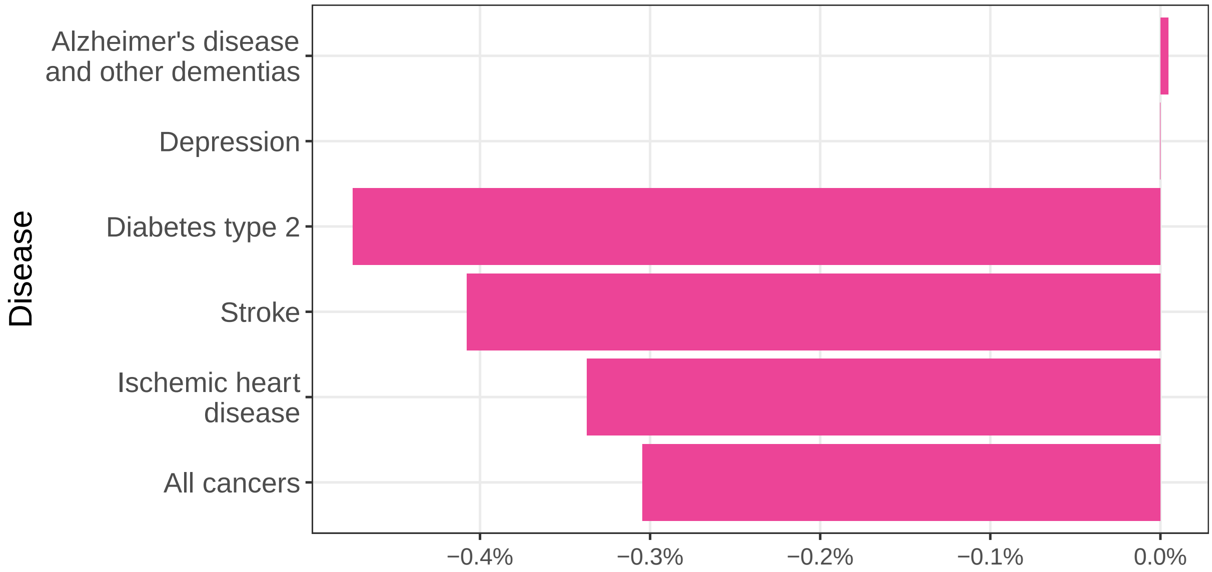

Figure 4.a: Percentage change in mortality by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

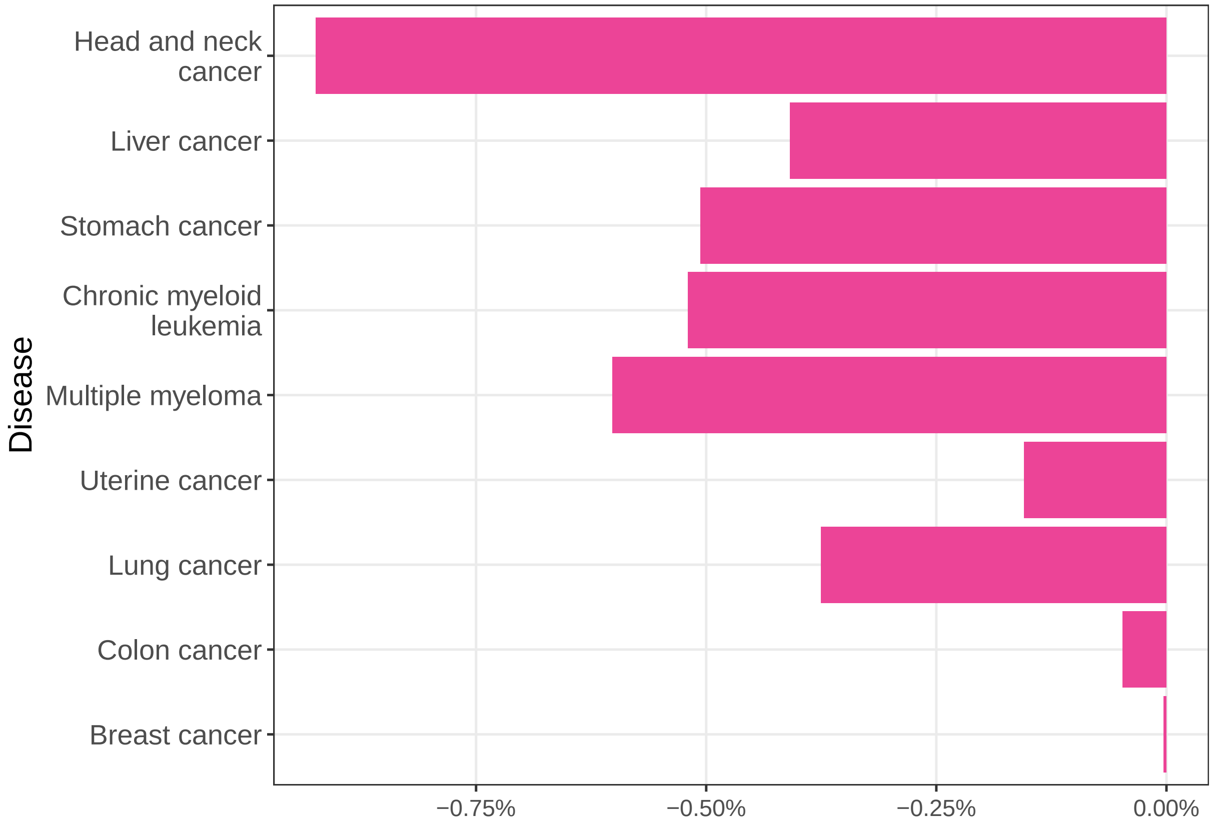

Figure 4.b: Percentage change in mortality for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

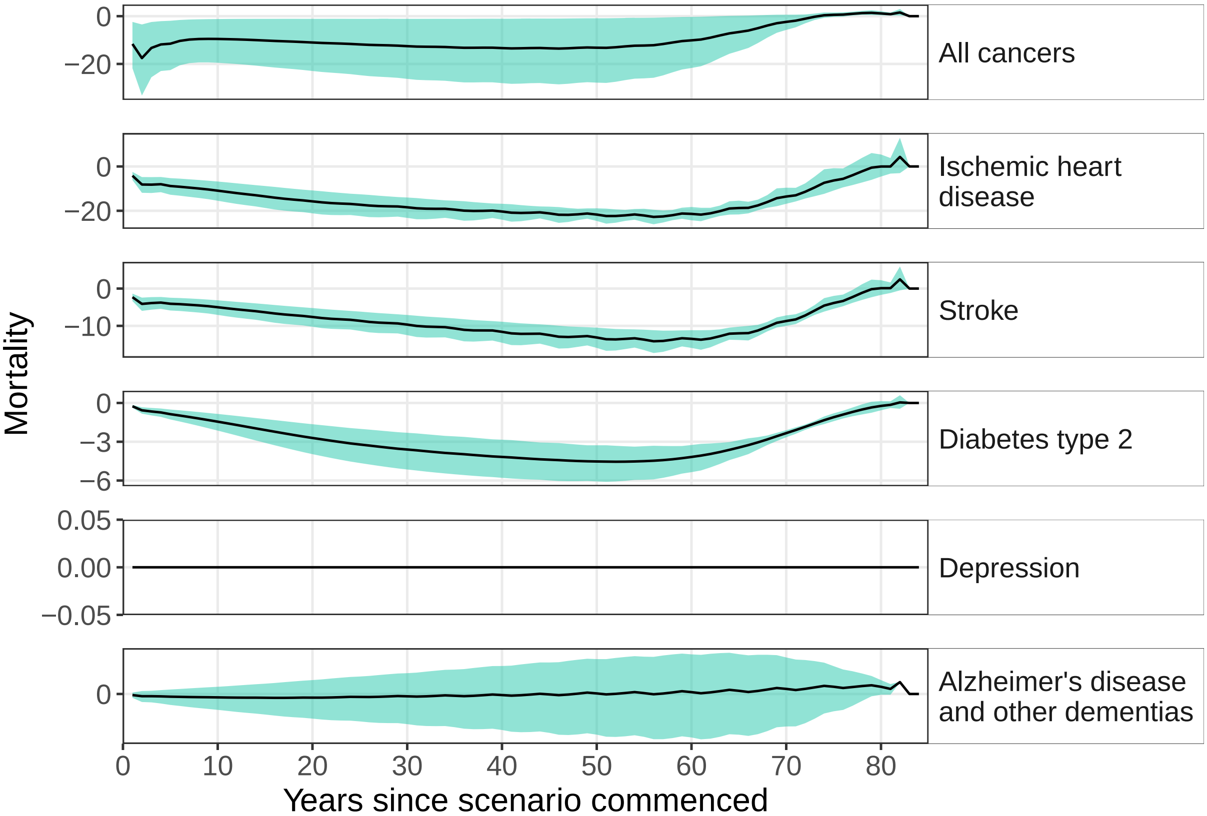

Figure 5.a: The change in mortality over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

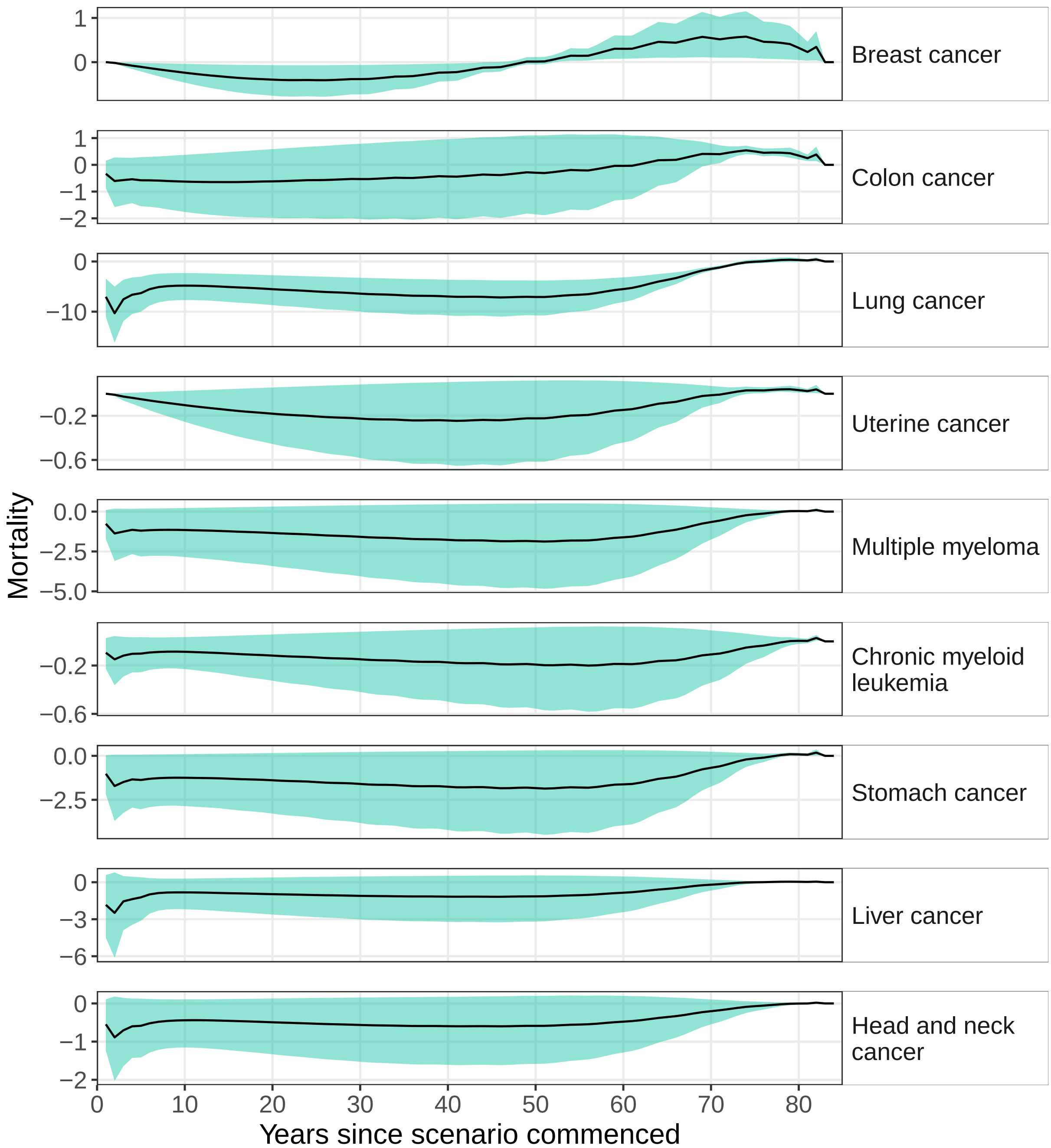

Figure 5.b: Percentage change in mortality for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Health

Figures 6 and 7 below show the change in Health Adjusted Life Years (HALYs)[1] and Life Years[2] for a snapshot of the population from 2019 for the scenario. Both figures show that the greatest gains from increasing physical activity occur midway through the life cycle with most of the gains occurring cumulatively in the long term. The decline from the mid-point onwards is due to individuals dying from natural causes within the model.

HALYS

The model estimates a total of **91,651** HALYs for the scenario population, which is **46** HALYs per 1,000 members of the population.

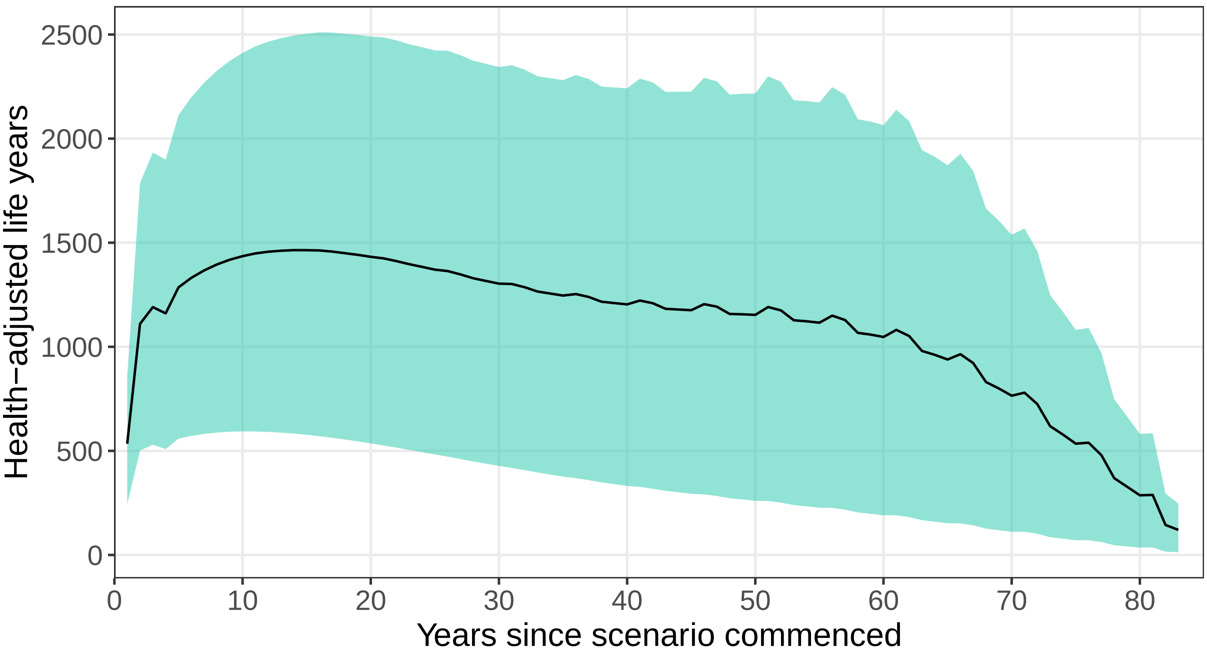

Figure 6. Total health-adjusted life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

[1]Health Adjusted Life Years are holistic measures of health that account for morbidity, mortality and quality of life.

[2]Life Years are similar to a HALYs however they exclude the quality of life component.

Life Years

The model estimates a total of **50,589** Life Years for the scenario population, which is **25** Life Years per 1,000 members of the population.

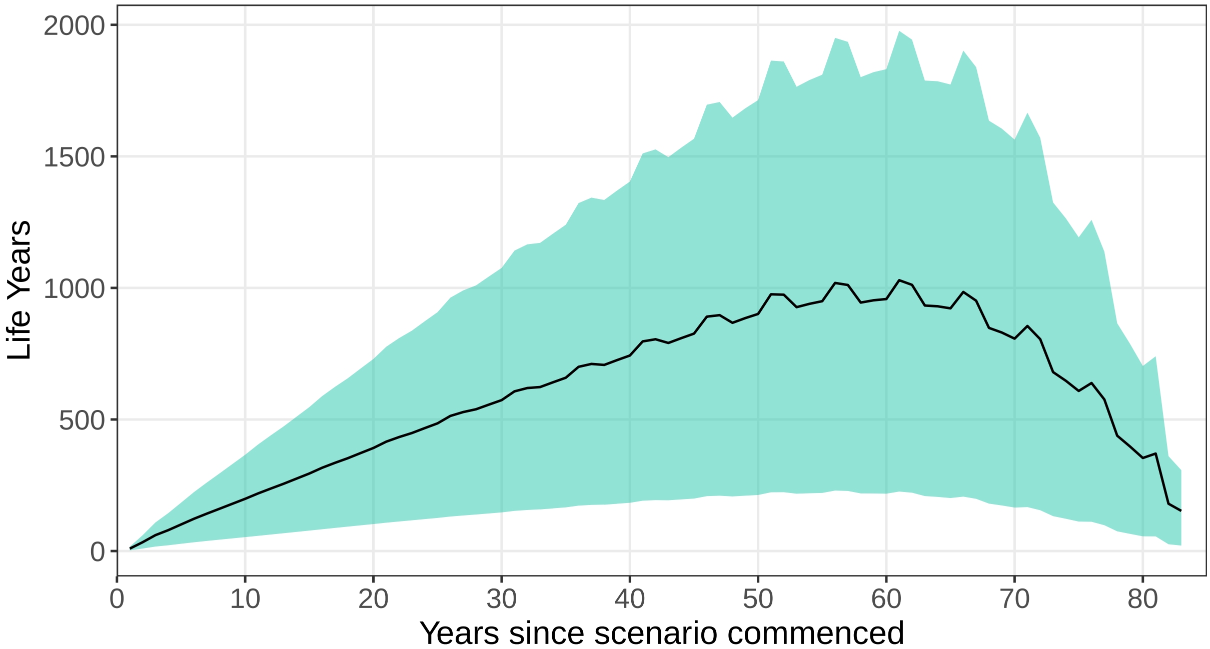

Figure 7. Total life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Value

The value of improvements to community health can be calculated**[a]** by translating the Health Adjusted Life Years (HALYs) from each scenario into dollar terms using the value of a statistical life year**[b]**. The value of a statistical life year is an estimate of the amount a society is willing to trade to reduce the risk of death for one year.

In the simulation model, HALYs are generated across time and are cumulative. Thus, to help us understand the value of HALYs across time in present day terms, it is necessary to use discounting**[c]** to reduce HALYs generated at the future point in time. Discounted HALYs from these future points can be added up to give the aggregate value of HALYs in today's terms as a measure of the value of improvements to community health arising from the chosen scenario.

The size of the discount rate can impact the aggregated value of HALYs and there is considerable debate on what discount rates should be used (with some arguing that health should not be discounted at all).[2] Hence, it is common to use a variety of discount rates to allow for differing risks, preferences and sensitivity when valuing health. The figures presented below were calculated using discount rates of 3%, 5% and 7% based on recent recommendations [3, 4] and represent the value of HALYs in present day terms resulting from an increase in physical activity from the chosen scenario.

The value of improvements to community health

The model estimates a total of **HALYs,** Health Adjusted Life Years (HALYs) gained for the scenario population, which is **46** HALYs per 1,000 members of the scenario population. The figures below represent the value of improvements to community health from the chosen scenario. These figures can be used in summary reports and for advocacy purposes**[d]**.

The HALYs gained in this scenario have a statistical value of:

- **4,023,467** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **2,667,277** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **1,940,503** per 1,000 members of the population, when calculated using a discount rate of 7%.

a. What is meant by value and how can it be measured?

Value is conceptual and measures a sense of worth or usefulness of something to individuals or to a society. Measuring the value of something, such as health, enables it to be included in assessments or analyses such as cost-benefit analyses to recognise its relative importance.

Value can be derived in many ways and a common approach is to use monetary terms, such as dollars. Valuing something using dollars is not the same as equating it with its price. Prices represent the amount at which something can be traded, prices therefore represent the amount of money for buying or selling something such as food, clothing or to pay bills. One way is to evaluate health in dollar terms is to use the Value of a Statistical Life and Value of a Statistical Life Year**[b]**.

b. What is the Value of a Statistical Life and Value of a Statistical Life Year?

The value of a **statistical life** is the estimated amount that a society is willing to trade to reduce the risk of death. The word 'Statistical' refers to the average value for life and therefore means the value of a statistical life doesn't relate to any specific individual. This value can change across risk factors and different societies who may value life differently. There are various ways of measuring the value of a statistical life with most approaches using revealed or stated preference approaches.[3] In Australia, the Office of Best Practice Regulation estimates a statistical life at $5.3M in 2022 dollar terms, and assumes that the life is of a young person with at least another 40 years to live.[5, 6]

Value of a Statistical Life Year

The value of a statistical life year is the estimated amount that a society is willing to trade to reduce the risk of death over **one year.** It can be derived from the value of a statistical life or measured directly using surveys or willingness to pay techniques.[5] The current value of a **statistical life year** is $227,000 in 2022 dollars based on current estimates from the Office of Best Practice Regulation.[6] The value of a statistical life year is useful for evaluating small increases in life years instead of evaluating full life expectancy. It is appropriate for valuing the Health Adjusted Life Years estimated from the scenarios and modelling presented in this tool. For the modelling and results presented here, the value of $227,000 was converted to 2019 dollars based on the Wage Price Index for Brisbane.

c. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

d. Application in advocacy and reporting

This section uses figures to show how the value of community health (estimated from HALYs and the value of statistical life year) can be used for reporting and advocacy purposes.

The simulation model uses **population-based estimates** for disease morbidity and mortality and is best applied to larger groups of people. It also assumes that the people of interest have similar characteristics and behaviours to the population data used in the simulation model and scenarios. The **example** below shows results from a scenario that replaces car trips with walking trips for distances of 0-2 km for All age groups.

Example:

The HALYs gained in this scenario have a statistical value of:

- **$10,859,605** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **$6,662,541** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **$4,533,392** per 1,000 members of the population, when calculated using a discount rate of 7%.

This **example** shows that the HALYs gained in this scenario have a statistical value of $10,859,605 per 1,000 members of the population using a discount of 3%.

This figure can be divided by 1,000 to give a per person figure. Once a per person figure is established, it can be multiplied by the number of people in any population size of interest for use in reports or as evidence to advocate for benefits associated with shifts to active transport modes.

$10,859,605 / 1,000 = $10,859.61 per person value

A good example of how this model can be applied links to previous research that investigated the impact of new more walkable development in Altona North on a population of 21,000 people [11]. If we assume that these people have similar characteristics to the underlying population based estimates and behaviours based on the travel survey data in the simulation model underlying this tool, then the value of community health according to the chosen scenario can be calculated as:

21,000 (people) x $10,859 (statistical value from HALYs gained) = $228 M.

Savings

An increase in physical activity due to the chosen scenario reduces chronic disease cases across a lifetime and reduces spending for each disease within the health care system resulting in overall health care cost savings**[a]**.

Table 3 provides estimated health care cost savings associated with the prevented cases of chronic diseases per 1,000 members of the population according to the selected scenario. These figures are based on applying average health care system costs per prevalent case of disease and using three alternative discount rates**[b]**:

Table 3. Total health care cost savings by disease per 1,000 members of the population.

Disease	3% discount rate	5% discount rate	7% discount rate
Alzheimer's disease and other dementias	$2,378	$1,532	$1,077
Breast cancer	$12,160	$7,949	$5,413
All cancers	$47,347	$31,797	$22,896
Colon cancer	$11,173	$8,060	$6,079
Chronic myeloid leukemia	$3,931	$2,353	$1,557
Diabetes type 2	$14,963	$9,522	$6,592
Depression	$114,123	$88,757	$71,001
Head and neck cancer	$636	$438	$329
Ischemic heart disease	$38,043	$24,967	$17,901
Liver cancer	$477	$343	$269
Multiple myeloma	$9,292	$6,166	$4,485
Stomach cancer	$3,373	$2,253	$1,651
Stroke	$5,389	$3,287	$2,210
Lung cancer	$5,431	$3,705	$2,767
Uterine cancer	$876	$536	$352

a. What do we mean by health care cost savings?

To calculate health care cost savings for each disease, the annual costs for each disease in each year is multiplied by the number of prevented cases of each disease for each scenario. This results in a total saving in spending for each disease by year. The savings in spending for future years are discounted**[b]** with annual savings aggregated to give a total amount saved for each disease. Total savings are presented as the amount saved per 1,000 members of the population to enable comparisons against populations of different sizes.

We use the term **health care cost saving** because it represents a reduction in health spending. However, the Australian Institute of Health and Welfare (AIHW) stress that the term cost is broad and not representative of the full cost experienced by individuals, families, or the health system, consequently AIHW use the term spending.[8]

These figures use AIHW estimates of the amounts spent through the health system in 2018-19 for each case of disease. This is extracted from Health system spending per case of disease and for certain risk factors, Table 1 – Estimates of health system spending per case, by burden of disease group, condition and sex, Australia 2018-2019.[9]. For head and neck cancers, supplementary figures were obtained from the Global Burden of Disease incidence data.[10]

b. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

References

1. Gold, M. R., Stevenson, D., & Fryback, D. G. (2002). *HALYS and QALYS and DALYS, Oh My: similarities and differences in summary measures of population Health.* Annual review of public health, 23(1), 115-134.
2. Attema, A.E., Brouwer, W.B. & Claxton, K. (2018). *Discounting in economic evaluations.* Pharmacoeconomics. 36: p. 745-758.
3. Ananthapavan, J., Moodie, M., Milat, A.J., & Carter, R. (2021). *Systematic review to update 'value of a statistical life' estimates for Australia.* International journal of environmental research and public health, 2021. 18(11): p. 6168.
4. Terrill, M. & Batrouney, H. (2018). *Unfreezing discount rates: Transport infrastructure for tomorrow.* Grattan Institute.
5. Abelson, P. (2008). *Establishing a monetary value for lives saved: issues and controversies.* Canberra: Office of Best Practice Regulation, Department of Finance and Deregulation.
6. Department of the Prime Minister and Cabinet. (2022). *Best practice regulation guidance note: Value of statistical life.* Australian Government.
7. Haacker, M., Hallett, T.B. & Atun, R. (2020). *On discount rates for economic evaluations in global health.* Health Policy and Planning, 2020. 35(1): p. 107-114.
8. Australian Institute of Health and Welfare (2023). Technical Notes: Estimating Spending per prevalent case of disease. Health system spending per case of disease and for certain risk factors, Estimating the spending per prevalent case of disease - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
9. Australian Institute of Health and Welfare (2023). Health system spending per case of disease and for certain risk factors. Health system spending per case of disease and for certain risk factors, Data - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
10. Global Burden of Disease (2019). Global Health Data Exchange. https://vizhub.healthdata.org/gbd-results. Accessed September 20, 2023.
11. Zapata-Diomedi, B., Boulangé, C., Giles-Corti, B., Phelan, K., Washington, S., Veerman, L.J., & Gunn, L. (2019). Physical activity-related health and economic benefits of building walkable neighbourhoods: A modelled comparison between brownfield and greenfield developments. International Journal of Behavioural Nutrition and Physical Activity.
12. Khorasani, E., Davari, M., Kebriaeezadeh, A., Fatemi, F., Akbari Sari, A., & Varahrami, V. (2022). A comprehensive review of official discount rates in guidelines of health economic evaluations over time: the trends and roots. The European Journal of Health Economics, 23(9), 1577-1590.

Scenario: replacing car trips under 2km with walking for all trip purposes

This scenario shows the results of replacing car trips under 2km for leisure, shopping, work, education or other purposes with walking trips for all adults of all ages.

This implies that the selected scenario results in a mode shift in walking from 16.8% to 28.9% and from 74.7% to 62.6% for car trips taken as either a driver or passenger.

Increases in walking translate into a shift from 47.9% to 56.1% of the population accumulating the required minutes spent being moderately (150 – 300 mins) or vigorously physically active (75 – 150 mins) or an equivalent combination of both contributing to recommended levels as detailed in the Physical Activity Guidelines.

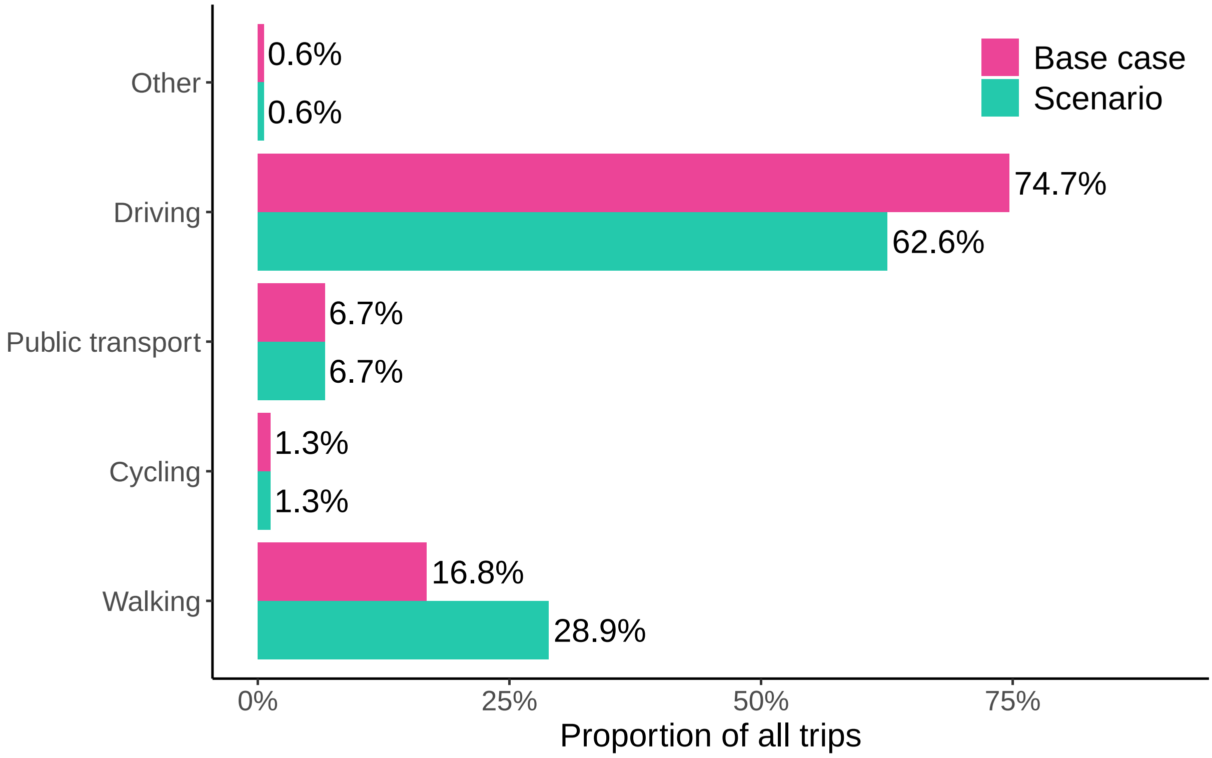

Figure 1: Distribution of base case and scenario trips.

Incidence

Incidence describes the rate of occurrence of new cases of a disease over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of disease prevented, due to increases in physical activity associated with the scenario. Figure 2 presents the change (%) in the disease incidence across the life course. Figure 3 presents how the difference in disease incidence changes over time, by year, using a snapshot of the population from 2019.

Table 1 shows how the scenario impacts the incidence of chronic diseases as both as a percentage and total number of prevented cases.

Table 1. Chronic disease incidence reduction and total number of prevented cases of disease measured across the years of the simulation

Disease*	Incidence of disease is reduced by	Total number of prevented cases of disease aggregated across the simulation
Alzheimer's disease and other dementias	0.58%	3,706
Breast cancer	0.44%	320
All cancers	0.99%	3,889
Colon cancer	0.44%	576
Chronic myeloid leukemia	1.88%	51
Diabetes type 2	2.62%	8,662
Depression	0.64%	10,191
Head and neck cancer	3.21%	142
Ischemic heart disease	1.42%	12,515
Liver cancer	1.66%	293
Multiple myeloma	2.26%	437
Stomach cancer	2.11%	503
Stroke	1.75%	4,546
Lung cancer	1.30%	1,495
Uterine cancer	0.83%	71

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

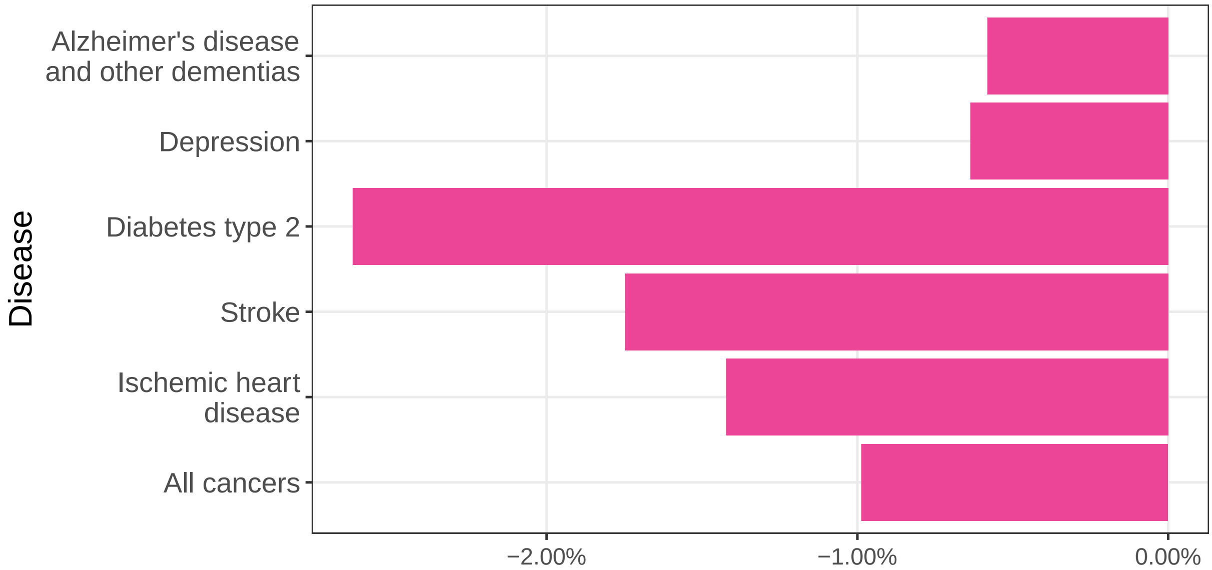

Figure 2.a: Percentage change in incidence by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

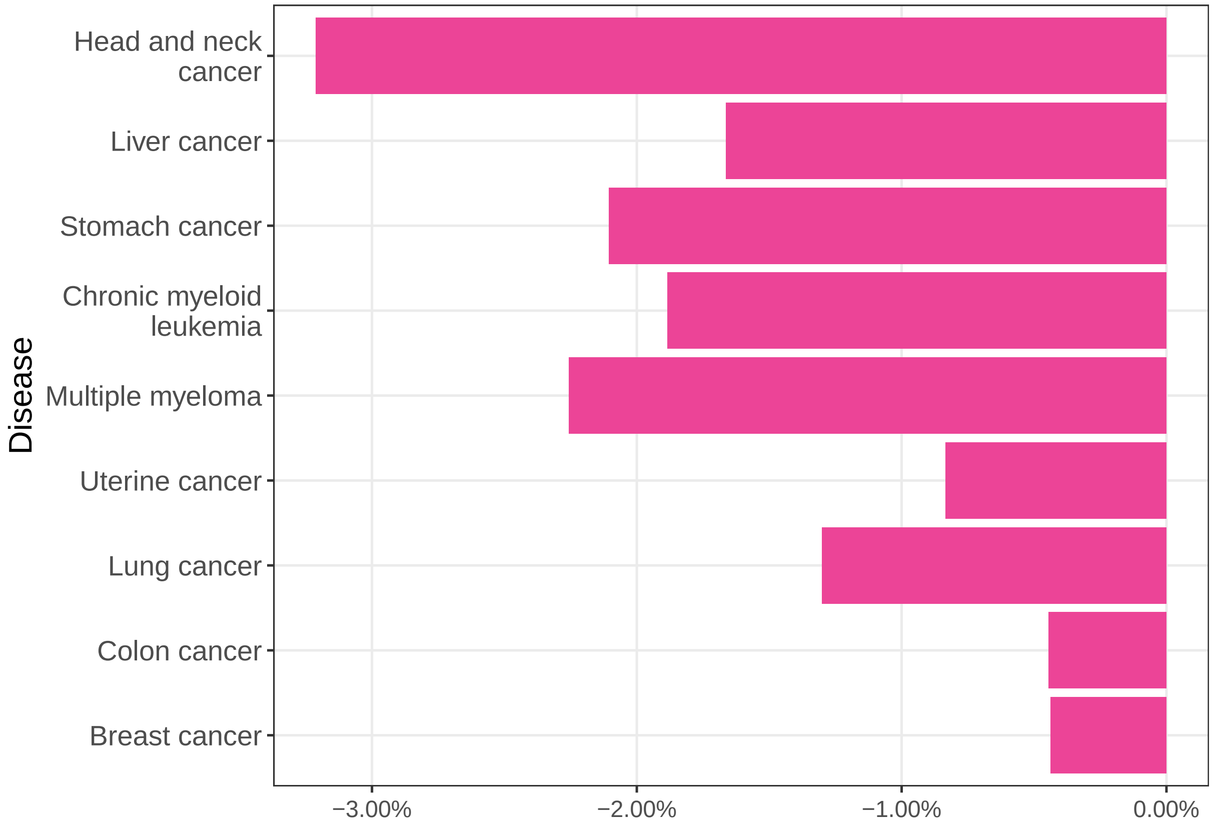

Figure 2.b: Percentage change in incidence for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

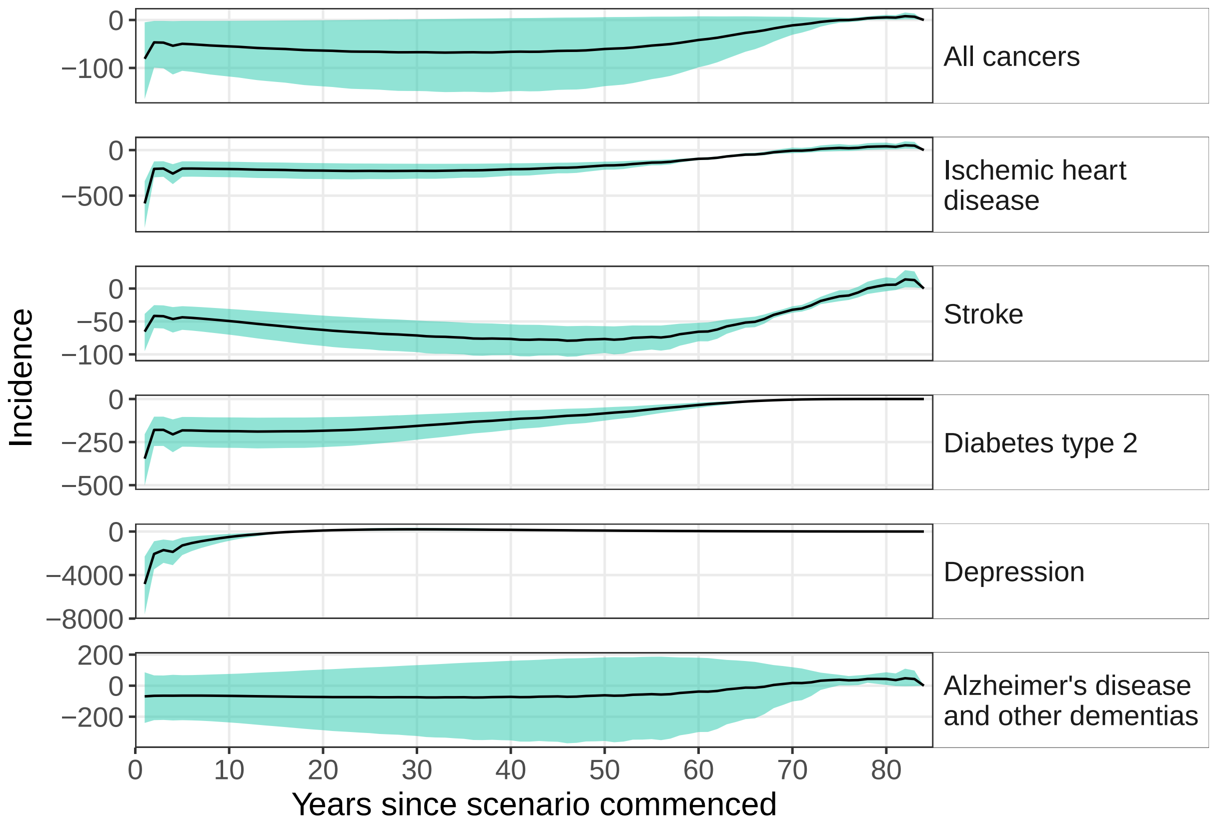

Figure 3.a: The change in incidence over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

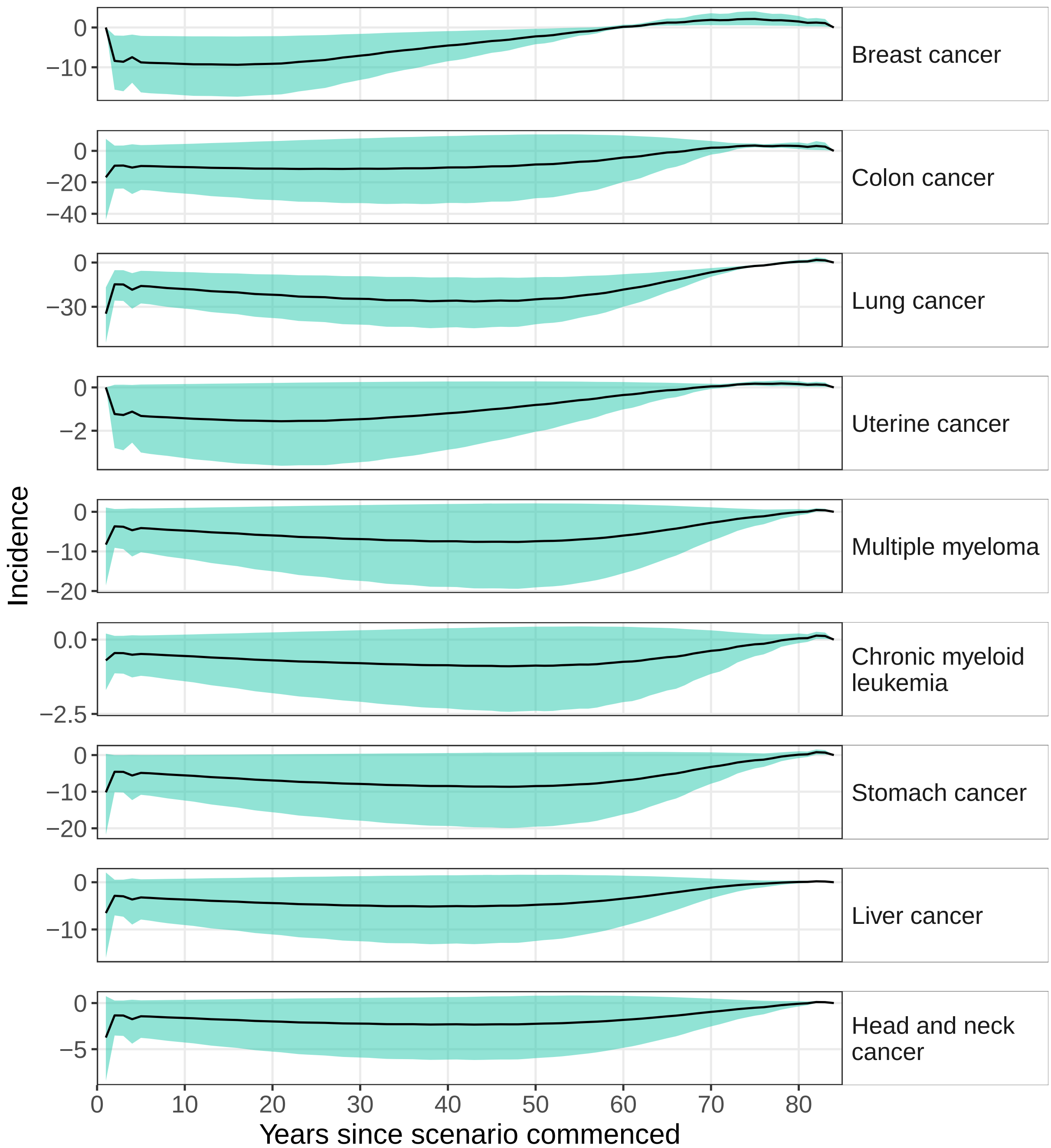

Figure 3.b: Percentage change in incidence for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Mortality

Mortality is the number of deaths due to a given disease over over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of prevented deaths due to increases in physical activity associated with the scenario. Figure 4 presents the total change in mortality over the life course. Figure 5 presents the difference in the number of deaths by year using a snapshot of the population from 2019.

Table 2 shows how the scenario impacts reductions in mortality presented as a percentage and total number of prevented deaths caused by chronic diseases.

Table 2. Percentage reduction in mortality and total number of prevented deaths by chronic disease measured across the years of the simulation.

Disease*	Mortality is reduced by	Total number of prevented deaths aggregated across the simulation
Alzheimer's disease and other dementias	0.22%	521
Breast cancer	0.18%	58
All cancers	1.13%	2,850
Colon cancer	0.21%	88
Chronic myeloid leukemia	1.76%	36
Diabetes type 2	1.88%	927
Depression	0.00%	0
Head and neck cancer	3.17%	126
Ischemic heart disease	1.25%	4,700
Liver cancer	1.66%	283
Multiple myeloma	2.19%	382
Stomach cancer	2.05%	434
Stroke	1.63%	2,848
Lung cancer	1.28%	1,392
Uterine cancer	0.68%	49

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

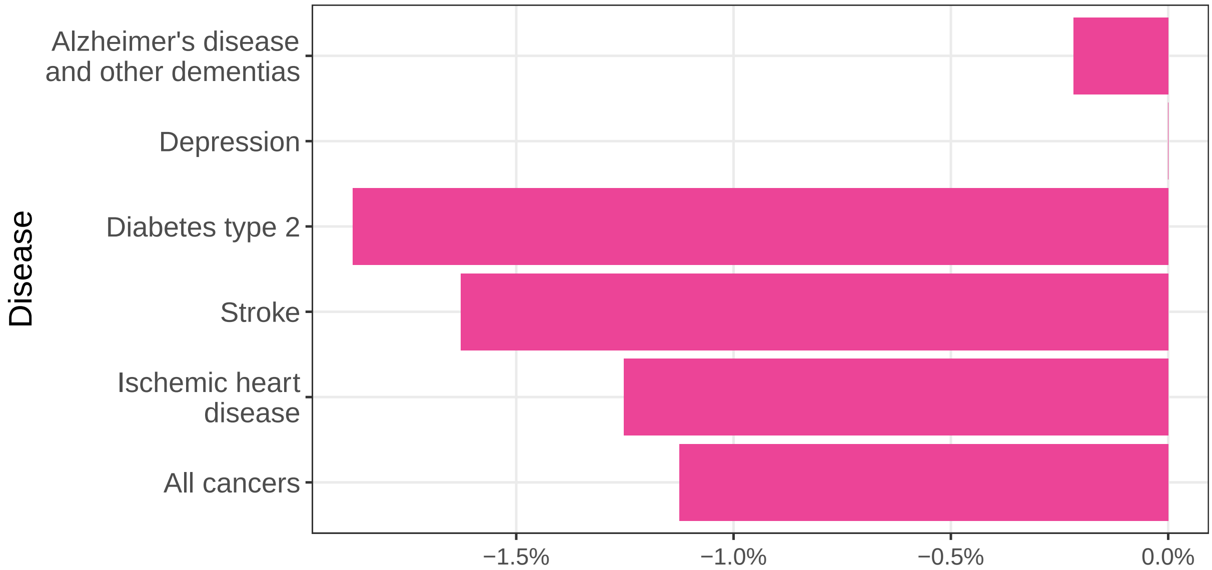

Figure 4.a: Percentage change in mortality by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

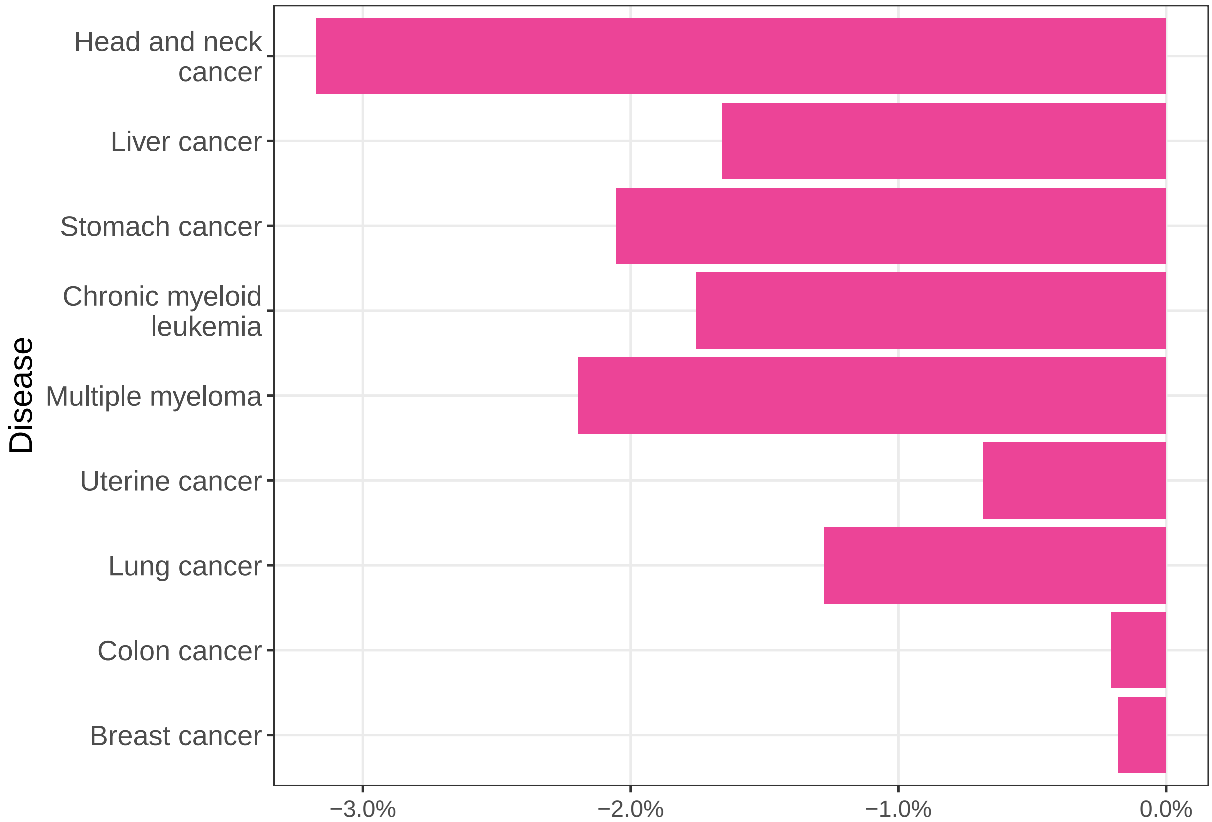

Figure 4.b: Percentage change in mortality for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

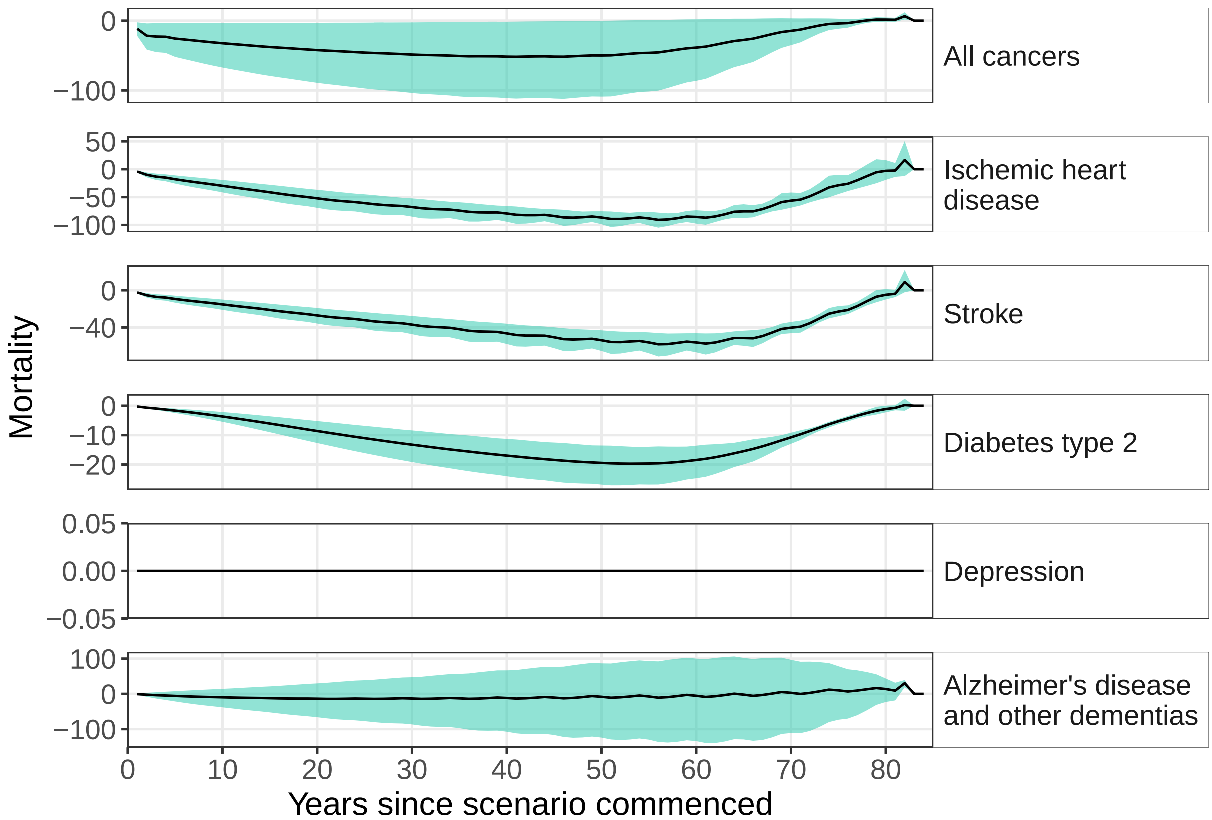

Figure 5.a: The change in mortality over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

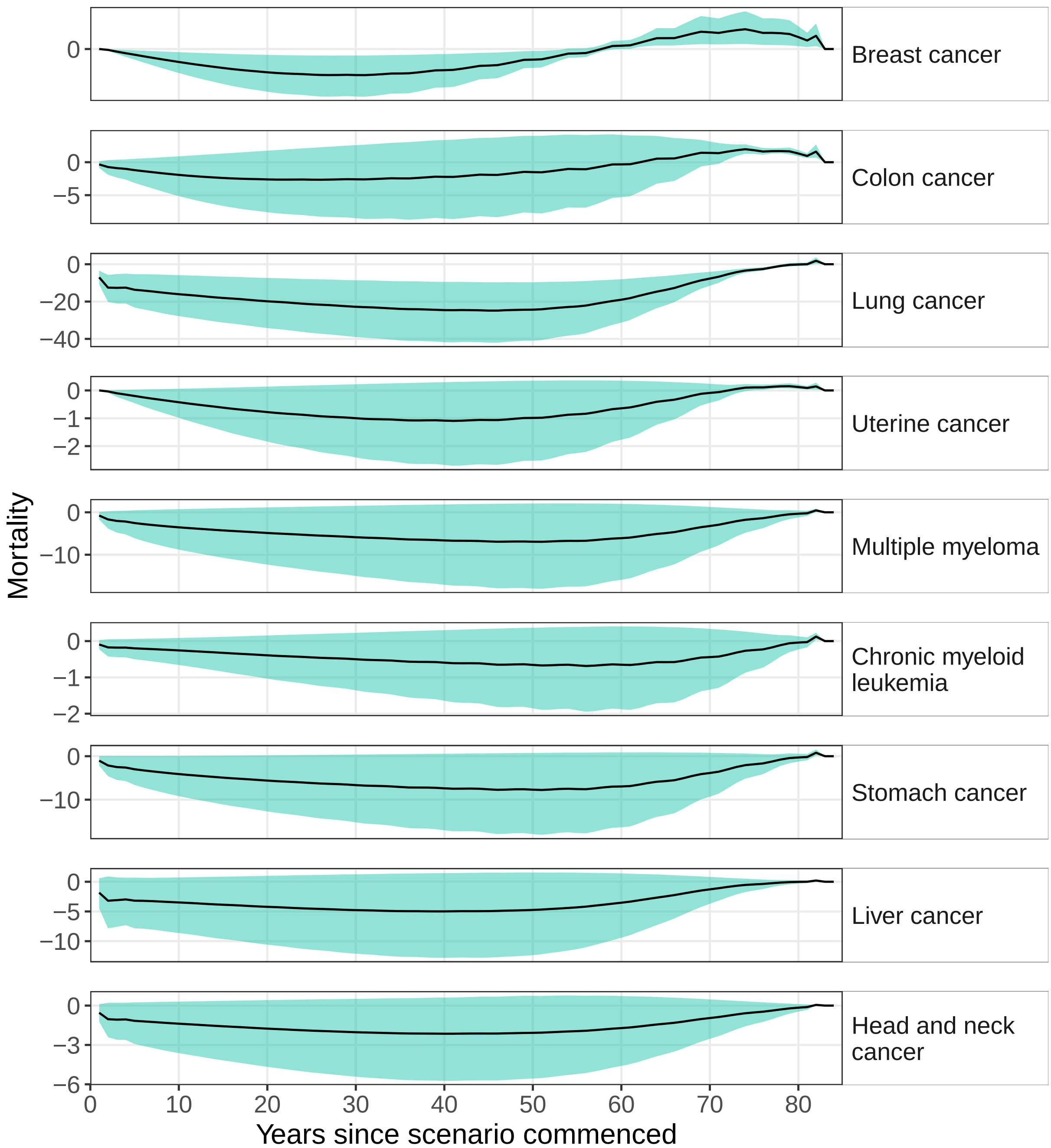

Figure 5.b: Percentage change in mortality for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Health

Figures 6 and 7 below show the change in Health Adjusted Life Years (HALYs)[1] and Life Years[2] for a snapshot of the population from 2019 for the scenario. Both figures show that the greatest gains from increasing physical activity occur midway through the life cycle with most of the gains occurring cumulatively in the long term. The decline from the mid-point onwards is due to individuals dying from natural causes within the model.

HALYS

The model estimates a total of **305,291** HALYs for the scenario population, which is **152** HALYs per 1,000 members of the population.

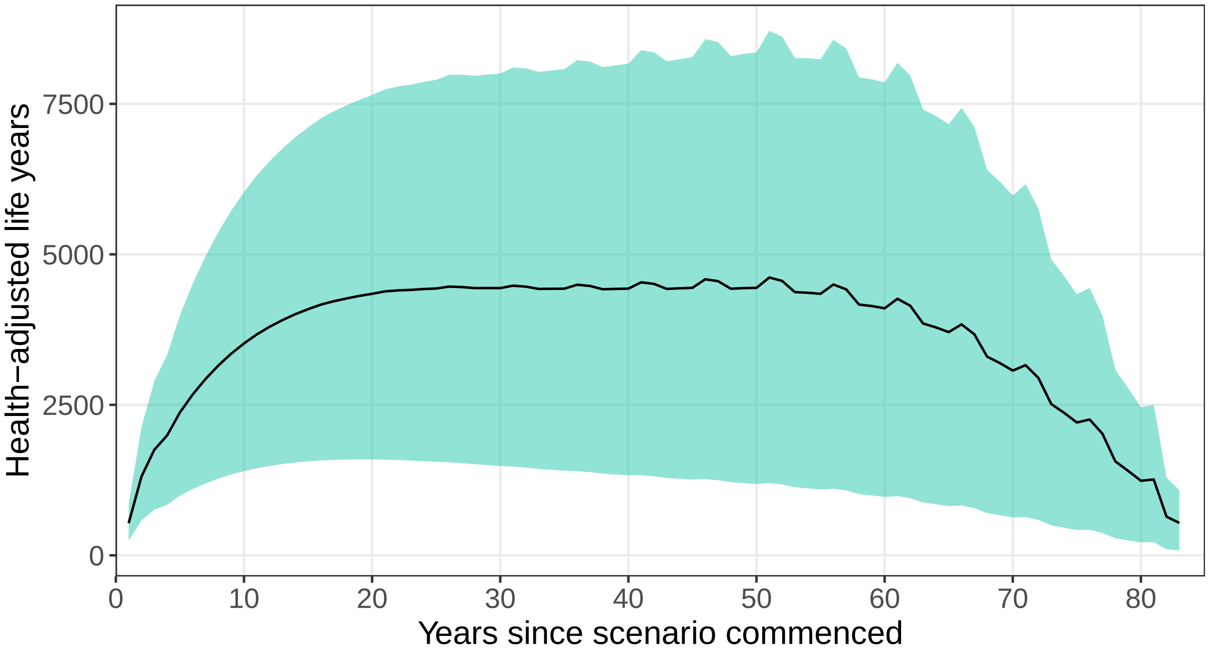

Figure 6. Total health-adjusted life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

[1] Health Adjusted Life Years are holistic measures of health that account for morbidity, mortality and quality of life.

[2] Life Years are similar to a HALYs however they exclude the quality of life component.

Life Years

The model estimates a total of **189,216** Life Years for the scenario population, which is **94** Life Years per 1,000 members of the population.

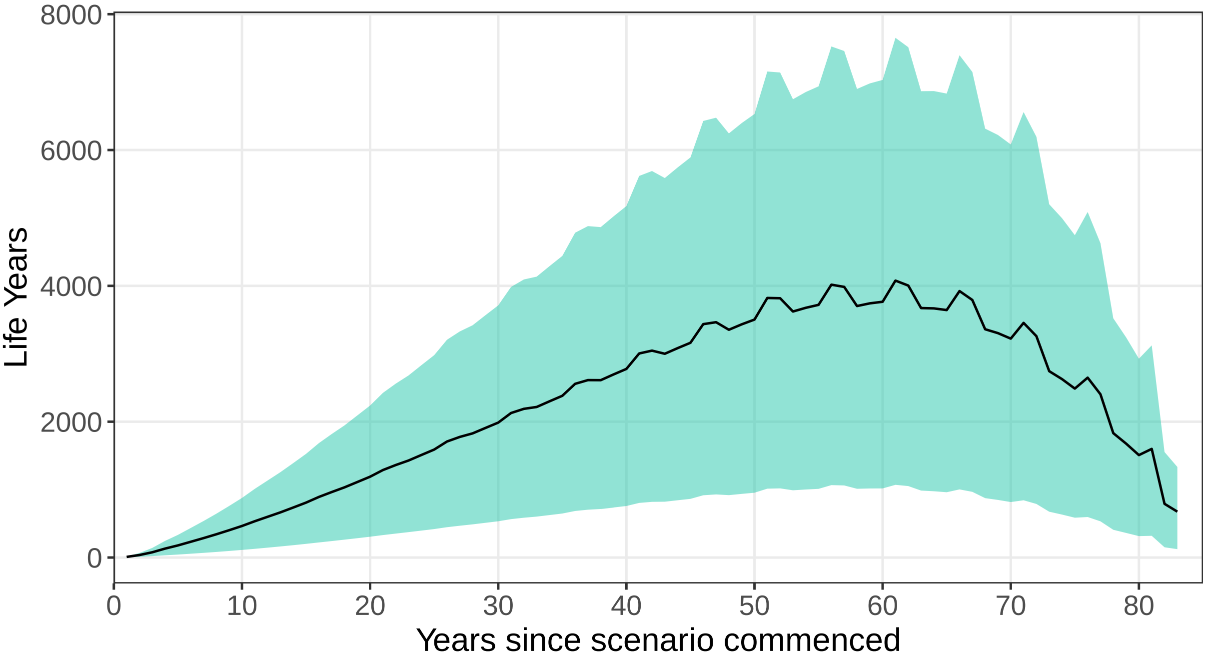

Figure 7. Total life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Value

The value of improvements to community health can be calculated**[a]** by translating the Health Adjusted Life Years (HALYs) from each scenario into dollar terms using the value of a statistical life year**[b]**. The value of a statistical life year is an estimate of the amount a society is willing to trade to reduce the risk of death for one year.

In the simulation model, HALYs are generated across time and are cumulative. Thus, to help us understand the value of HALYs across time in present day terms, it is necessary to use discounting**[c]** to reduce HALYs generated at the future point in time. Discounted HALYs from these future points can be added up to give the aggregate value of HALYs in today's terms as a measure of the value of improvements to community health arising from the chosen scenario.

The size of the discount rate can impact the aggregated value of HALYs and there is considerable debate on what discount rates should be used (with some arguing that health should not be discounted at all).[2] Hence, it is common to use a variety of discount rates to allow for differing risks, preferences and sensitivity when valuing health. The figures presented below were calculated using discount rates of 3%, 5% and 7% based on recent recommendations [3, 4] and represent the value of HALYs in present day terms resulting from an increase in physical activity from the chosen scenario.

The value of improvements to community health

The model estimates a total of **HALYs,** Health Adjusted Life Years (HALYs) gained for the scenario population, which is **152** HALYs per 1,000 members of the scenario population. The figures below represent the value of improvements to community health from the chosen scenario. These figures can be used in summary reports and for advocacy purposes**[d]**.

The HALYs gained in this scenario have a statistical value of:

- **11,777,115** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **7,210,756** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **4,898,813** per 1,000 members of the population, when calculated using a discount rate of 7%.

a. What is meant by value and how can it be measured?

Value is conceptual and measures a sense of worth or usefulness of something to individuals or to a society. Measuring the value of something, such as health, enables it to be included in assessments or analyses such as cost-benefit analyses to recognise its relative importance.

Value can be derived in many ways and a common approach is to use monetary terms, such as dollars. Valuing something using dollars is not the same as equating it with its price. Prices represent the amount at which something can be traded, prices therefore represent the amount of money for buying or selling something such as food, clothing or to pay bills. One way is to evaluate health in dollar terms is to use the Value of a Statistical Life and Value of a Statistical Life Year**[b]**.

b. What is the Value of a Statistical Life and Value of a Statistical Life Year?

The value of a **statistical life** is the estimated amount that a society is willing to trade to reduce the risk of death. The word 'Statistical' refers to the average value for life and therefore means the value of a statistical life doesn't relate to any specific individual. This value can change across risk factors and different societies who may value life differently. There are various ways of measuring the value of a statistical life with most approaches using revealed or stated preference approaches.[3] In Australia, the Office of Best Practice Regulation estimates a statistical life at $5.3M in 2022 dollar terms, and assumes that the life is of a young person with at least another 40 years to live.[5, 6]

Value of a Statistical Life Year

The value of a statistical life year is the estimated amount that a society is willing to trade to reduce the risk of death over **one year.** It can be derived from the value of a statistical life or measured directly using surveys or willingness to pay techniques.[5] The current value of a **statistical life year** is $227,000 in 2022 dollars based on current estimates from the Office of Best Practice Regulation.[6] The value of a statistical life year is useful for evaluating small increases in life years instead of evaluating full life expectancy. It is appropriate for valuing the Health Adjusted Life Years estimated from the scenarios and modelling presented in this tool. For the modelling and results presented here, the value of $227,000 was converted to 2019 dollars based on the Wage Price Index for Brisbane.

c. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

d. Application in advocacy and reporting

This section uses figures to show how the value of community health (estimated from HALYs and the value of statistical life year) can be used for reporting and advocacy purposes.

The simulation model uses **population-based estimates** for disease morbidity and mortality and is best applied to larger groups of people. It also assumes that the people of interest have similar characteristics and behaviours to the population data used in the simulation model and scenarios. The **example** below shows results from a scenario that replaces car trips with walking trips for distances of 0-2 km for All age groups.

Example:

The HALYs gained in this scenario have a statistical value of:

- **$10,859,605** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **$6,662,541** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **$4,533,392** per 1,000 members of the population, when calculated using a discount rate of 7%.

This **example** shows that the HALYs gained in this scenario have a statistical value of $10,859,605 per 1,000 members of the population using a discount of 3%.

This figure can be divided by 1,000 to give a per person figure. Once a per person figure is established, it can be multiplied by the number of people in any population size of interest for use in reports or as evidence to advocate for benefits associated with shifts to active transport modes.

$10,859,605 / 1,000 = $10,859.61 per person value

A good example of how this model can be applied links to previous research that investigated the impact of new more walkable development in Altona North on a population of 21,000 people [11]. If we assume that these people have similar characteristics to the underlying population based estimates and behaviours based on the travel survey data in the simulation model underlying this tool, then the value of community health according to the chosen scenario can be calculated as:

21,000 (people) x $10,859 (statistical value from HALYs gained) = $228 M.

Savings

An increase in physical activity due to the chosen scenario reduces chronic disease cases across a lifetime and reduces spending for each disease within the health care system resulting in overall health care cost savings**[a]**.

Table 3 provides estimated health care cost savings associated with the prevented cases of chronic diseases per 1,000 members of the population according to the selected scenario. These figures are based on applying average health care system costs per prevalent case of disease and using three alternative discount rates**[b]**:

Table 3. Total health care cost savings by disease per 1,000 members of the population.

Disease	3% discount rate	5% discount rate	7% discount rate
Alzheimer's disease and other dementias	$9,308	$5,609	$3,704
Breast cancer	$67,653	$42,574	$28,318
All cancers	$184,699	$117,571	$80,153
Colon cancer	$41,129	$27,592	$19,414
Chronic myeloid leukemia	$11,734	$6,889	$4,445
Diabetes type 2	$53,469	$31,851	$20,651
Depression	$286,291	$216,104	$167,268
Head and neck cancer	$1,940	$1,254	$884
Ischemic heart disease	$118,670	$71,560	$47,331
Liver cancer	$1,676	$1,114	$806
Multiple myeloma	$28,899	$18,085	$12,378
Stomach cancer	$11,207	$7,009	$4,802
Stroke	$18,017	$10,483	$6,713
Lung cancer	$16,569	$10,703	$7,544
Uterine cancer	$3,951	$2,415	$1,583

a. What do we mean by health care cost savings?

To calculate health care cost savings for each disease, the annual costs for each disease in each year is multiplied by the number of prevented cases of each disease for each scenario. This results in a total saving in spending for each disease by year. The savings in spending for future years are discounted**[b]** with annual savings aggregated to give a total amount saved for each disease. Total savings are presented as the amount saved per 1,000 members of the population to enable comparisons against populations of different sizes.

We use the term **health care cost saving** because it represents a reduction in health spending. However, the Australian Institute of Health and Welfare (AIHW) stress that the term cost is broad and not representative of the full cost experienced by individuals, families, or the health system, consequently AIHW use the term spending.[8]

These figures use AIHW estimates of the amounts spent through the health system in 2018-19 for each case of disease. This is extracted from Health system spending per case of disease and for certain risk factors, Table 1 – Estimates of health system spending per case, by burden of disease group, condition and sex, Australia 2018-2019.[9]. For head and neck cancers, supplementary figures were obtained from the Global Burden of Disease incidence data.[10]

b. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

References

1. Gold, M. R., Stevenson, D., & Fryback, D. G. (2002). *HALYS and QALYS and DALYS, Oh My: similarities and differences in summary measures of population Health.* Annual review of public health, 23(1), 115-134.
2. Attema, A.E., Brouwer, W.B. & Claxton, K. (2018). *Discounting in economic evaluations.* Pharmacoeconomics. 36: p. 745-758.
3. Ananthapavan, J., Moodie, M., Milat, A.J., & Carter, R. (2021). *Systematic review to update 'value of a statistical life' estimates for Australia.* International journal of environmental research and public health, 2021. 18(11): p. 6168.
4. Terrill, M. & Batrouney, H. (2018). *Unfreezing discount rates: Transport infrastructure for tomorrow.* Grattan Institute.
5. Abelson, P. (2008). *Establishing a monetary value for lives saved: issues and controversies.* Canberra: Office of Best Practice Regulation, Department of Finance and Deregulation.
6. Department of the Prime Minister and Cabinet. (2022). *Best practice regulation guidance note: Value of statistical life.* Australian Government.
7. Haacker, M., Hallett, T.B. & Atun, R. (2020). *On discount rates for economic evaluations in global health.* Health Policy and Planning, 2020. 35(1): p. 107-114.
8. Australian Institute of Health and Welfare (2023). Technical Notes: Estimating Spending per prevalent case of disease. Health system spending per case of disease and for certain risk factors, Estimating the spending per prevalent case of disease - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
9. Australian Institute of Health and Welfare (2023). Health system spending per case of disease and for certain risk factors. Health system spending per case of disease and for certain risk factors, Data - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
10. Global Burden of Disease (2019). Global Health Data Exchange. https://vizhub.healthdata.org/gbd-results. Accessed September 20, 2023.
11. Zapata-Diomedi, B., Boulangé, C., Giles-Corti, B., Phelan, K., Washington, S., Veerman, L.J., & Gunn, L. (2019). Physical activity-related health and economic benefits of building walkable neighbourhoods: A modelled comparison between brownfield and greenfield developments. International Journal of Behavioural Nutrition and Physical Activity.
12. Khorasani, E., Davari, M., Kebriaeezadeh, A., Fatemi, F., Akbari Sari, A., & Varahrami, V. (2022). A comprehensive review of official discount rates in guidelines of health economic evaluations over time: the trends and roots. The European Journal of Health Economics, 23(9), 1577-1590.

Scenario: replacing car trips under 1km with walking for commuting trip purposes

This scenario shows the results of replacing car trips under 1km for work related or education purposes with walking trips for all adults of all ages.

This implies that the selected scenario results in a mode shift in walking from 16.8% to 17.2% and from 74.7% to 74.2% for car trips taken as either a driver or passenger.

Increases in walking translate into a shift from 47.9% to 48.1% of the population accumulating the required minutes spent being moderately (150 – 300 mins) or vigorously physically active (75 – 150 mins) or an equivalent combination of both contributing to recommended levels as detailed in the Physical Activity Guidelines.

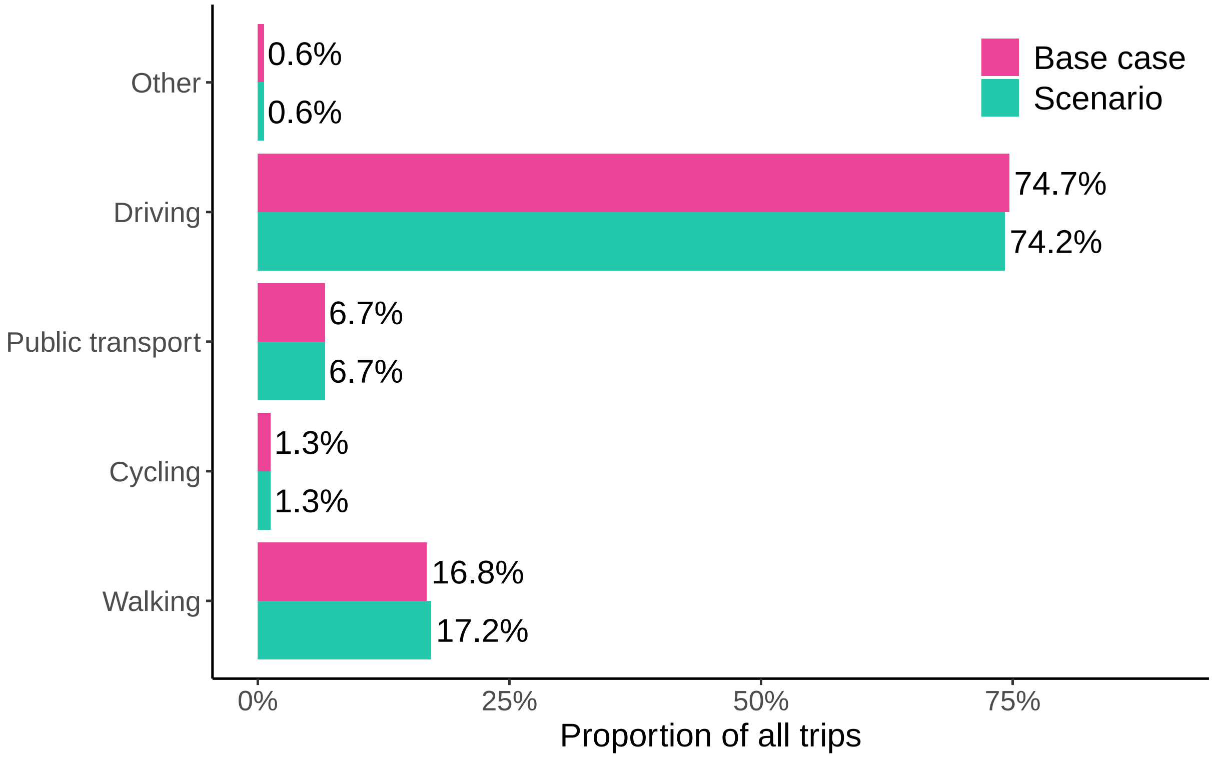

Figure 1: Distribution of base case and scenario trips.

Incidence

Incidence describes the rate of occurrence of new cases of a disease over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of disease prevented, due to increases in physical activity associated with the scenario. Figure 2 presents the change (%) in the disease incidence across the life course. Figure 3 presents how the difference in disease incidence changes over time, by year, using a snapshot of the population from 2019.

Table 1 shows how the scenario impacts the incidence of chronic diseases as both as a percentage and total number of prevented cases.

Table 1. Chronic disease incidence reduction and total number of prevented cases of disease measured across the years of the simulation

Disease*	Incidence of disease is reduced by	Total number of prevented cases of disease aggregated across the simulation
Alzheimer's disease and other dementias	0.00%	-27
Breast cancer	0.01%	5
All cancers	0.01%	27
Colon cancer	0.00%	1
Chronic myeloid leukemia	0.01%	0
Diabetes type 2	0.05%	153
Depression	0.01%	154
Head and neck cancer	0.03%	1
Ischemic heart disease	0.01%	114
Liver cancer	0.01%	2
Multiple myeloma	0.02%	3
Stomach cancer	0.01%	3
Stroke	0.01%	30
Lung cancer	0.01%	12
Uterine cancer	0.01%	1

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

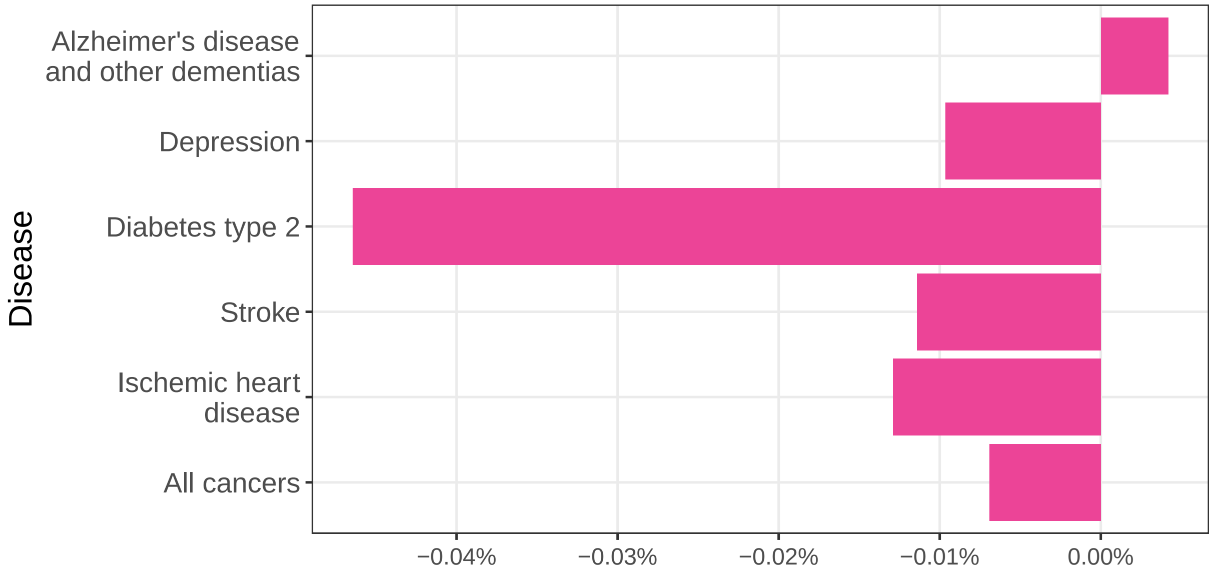

Figure 2.a: Percentage change in incidence by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

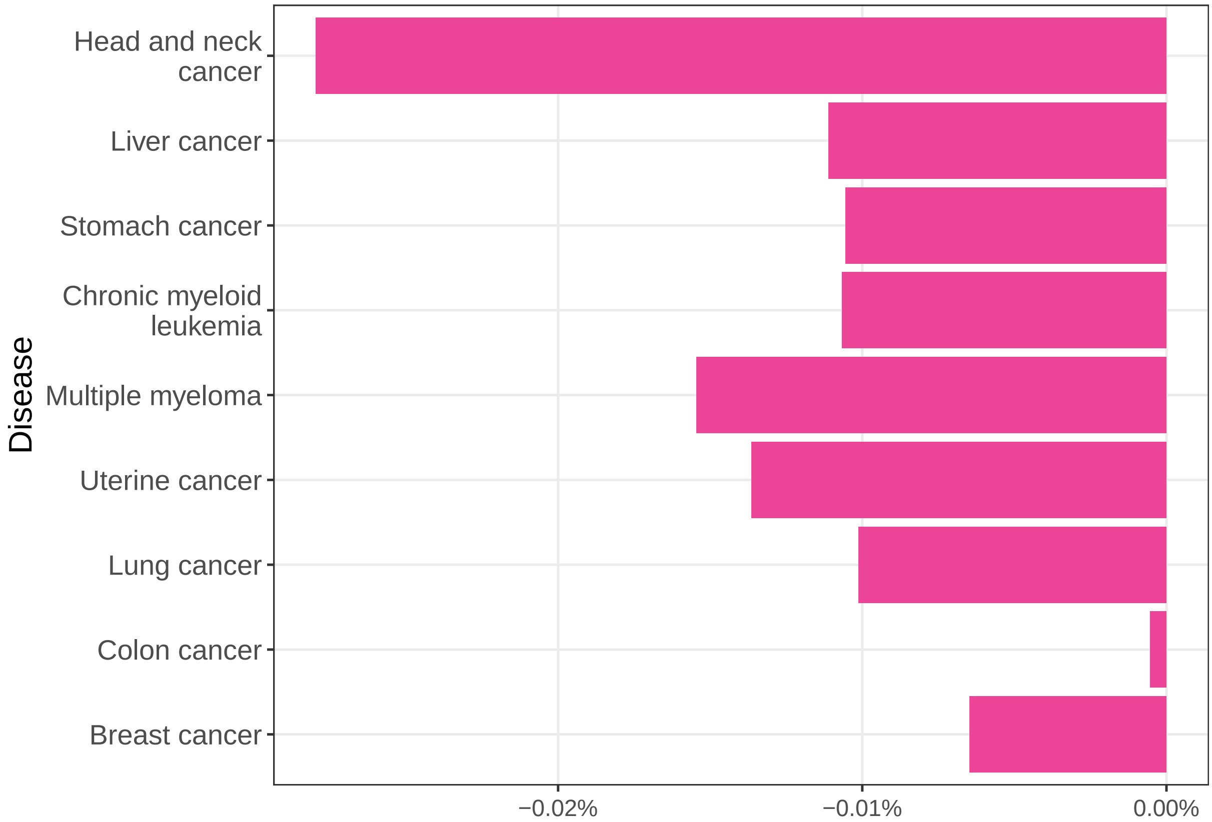

Figure 2.b: Percentage change in incidence for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

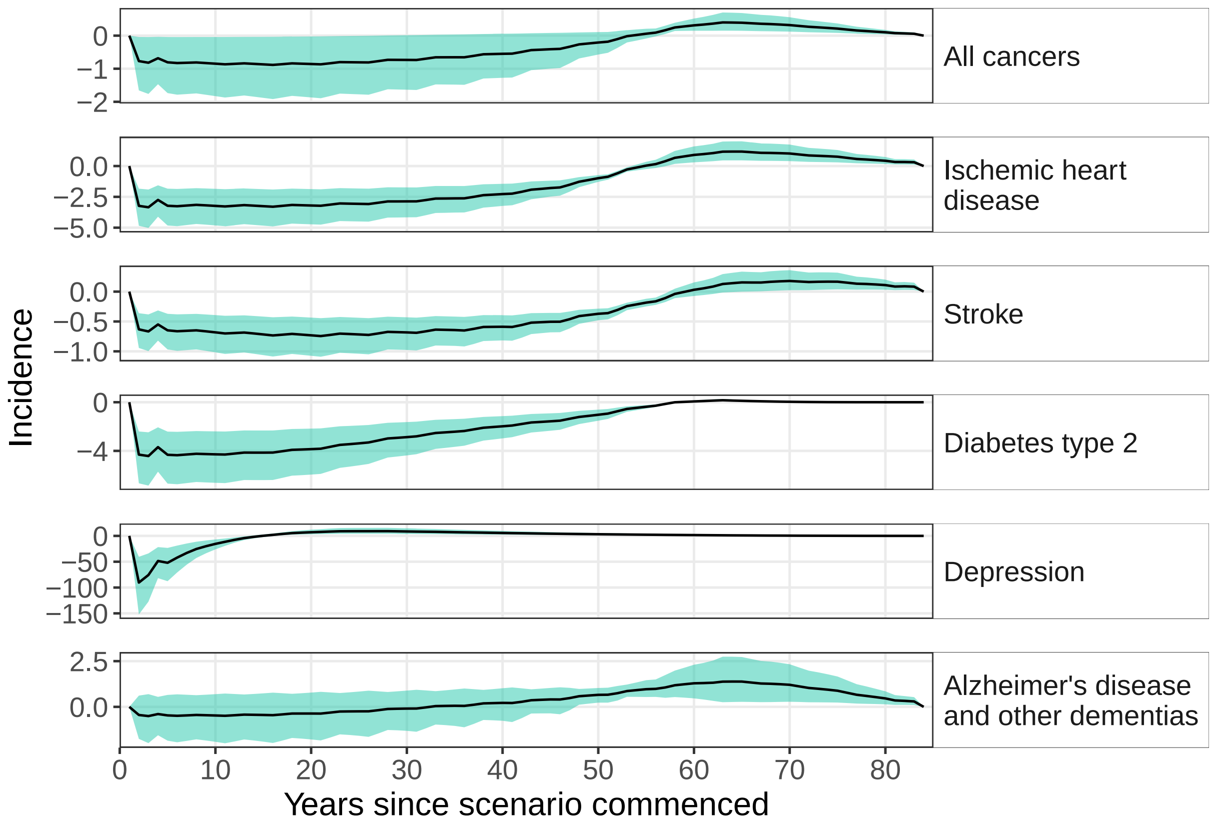

Figure 3.a: The change in incidence over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

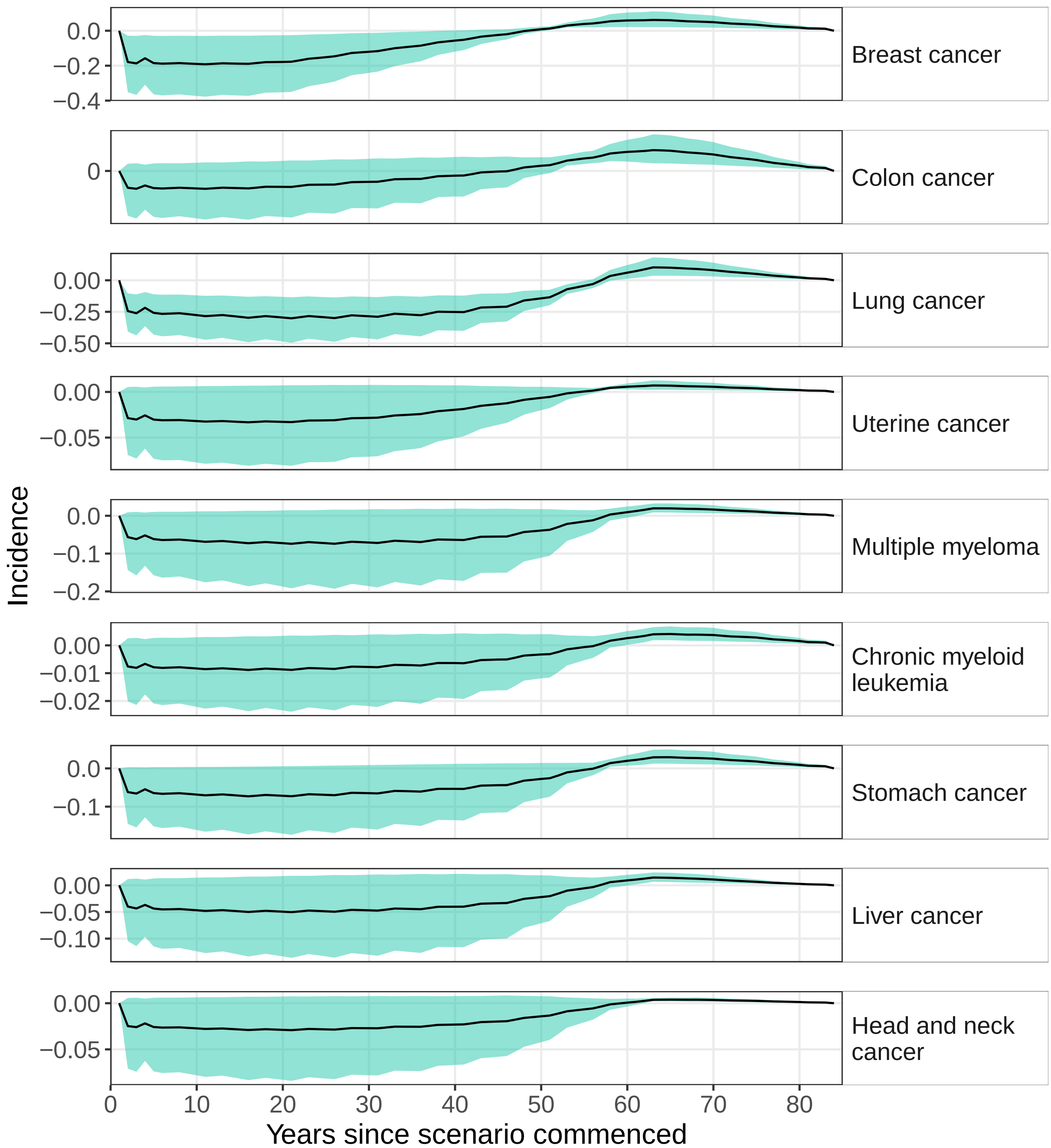

Figure 3.b: Percentage change in incidence for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Mortality

Mortality is the number of deaths due to a given disease over over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of prevented deaths due to increases in physical activity associated with the scenario. Figure 4 presents the total change in mortality over the life course. Figure 5 presents the difference in the number of deaths by year using a snapshot of the population from 2019.

Table 2 shows how the scenario impacts reductions in mortality presented as a percentage and total number of prevented deaths caused by chronic diseases.

Table 2. Percentage reduction in mortality and total number of prevented deaths by chronic disease measured across the years of the simulation.

Disease*	Mortality is reduced by	Total number of prevented deaths aggregated across the simulation
Alzheimer's disease and other dementias	-0.01%	-20
Breast cancer	0.01%	2
All cancers	0.01%	22
Colon cancer	0.00%	1
Chronic myeloid leukemia	0.01%	0
Diabetes type 2	0.04%	20
Depression	0.00%	0
Head and neck cancer	0.03%	1
Ischemic heart disease	0.01%	51
Liver cancer	0.01%	2
Multiple myeloma	0.02%	3
Stomach cancer	0.01%	2
Stroke	0.01%	17
Lung cancer	0.01%	11
Uterine cancer	0.01%	1

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

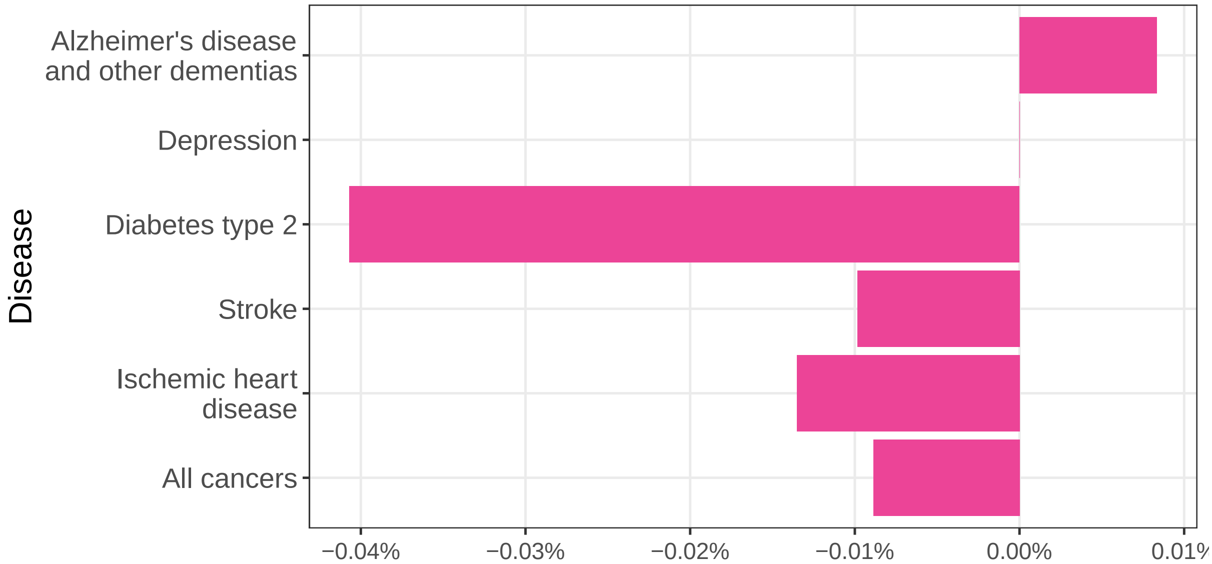

Figure 4.a: Percentage change in mortality by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

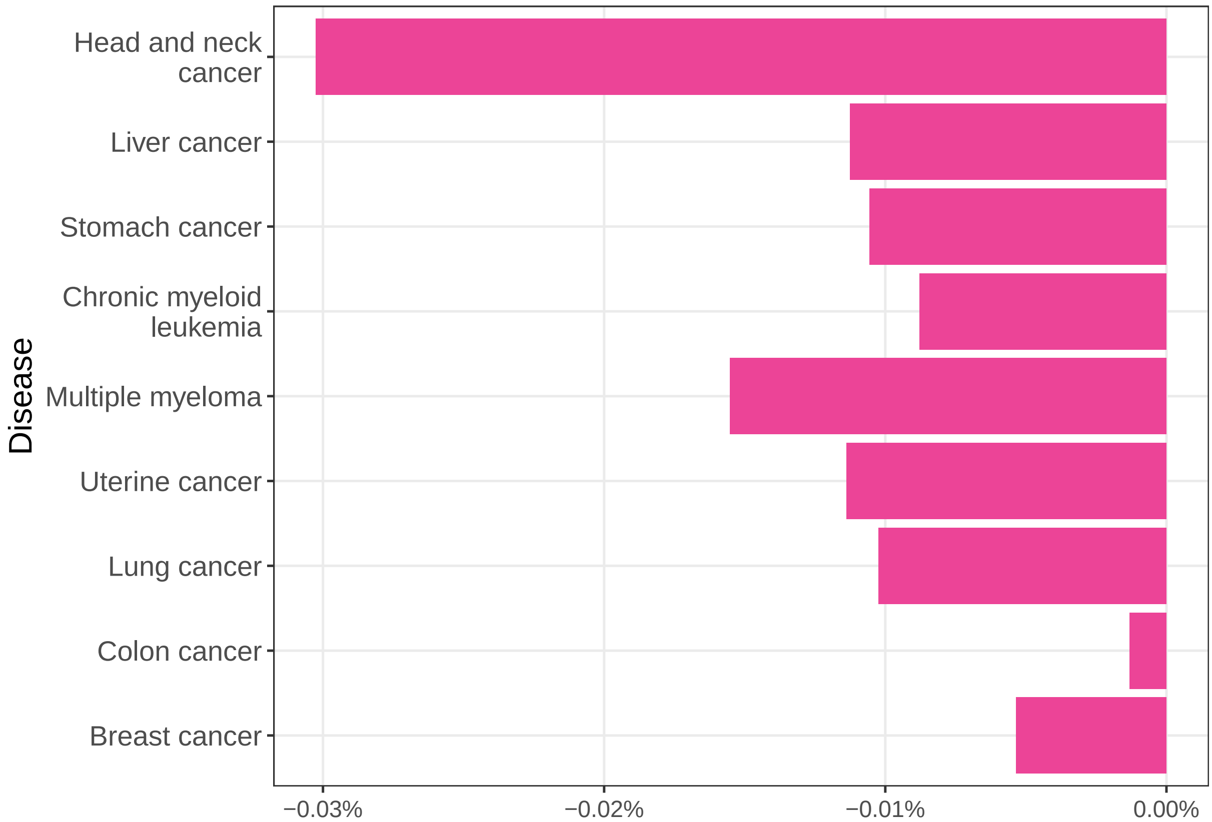

Figure 4.b: Percentage change in mortality for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

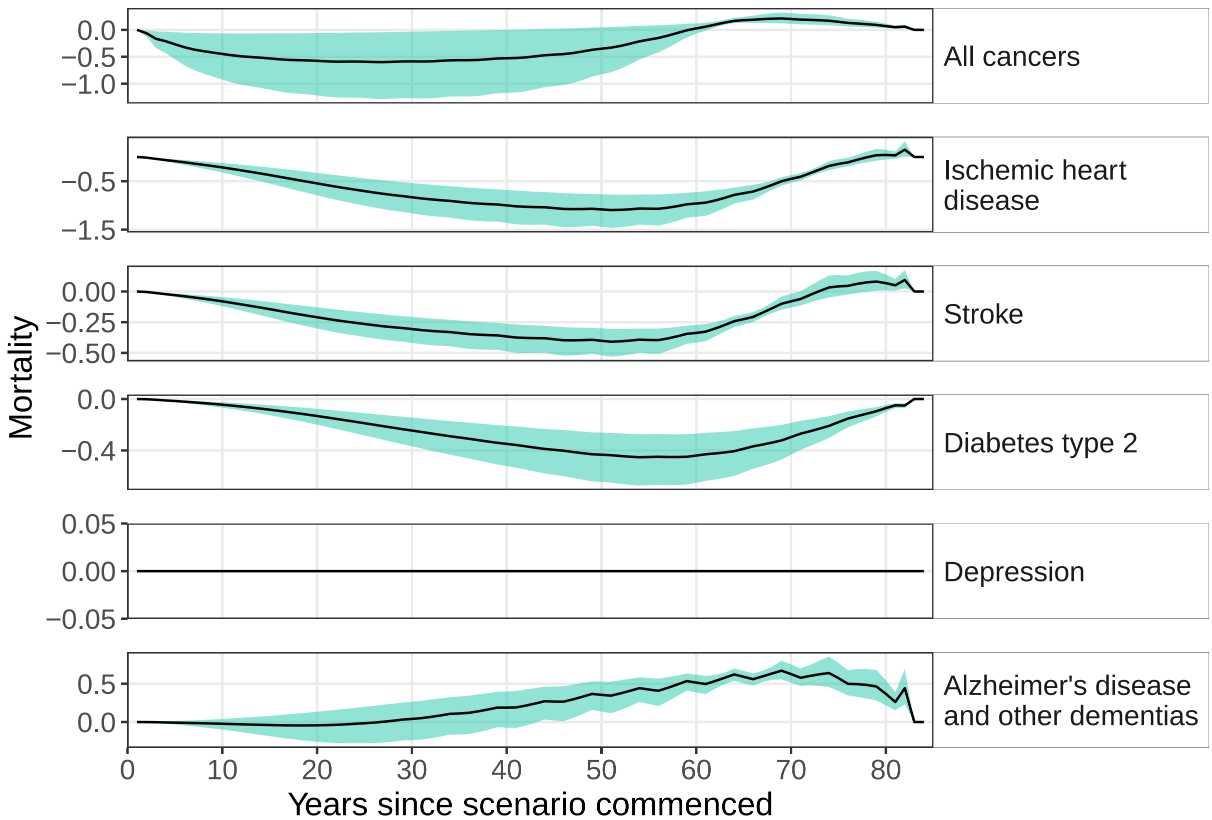

Figure 5.a: The change in mortality over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

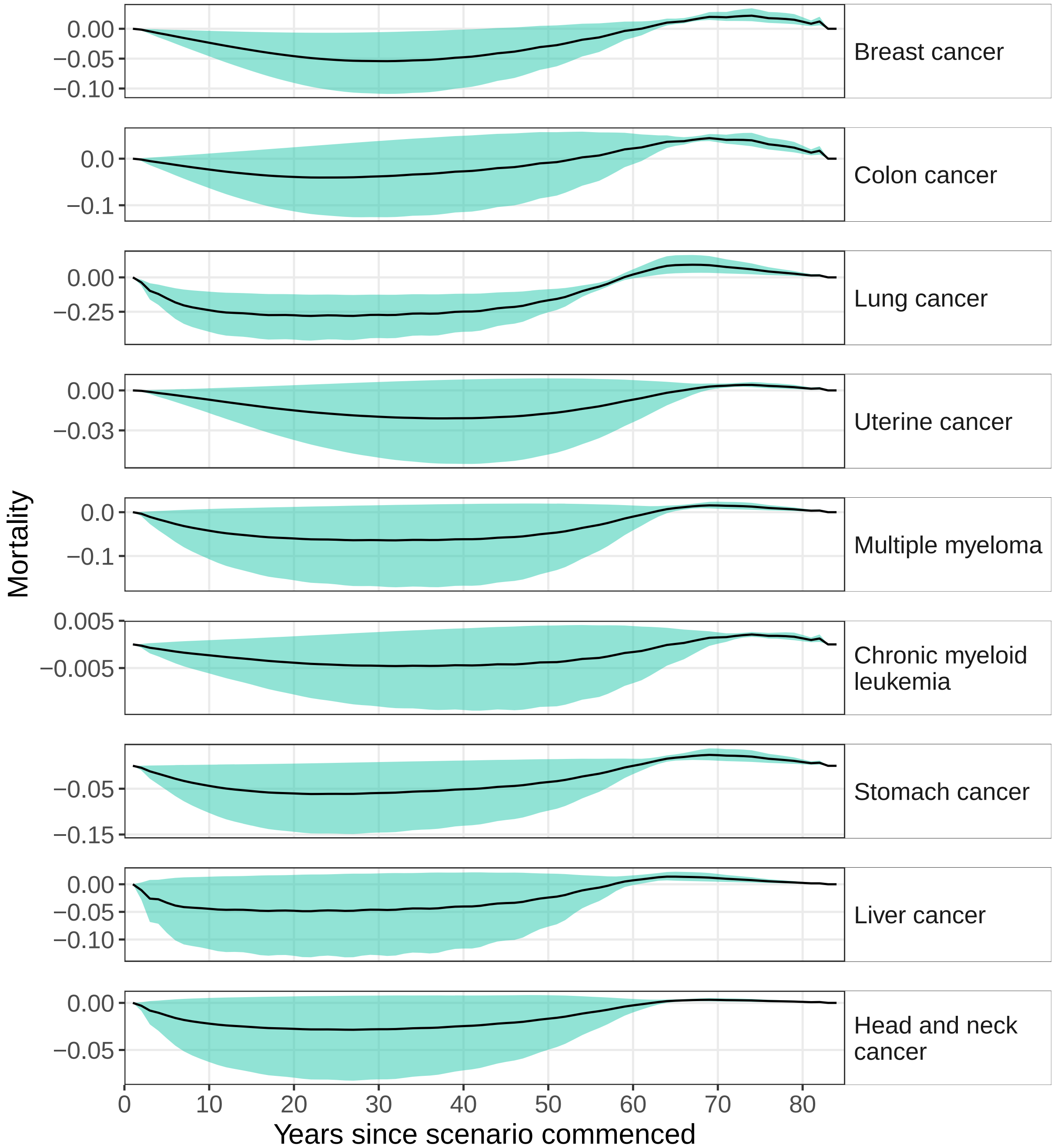

Figure 5.b: Percentage change in mortality for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Health

Figures 6 and 7 below show the change in Health Adjusted Life Years (HALYs)[1] and Life Years[2] for a snapshot of the population from 2019 for the scenario. Both figures show that the greatest gains from increasing physical activity occur midway through the life cycle with most of the gains occurring cumulatively in the long term. The decline from the mid-point onwards is due to individuals dying from natural causes within the model.

HALYS

The model estimates a total of **5,388** HALYs for the scenario population, which is **2.7** HALYs per 1,000 members of the population.

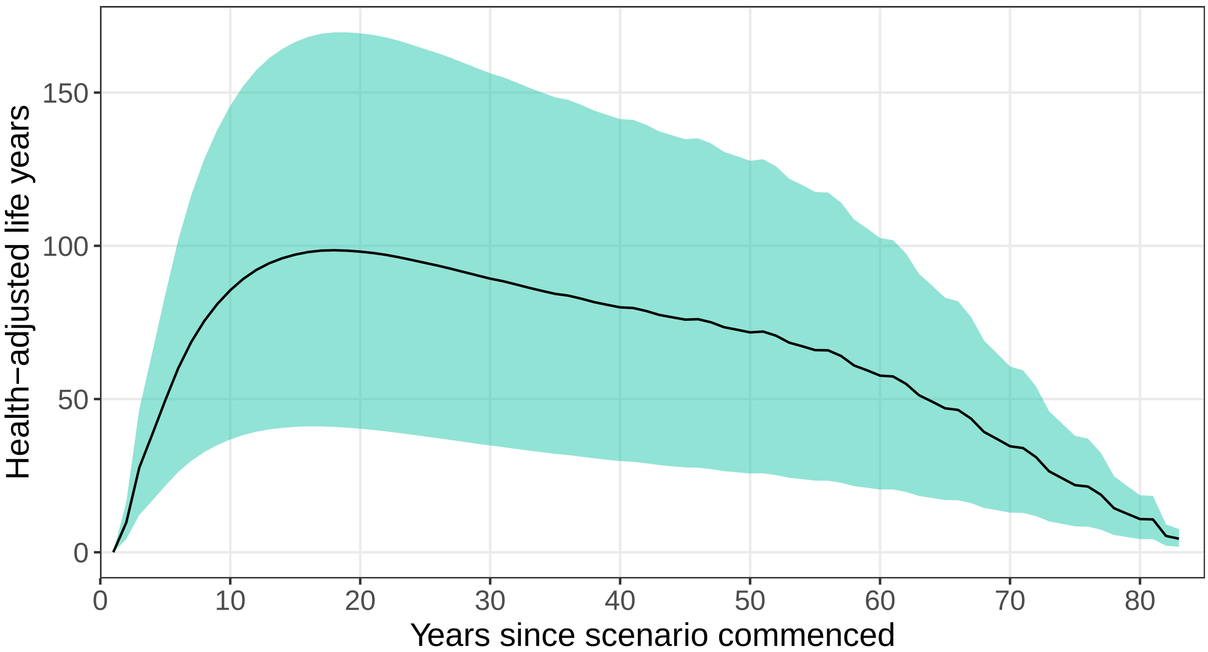

Figure 6. Total health-adjusted life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

[1]Health Adjusted Life Years are holistic measures of health that account for morbidity, mortality and quality of life.

[2]Life Years are similar to a HALYs however they exclude the quality of life component.

Life Years

The model estimates a total of **2,356** Life Years for the scenario population, which is **1.2** Life Years per 1,000 members of the population.

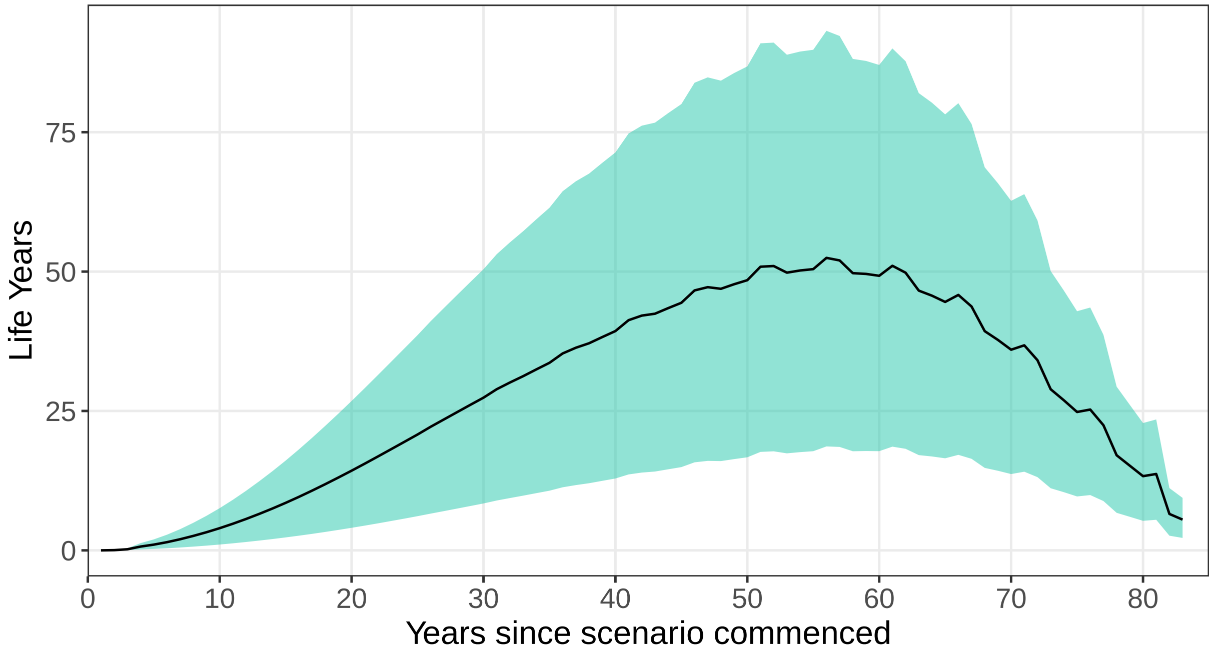

Figure 7. Total life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Value

The value of improvements to community health can be calculated**[a]** by translating the Health Adjusted Life Years (HALYs) from each scenario into dollar terms using the value of a statistical life year**[b]**. The value of a statistical life year is an estimate of the amount a society is willing to trade to reduce the risk of death for one year.

In the simulation model, HALYs are generated across time and are cumulative. Thus, to help us understand the value of HALYs across time in present day terms, it is necessary to use discounting**[c]** to reduce HALYs generated at the future point in time. Discounted HALYs from these future points can be added up to give the aggregate value of HALYs in today's terms as a measure of the value of improvements to community health arising from the chosen scenario.

The size of the discount rate can impact the aggregated value of HALYs and there is considerable debate on what discount rates should be used (with some arguing that health should not be discounted at all).[2] Hence, it is common to use a variety of discount rates to allow for differing risks, preferences and sensitivity when valuing health. The figures presented below were calculated using discount rates of 3%, 5% and 7% based on recent recommendations [3, 4] and represent the value of HALYs in present day terms resulting from an increase in physical activity from the chosen scenario.

The value of improvements to community health

The model estimates a total of **HALYs,** Health Adjusted Life Years (HALYs) gained for the scenario population, which is **2.7** HALYs per 1,000 members of the scenario population. The figures below represent the value of improvements to community health from the chosen scenario. These figures can be used in summary reports and for advocacy purposes**[d]**.

The HALYs gained in this scenario have a statistical value of:

- **233,423** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **149,311** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **103,775** per 1,000 members of the population, when calculated using a discount rate of 7%.

a. What is meant by value and how can it be measured?

Value is conceptual and measures a sense of worth or usefulness of something to individuals or to a society. Measuring the value of something, such as health, enables it to be included in assessments or analyses such as cost-benefit analyses to recognise its relative importance.

Value can be derived in many ways and a common approach is to use monetary terms, such as dollars. Valuing something using dollars is not the same as equating it with its price. Prices represent the amount at which something can be traded, prices therefore represent the amount of money for buying or selling something such as food, clothing or to pay bills. One way is to evaluate health in dollar terms is to use the Value of a Statistical Life and Value of a Statistical Life Year**[b]**.

b. What is the Value of a Statistical Life and Value of a Statistical Life Year?

The value of a **statistical life** is the estimated amount that a society is willing to trade to reduce the risk of death. The word 'Statistical' refers to the average value for life and therefore means the value of a statistical life doesn't relate to any specific individual. This value can change across risk factors and different societies who may value life differently. There are various ways of measuring the value of a statistical life with most approaches using revealed or stated preference approaches.[3] In Australia, the Office of Best Practice Regulation estimates a statistical life at $5.3M in 2022 dollar terms, and assumes that the life is of a young person with at least another 40 years to live.[5, 6]

Value of a Statistical Life Year

The value of a statistical life year is the estimated amount that a society is willing to trade to reduce the risk of death over **one year.** It can be derived from the value of a statistical life or measured directly using surveys or willingness to pay techniques.[5] The current value of a **statistical life year** is $227,000 in 2022 dollars based on current estimates from the Office of Best Practice Regulation.[6] The value of a statistical life year is useful for evaluating small increases in life years instead of evaluating full life expectancy. It is appropriate for valuing the Health Adjusted Life Years estimated from the scenarios and modelling presented in this tool. For the modelling and results presented here, the value of $227,000 was converted to 2019 dollars based on the Wage Price Index for Brisbane.

c. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

d. Application in advocacy and reporting

This section uses figures to show how the value of community health (estimated from HALYs and the value of statistical life year) can be used for reporting and advocacy purposes.

The simulation model uses **population-based estimates** for disease morbidity and mortality and is best applied to larger groups of people. It also assumes that the people of interest have similar characteristics and behaviours to the population data used in the simulation model and scenarios. The **example** below shows results from a scenario that replaces car trips with walking trips for distances of 0-2 km for All age groups.

Example:

The HALYs gained in this scenario have a statistical value of:

- **$10,859,605** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **$6,662,541** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **$4,533,392** per 1,000 members of the population, when calculated using a discount rate of 7%.

This **example** shows that the HALYs gained in this scenario have a statistical value of $10,859,605 per 1,000 members of the population using a discount of 3%.

This figure can be divided by 1,000 to give a per person figure. Once a per person figure is established, it can be multiplied by the number of people in any population size of interest for use in reports or as evidence to advocate for benefits associated with shifts to active transport modes.

$10,859,605 / 1,000 = $10,859.61 per person value

A good example of how this model can be applied links to previous research that investigated the impact of new more walkable development in Altona North on a population of 21,000 people [11]. If we assume that these people have similar characteristics to the underlying population based estimates and behaviours based on the travel survey data in the simulation model underlying this tool, then the value of community health according to the chosen scenario can be calculated as:

21,000 (people) x $10,859 (statistical value from HALYs gained) = $228 M.

Savings

An increase in physical activity due to the chosen scenario reduces chronic disease cases across a lifetime and reduces spending for each disease within the health care system resulting in overall health care cost savings**[a]**.

Table 3 provides estimated health care cost savings associated with the prevented cases of chronic diseases per 1,000 members of the population according to the selected scenario. These figures are based on applying average health care system costs per prevalent case of disease and using three alternative discount rates**[b]**:

Table 3. Total health care cost savings by disease per 1,000 members of the population.

Disease	3% discount rate	5% discount rate	7% discount rate
Alzheimer's disease and other dementias	$58	$42	$30
Breast cancer	$1,563	$974	$644
All cancers	$3,382	$2,162	$1,461
Colon cancer	$557	$384	$269
Chronic myeloid leukemia	$246	$147	$95
Diabetes type 2	$1,160	$674	$426
Depression	$8,123	$5,931	$4,484
Head and neck cancer	$32	$21	$15
Ischemic heart disease	$1,902	$1,109	$701
Liver cancer	$20	$14	$10
Multiple myeloma	$455	$290	$198
Stomach cancer	$149	$96	$66
Stroke	$325	$191	$121
Lung cancer	$262	$174	$123
Uterine cancer	$100	$61	$40

a. What do we mean by health care cost savings?

To calculate health care cost savings for each disease, the annual costs for each disease in each year is multiplied by the number of prevented cases of each disease for each scenario. This results in a total saving in spending for each disease by year. The savings in spending for future years are discounted**[b]** with annual savings aggregated to give a total amount saved for each disease. Total savings are presented as the amount saved per 1,000 members of the population to enable comparisons against populations of different sizes.

We use the term **health care cost saving** because it represents a reduction in health spending. However, the Australian Institute of Health and Welfare (AIHW) stress that the term cost is broad and not representative of the full cost experienced by individuals, families, or the health system, consequently AIHW use the term spending.[8]

These figures use AIHW estimates of the amounts spent through the health system in 2018-19 for each case of disease. This is extracted from Health system spending per case of disease and for certain risk factors, Table 1 – Estimates of health system spending per case, by burden of disease group, condition and sex, Australia 2018-2019.[9]. For head and neck cancers, supplementary figures were obtained from the Global Burden of Disease incidence data.[10]

b. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

References

1. Gold, M. R., Stevenson, D., & Fryback, D. G. (2002). *HALYS and QALYS and DALYS, Oh My: similarities and differences in summary measures of population Health.* Annual review of public health, 23(1), 115-134.
2. Attema, A.E., Brouwer, W.B. & Claxton, K. (2018). *Discounting in economic evaluations.* Pharmacoeconomics. 36: p. 745-758.
3. Ananthapavan, J., Moodie, M., Milat, A.J., & Carter, R. (2021). *Systematic review to update 'value of a statistical life' estimates for Australia.* International journal of environmental research and public health, 2021. 18(11): p. 6168.
4. Terrill, M. & Batrouney, H. (2018). *Unfreezing discount rates: Transport infrastructure for tomorrow.* Grattan Institute.
5. Abelson, P. (2008). *Establishing a monetary value for lives saved: issues and controversies.* Canberra: Office of Best Practice Regulation, Department of Finance and Deregulation.
6. Department of the Prime Minister and Cabinet. (2022). *Best practice regulation guidance note: Value of statistical life.* Australian Government.
7. Haacker, M., Hallett, T.B. & Atun, R. (2020). *On discount rates for economic evaluations in global health.* Health Policy and Planning, 2020. 35(1): p. 107-114.
8. Australian Institute of Health and Welfare (2023). Technical Notes: Estimating Spending per prevalent case of disease. Health system spending per case of disease and for certain risk factors, Estimating the spending per prevalent case of disease - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
9. Australian Institute of Health and Welfare (2023). Health system spending per case of disease and for certain risk factors. Health system spending per case of disease and for certain risk factors, Data - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
10. Global Burden of Disease (2019). Global Health Data Exchange. https://vizhub.healthdata.org/gbd-results. Accessed September 20, 2023.
11. Zapata-Diomedi, B., Boulangé, C., Giles-Corti, B., Phelan, K., Washington, S., Veerman, L.J., & Gunn, L. (2019). Physical activity-related health and economic benefits of building walkable neighbourhoods: A modelled comparison between brownfield and greenfield developments. International Journal of Behavioural Nutrition and Physical Activity.
12. Khorasani, E., Davari, M., Kebriaeezadeh, A., Fatemi, F., Akbari Sari, A., & Varahrami, V. (2022). A comprehensive review of official discount rates in guidelines of health economic evaluations over time: the trends and roots. The European Journal of Health Economics, 23(9), 1577-1590.

Scenario: replacing car trips under 2km with walking for commuting trip purposes

This scenario shows the results of replacing car trips under 2km for work related or education purposes with walking trips for all adults of all ages.

This implies that the selected scenario results in a mode shift in walking from 16.8% to 18.6% and from 74.7% to 72.9% for car trips taken as either a driver or passenger.

Increases in walking translate into a shift from 47.9% to 49.2% of the population accumulating the required minutes spent being moderately (150 – 300 mins) or vigorously physically active (75 – 150 mins) or an equivalent combination of both contributing to recommended levels as detailed in the Physical Activity Guidelines.

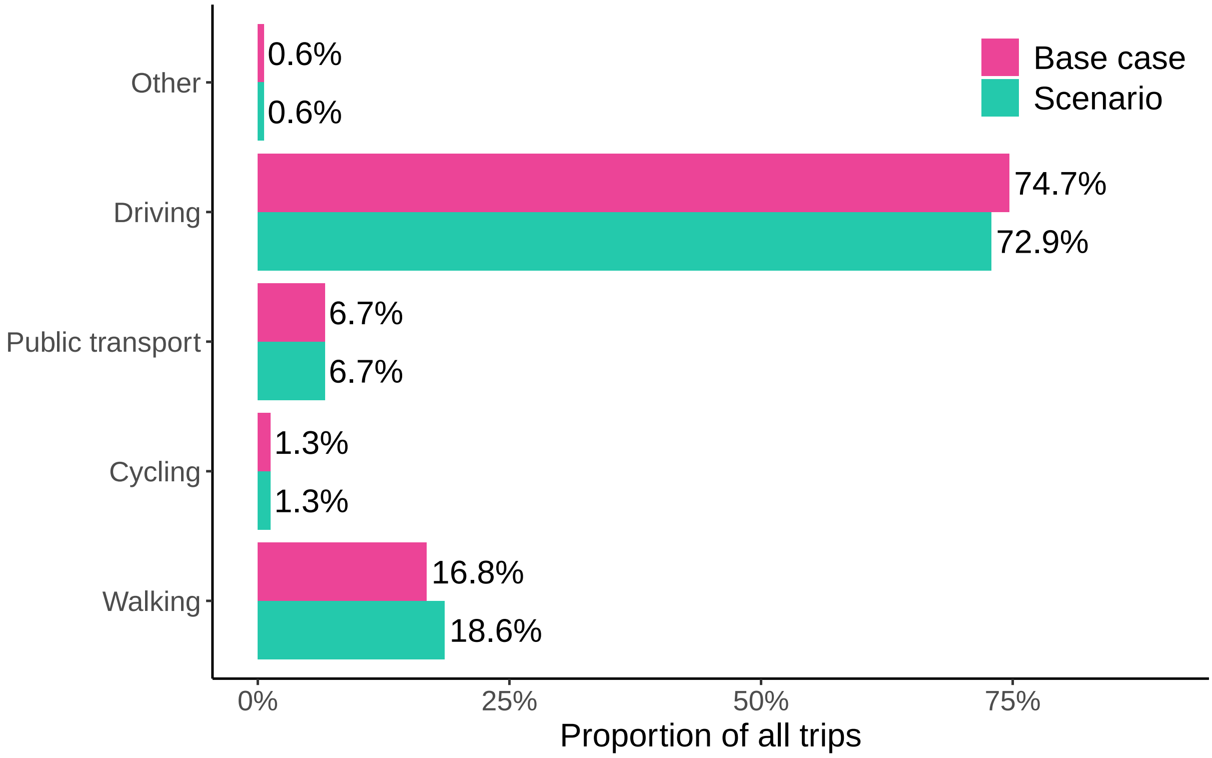

Figure 1: Distribution of base case and scenario trips.

Incidence

Incidence describes the rate of occurrence of new cases of a disease over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of disease prevented, due to increases in physical activity associated with the scenario. Figure 2 presents the change (%) in the disease incidence across the life course. Figure 3 presents how the difference in disease incidence changes over time, by year, using a snapshot of the population from 2019.

Table 1 shows how the scenario impacts the incidence of chronic diseases as both as a percentage and total number of prevented cases.

Table 1. Chronic disease incidence reduction and total number of prevented cases of disease measured across the years of the simulation

Disease*	Incidence of disease is reduced by	Total number of prevented cases of disease aggregated across the simulation
Alzheimer's disease and other dementias	-0.02%	-108
Breast cancer	0.04%	27
All cancers	0.03%	136
Colon cancer	0.01%	7
Chronic myeloid leukemia	0.03%	1
Diabetes type 2	0.24%	792
Depression	0.04%	708
Head and neck cancer	0.13%	6
Ischemic heart disease	0.07%	593
Liver cancer	0.07%	13
Multiple myeloma	0.07%	14
Stomach cancer	0.06%	15
Stroke	0.05%	142
Lung cancer	0.04%	50
Uterine cancer	0.06%	5

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

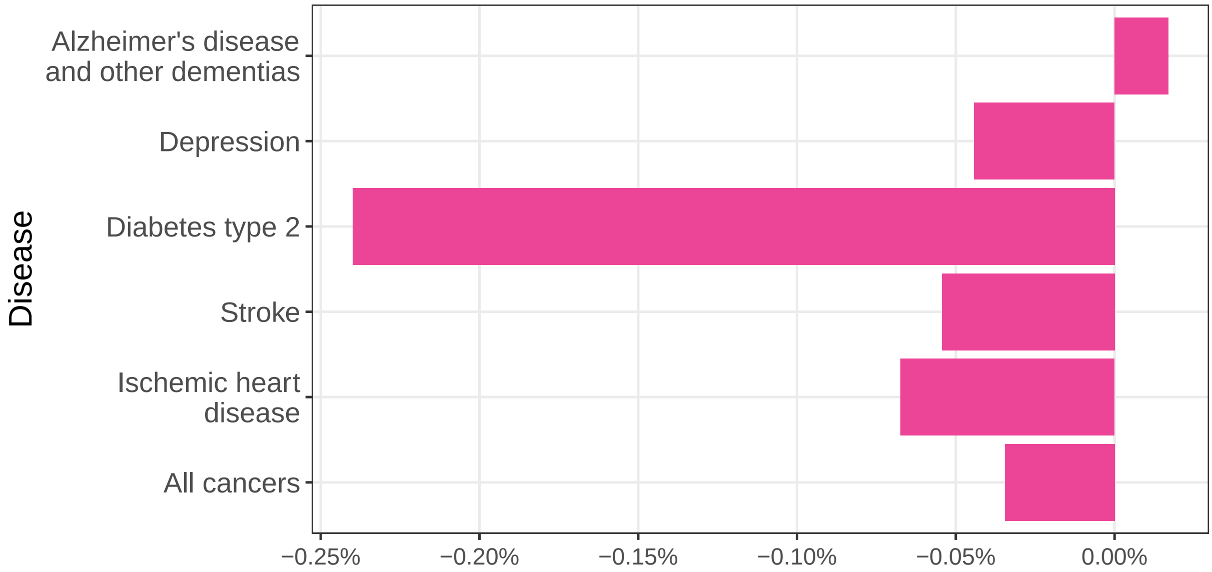

Figure 2.a: Percentage change in incidence by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

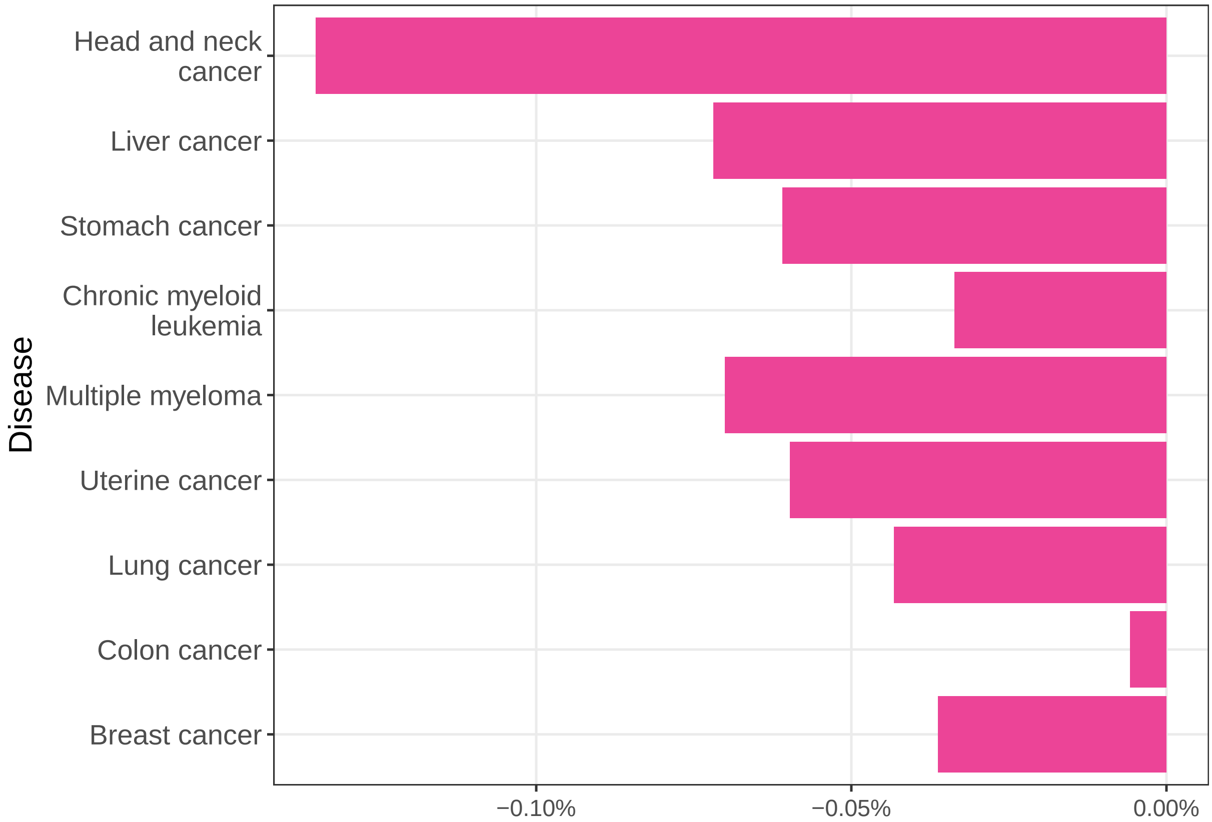

Figure 2.b: Percentage change in incidence for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

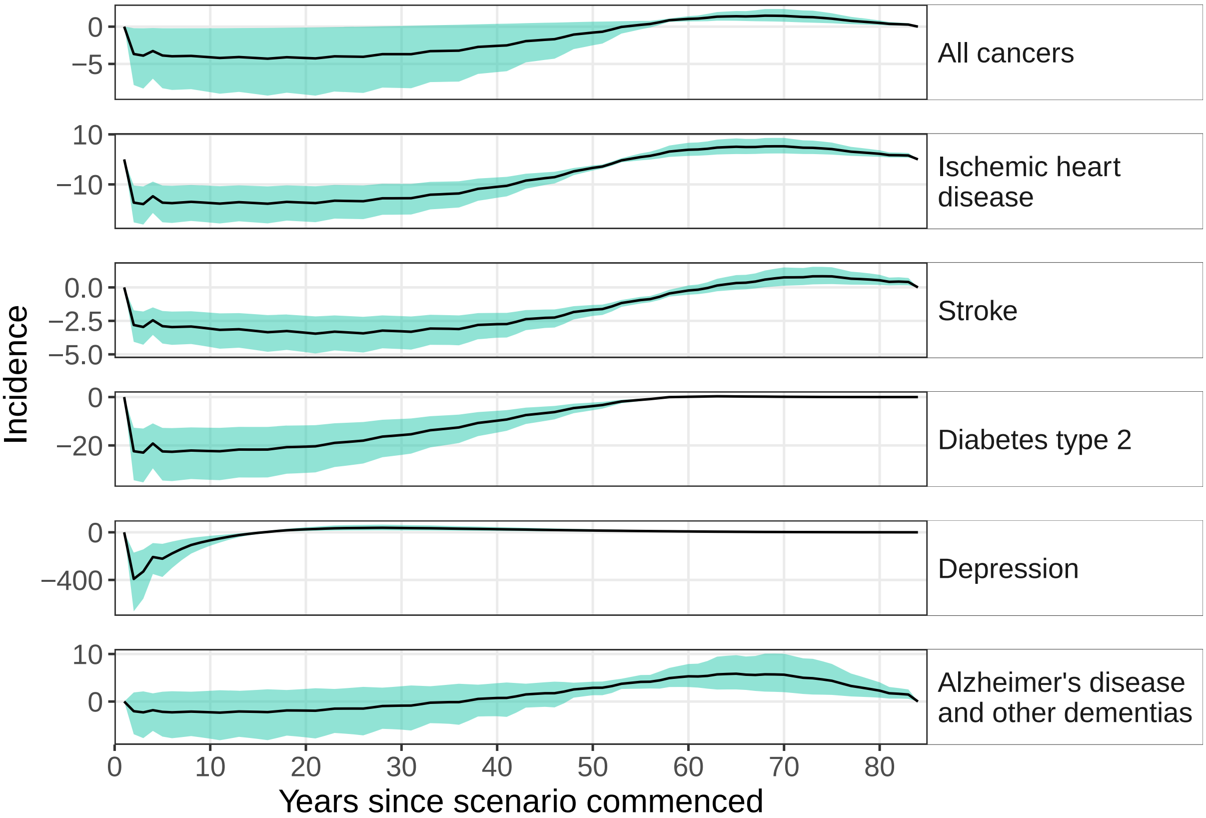

Figure 3.a: The change in incidence over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

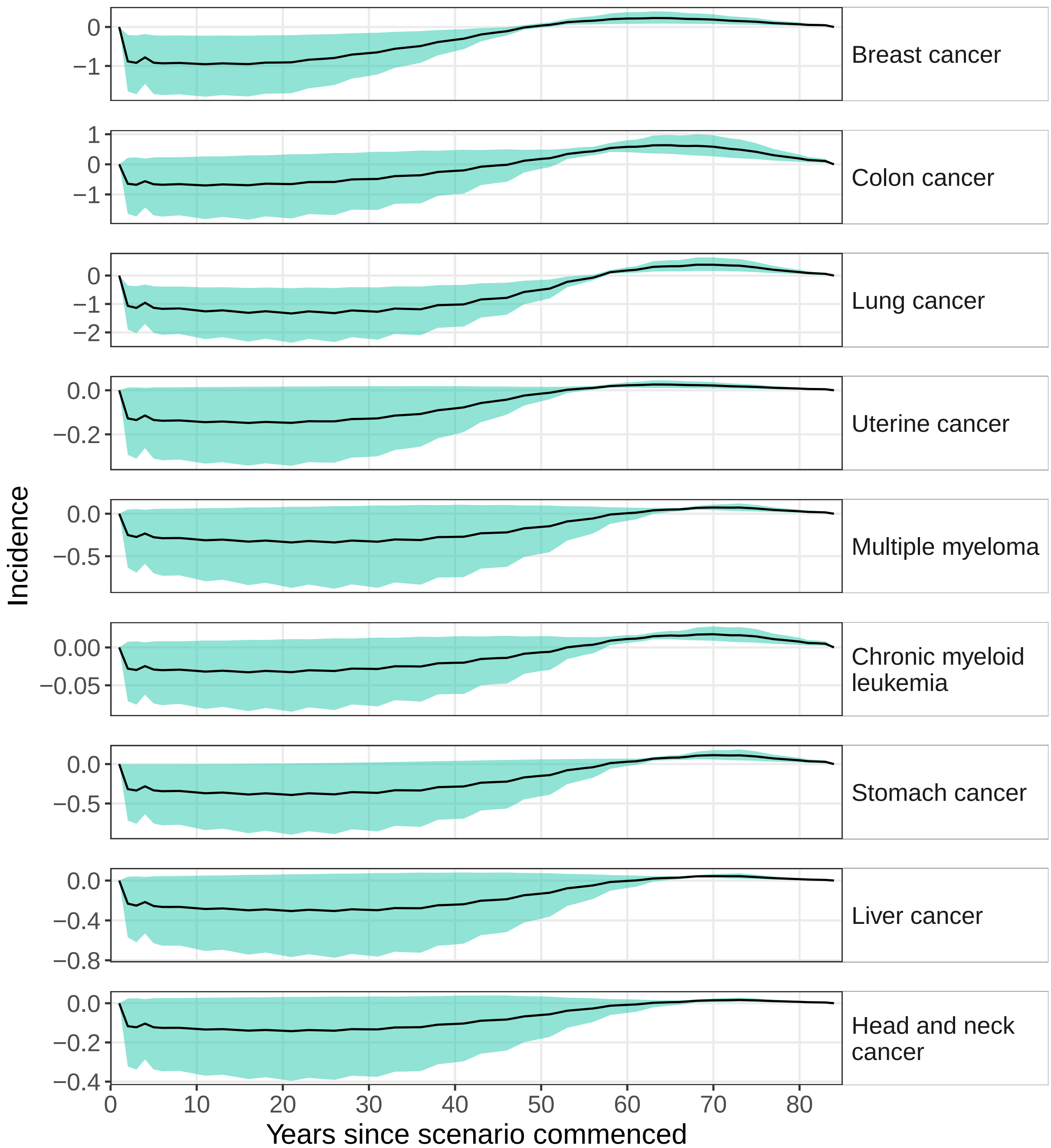

Figure 3.b: Percentage change in incidence for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Mortality

Mortality is the number of deaths due to a given disease over over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of prevented deaths due to increases in physical activity associated with the scenario. Figure 4 presents the total change in mortality over the life course. Figure 5 presents the difference in the number of deaths by year using a snapshot of the population from 2019.

Table 2 shows how the scenario impacts reductions in mortality presented as a percentage and total number of prevented deaths caused by chronic diseases.

Table 2. Percentage reduction in mortality and total number of prevented deaths by chronic disease measured across the years of the simulation.

Disease*	Mortality is reduced by	Total number of prevented deaths aggregated across the simulation
Alzheimer's disease and other dementias	-0.04%	-91
Breast cancer	0.04%	11
All cancers	0.04%	109
Colon cancer	0.01%	4
Chronic myeloid leukemia	0.03%	1
Diabetes type 2	0.21%	105
Depression	0.00%	0
Head and neck cancer	0.14%	6
Ischemic heart disease	0.07%	251
Liver cancer	0.07%	12
Multiple myeloma	0.07%	12
Stomach cancer	0.06%	13
Stroke	0.05%	82
Lung cancer	0.04%	47
Uterine cancer	0.05%	4

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

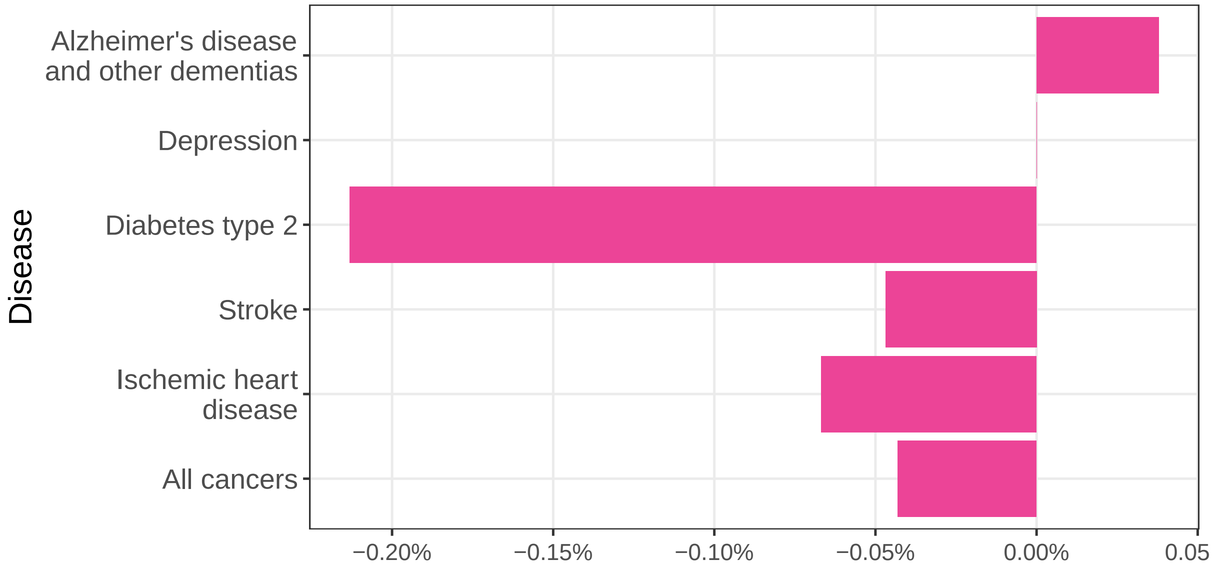

Figure 4.a: Percentage change in mortality by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

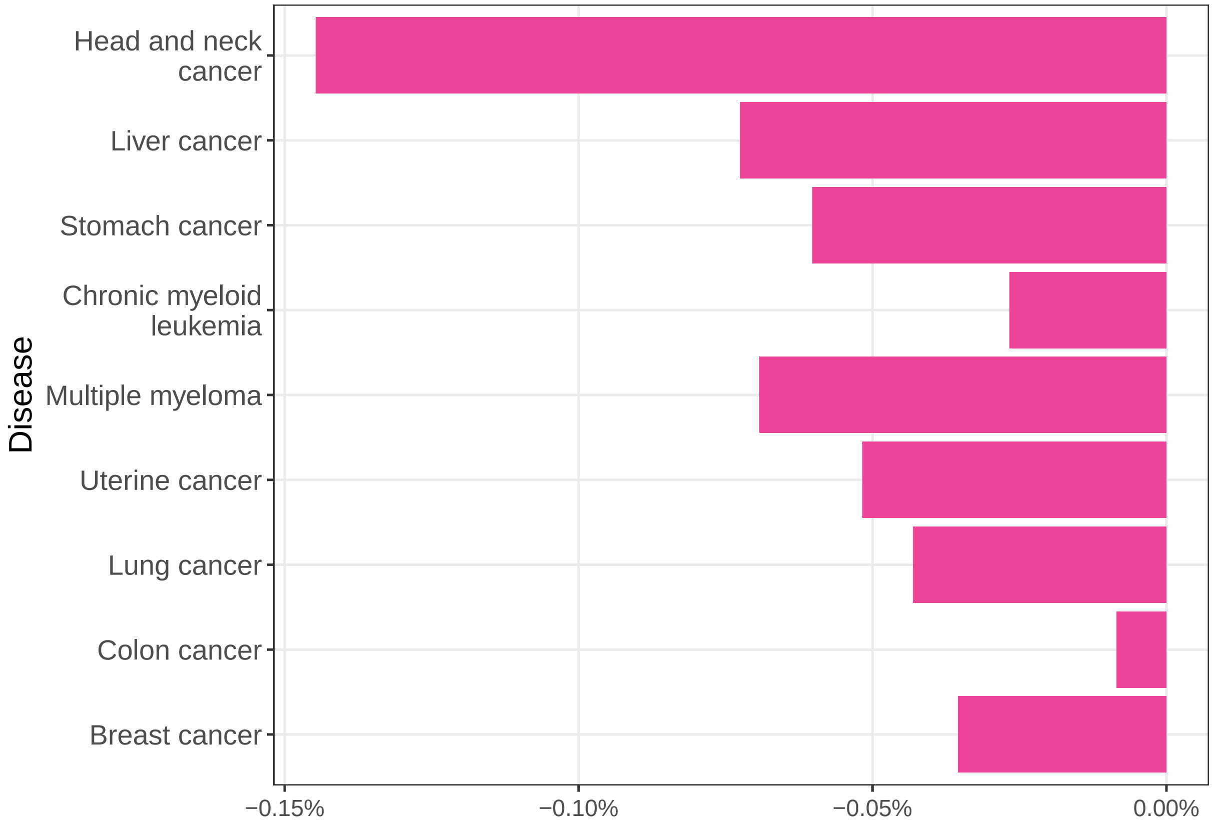

Figure 4.b: Percentage change in mortality for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

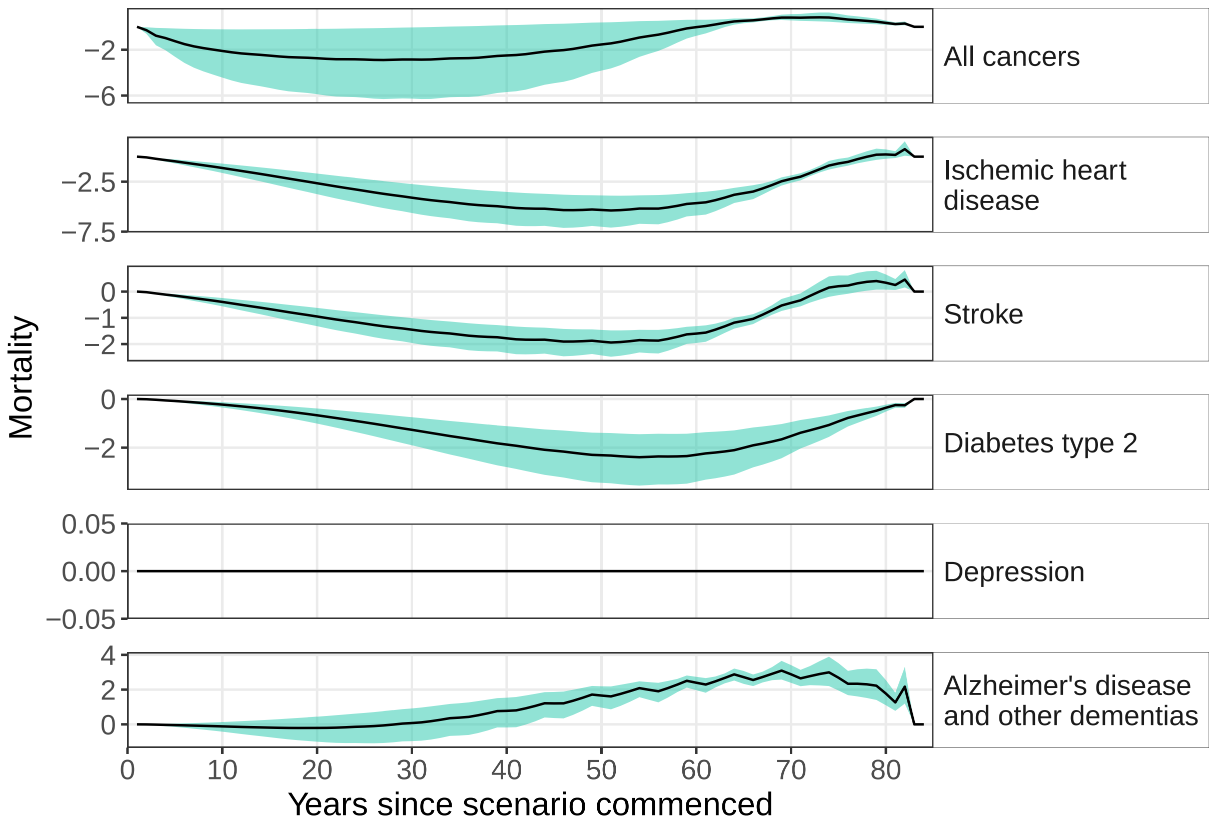

Figure 5.a: The change in mortality over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

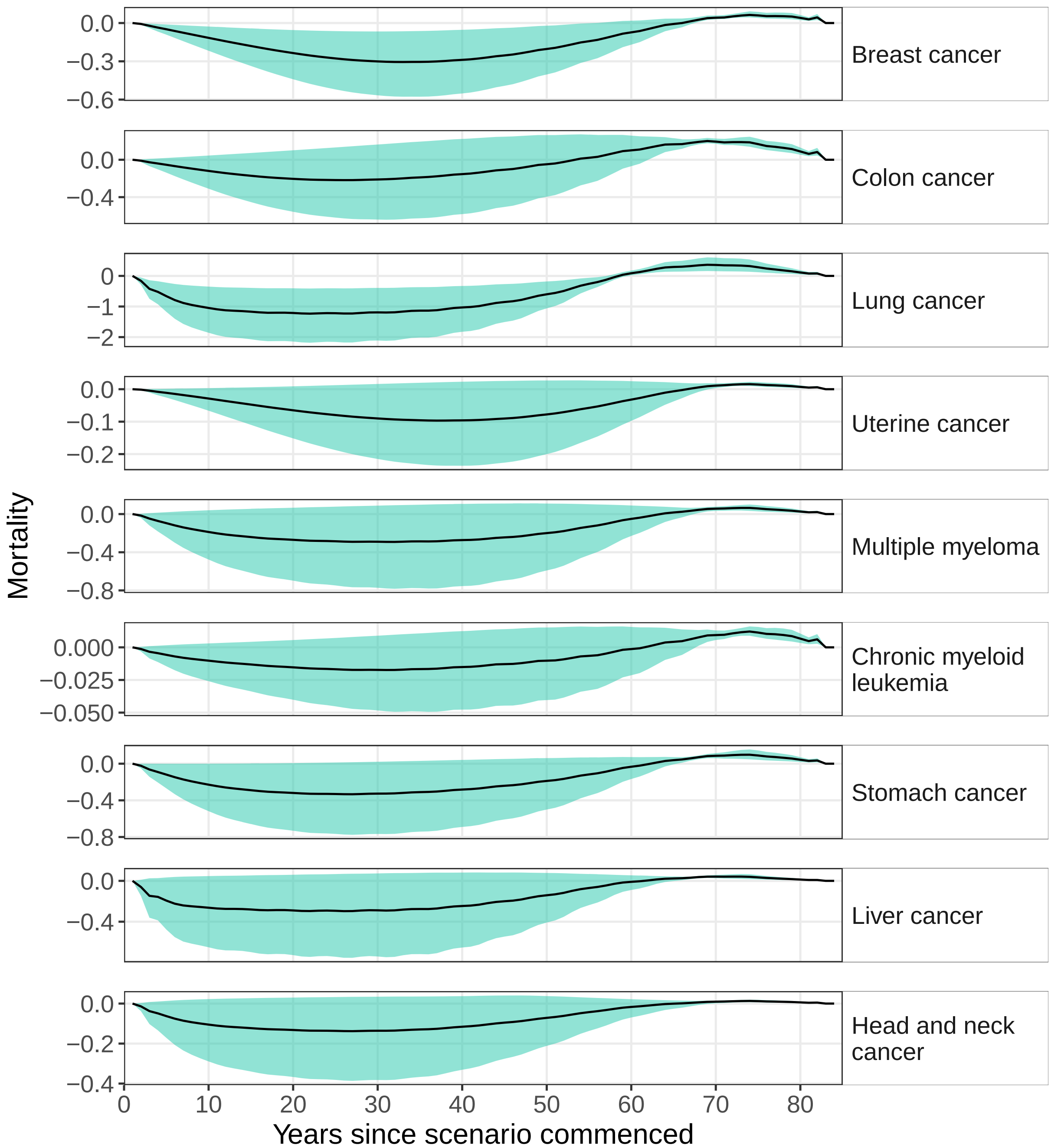

Figure 5.b: Percentage change in mortality for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Health

Figures 6 and 7 below show the change in Health Adjusted Life Years (HALYs)[1] and Life Years[2] for a snapshot of the population from 2019 for the scenario. Both figures show that the greatest gains from increasing physical activity occur midway through the life cycle with most of the gains occurring cumulatively in the long term. The decline from the mid-point onwards is due to individuals dying from natural causes within the model.

HALYS

The model estimates a total of **25,360** HALYs for the scenario population, which is **13** HALYs per 1,000 members of the population.

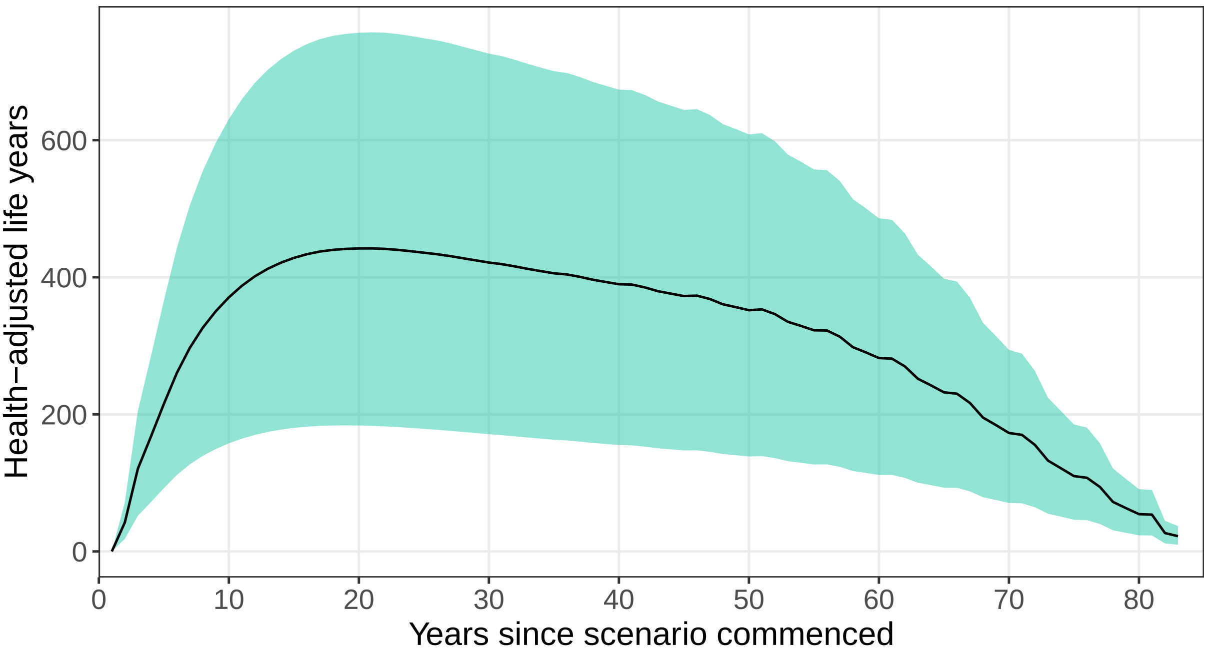

Figure 6. Total health-adjusted life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

[1] Health Adjusted Life Years are holistic measures of health that account for morbidity, mortality and quality of life.

[2] Life Years are similar to a HALYs however they exclude the quality of life component.

Life Years

The model estimates a total of **11,597** Life Years for the scenario population, which is **5.8** Life Years per 1,000 members of the population.

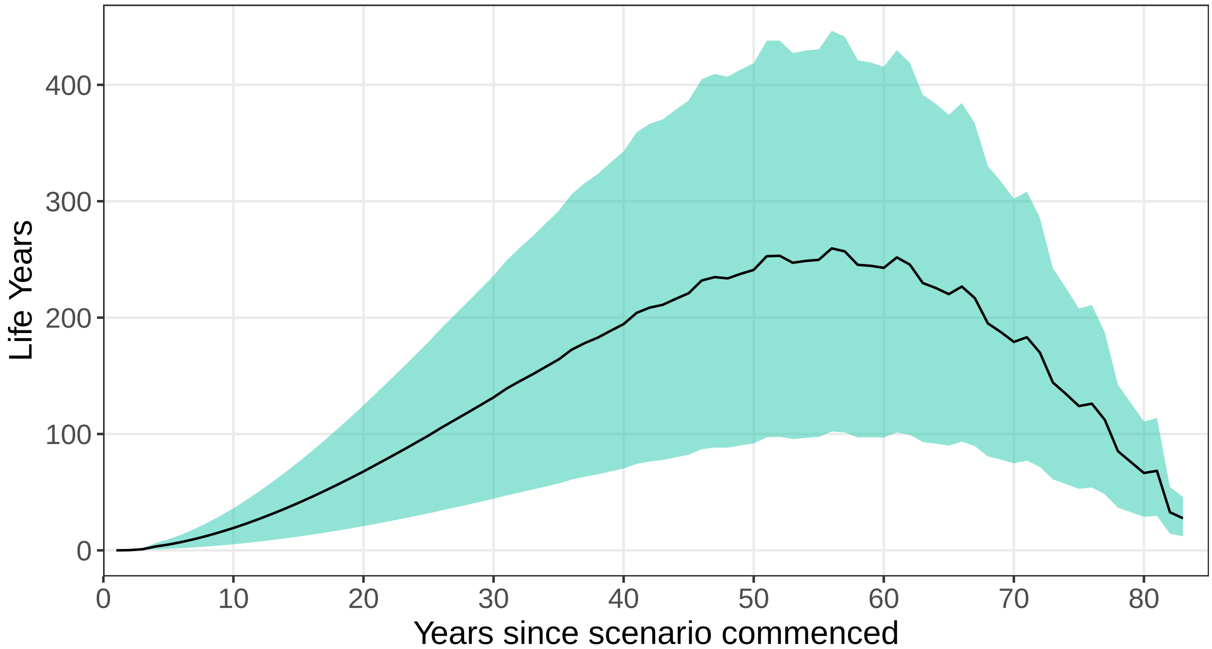

Figure 7. Total life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Value

The value of improvements to community health can be calculated**[a]** by translating the Health Adjusted Life Years (HALYs) from each scenario into dollar terms using the value of a statistical life year**[b]**. The value of a statistical life year is an estimate of the amount a society is willing to trade to reduce the risk of death for one year.

In the simulation model, HALYs are generated across time and are cumulative. Thus, to help us understand the value of HALYs across time in present day terms, it is necessary to use discounting**[c]** to reduce HALYs generated at the future point in time. Discounted HALYs from these future points can be added up to give the aggregate value of HALYs in today's terms as a measure of the value of improvements to community health arising from the chosen scenario.

The size of the discount rate can impact the aggregated value of HALYs and there is considerable debate on what discount rates should be used (with some arguing that health should not be discounted at all).[2] Hence, it is common to use a variety of discount rates to allow for differing risks, preferences and sensitivity when valuing health. The figures presented below were calculated using discount rates of 3%, 5% and 7% based on recent recommendations [3, 4] and represent the value of HALYs in present day terms resulting from an increase in physical activity from the chosen scenario.

The value of improvements to community health

The model estimates a total of **HALYs,** Health Adjusted Life Years (HALYs) gained for the scenario population, which is **13** HALYs per 1,000 members of the scenario population. The figures below represent the value of improvements to community health from the chosen scenario. These figures can be used in summary reports and for advocacy purposes**[d]**.

The HALYs gained in this scenario have a statistical value of:

- **1,071,442** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **676,202** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **465,123** per 1,000 members of the population, when calculated using a discount rate of 7%.

a. What is meant by value and how can it be measured?

Value is conceptual and measures a sense of worth or usefulness of something to individuals or to a society. Measuring the value of something, such as health, enables it to be included in assessments or analyses such as cost-benefit analyses to recognise its relative importance.

Value can be derived in many ways and a common approach is to use monetary terms, such as dollars. Valuing something using dollars is not the same as equating it with its price. Prices represent the amount at which something can be traded, prices therefore represent the amount of money for buying or selling something such as food, clothing or to pay bills. One way is to evaluate health in dollar terms is to use the Value of a Statistical Life and Value of a Statistical Life Year**[b]**.

b. What is the Value of a Statistical Life and Value of a Statistical Life Year?

The value of a **statistical life** is the estimated amount that a society is willing to trade to reduce the risk of death. The word 'Statistical' refers to the average value for life and therefore means the value of a statistical life doesn't relate to any specific individual. This value can change across risk factors and different societies who may value life differently. There are various ways of measuring the value of a statistical life with most approaches using revealed or stated preference approaches.[3] In Australia, the Office of Best Practice Regulation estimates a statistical life at $5.3M in 2022 dollar terms, and assumes that the life is of a young person with at least another 40 years to live.[5, 6]

Value of a Statistical Life Year

The value of a statistical life year is the estimated amount that a society is willing to trade to reduce the risk of death over **one year.** It can be derived from the value of a statistical life or measured directly using surveys or willingness to pay techniques.[5] The current value of a **statistical life year** is $227,000 in 2022 dollars based on current estimates from the Office of Best Practice Regulation.[6] The value of a statistical life year is useful for evaluating small increases in life years instead of evaluating full life expectancy. It is appropriate for valuing the Health Adjusted Life Years estimated from the scenarios and modelling presented in this tool. For the modelling and results presented here, the value of $227,000 was converted to 2019 dollars based on the Wage Price Index for Brisbane.

c. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

d. Application in advocacy and reporting

This section uses figures to show how the value of community health (estimated from HALYs and the value of statistical life year) can be used for reporting and advocacy purposes.

The simulation model uses **population-based estimates** for disease morbidity and mortality and is best applied to larger groups of people. It also assumes that the people of interest have similar characteristics and behaviours to the population data used in the simulation model and scenarios. The **example** below shows results from a scenario that replaces car trips with walking trips for distances of 0-2 km for All age groups.

Example:

The HALYs gained in this scenario have a statistical value of:

- **$10,859,605** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **$6,662,541** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **$4,533,392** per 1,000 members of the population, when calculated using a discount rate of 7%.

This **example** shows that the HALYs gained in this scenario have a statistical value of $10,859,605 per 1,000 members of the population using a discount of 3%.

This figure can be divided by 1,000 to give a per person figure. Once a per person figure is established, it can be multiplied by the number of people in any population size of interest for use in reports or as evidence to advocate for benefits associated with shifts to active transport modes.

$10,859,605 / 1,000 = $10,859.61 per person value

A good example of how this model can be applied links to previous research that investigated the impact of new more walkable development in Altona North on a population of 21,000 people [11]. If we assume that these people have similar characteristics to the underlying population based estimates and behaviours based on the travel survey data in the simulation model underlying this tool, then the value of community health according to the chosen scenario can be calculated as:

21,000 (people) x $10,859 (statistical value from HALYs gained) = $228 M.

Savings

An increase in physical activity due to the chosen scenario reduces chronic disease cases across a lifetime and reduces spending for each disease within the health care system resulting in overall health care cost savings**[a]**.

Table 3 provides estimated health care cost savings associated with the prevented cases of chronic diseases per 1,000 members of the population according to the selected scenario. These figures are based on applying average health care system costs per prevalent case of disease and using three alternative discount rates**[b]**:

Table 3. Total health care cost savings by disease per 1,000 members of the population.

Disease	3% discount rate	5% discount rate	7% discount rate
Alzheimer's disease and other dementias	$294	$206	$145
Breast cancer	$8,322	$5,097	$3,329
All cancers	$16,794	$10,649	$7,153
Colon cancer	$2,950	$2,012	$1,402
Chronic myeloid leukemia	$835	$505	$328
Diabetes type 2	$6,216	$3,608	$2,273
Depression	$34,996	$25,488	$19,225
Head and neck cancer	$146	$99	$71
Ischemic heart disease	$10,551	$6,164	$3,897
Liver cancer	$127	$87	$63
Multiple myeloma	$2,047	$1,310	$895
Stomach cancer	$764	$493	$339
Stroke	$1,442	$843	$534
Lung cancer	$1,143	$765	$542
Uterine cancer	$459	$282	$185

a. What do we mean by health care cost savings?

To calculate health care cost savings for each disease, the annual costs for each disease in each year is multiplied by the number of prevented cases of each disease for each scenario. This results in a total saving in spending for each disease by year. The savings in spending for future years are discounted**[b]** with annual savings aggregated to give a total amount saved for each disease. Total savings are presented as the amount saved per 1,000 members of the population to enable comparisons against populations of different sizes.

We use the term **health care cost saving** because it represents a reduction in health spending. However, the Australian Institute of Health and Welfare (AIHW) stress that the term cost is broad and not representative of the full cost experienced by individuals, families, or the health system, consequently AIHW use the term spending.[8]

These figures use AIHW estimates of the amounts spent through the health system in 2018-19 for each case of disease. This is extracted from Health system spending per case of disease and for certain risk factors, Table 1 – Estimates of health system spending per case, by burden of disease group, condition and sex, Australia 2018-2019.[9]. For head and neck cancers, supplementary figures were obtained from the Global Burden of Disease incidence data.[10]

b. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

References

1. Gold, M. R., Stevenson, D., & Fryback, D. G. (2002). *HALYS and QALYS and DALYS, Oh My: similarities and differences in summary measures of population Health.* Annual review of public health, 23(1), 115-134.
2. Attema, A.E., Brouwer, W.B. & Claxton, K. (2018). *Discounting in economic evaluations.* Pharmacoeconomics. 36: p. 745-758.
3. Ananthapavan, J., Moodie, M., Milat, A.J., & Carter, R. (2021). *Systematic review to update 'value of a statistical life' estimates for Australia.* International journal of environmental research and public health, 2021. 18(11): p. 6168.
4. Terrill, M. & Batrouney, H. (2018). *Unfreezing discount rates: Transport infrastructure for tomorrow.* Grattan Institute.
5. Abelson, P. (2008). *Establishing a monetary value for lives saved: issues and controversies.* Canberra: Office of Best Practice Regulation, Department of Finance and Deregulation.
6. Department of the Prime Minister and Cabinet. (2022). *Best practice regulation guidance note: Value of statistical life.* Australian Government.
7. Haacker, M., Hallett, T.B. & Atun, R. (2020). *On discount rates for economic evaluations in global health.* Health Policy and Planning, 2020. 35(1): p. 107-114.
8. Australian Institute of Health and Welfare (2023). Technical Notes: Estimating Spending per prevalent case of disease. Health system spending per case of disease and for certain risk factors, Estimating the spending per prevalent case of disease - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
9. Australian Institute of Health and Welfare (2023). Health system spending per case of disease and for certain risk factors. Health system spending per case of disease and for certain risk factors, Data - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
10. Global Burden of Disease (2019). Global Health Data Exchange. https://vizhub.healthdata.org/gbd-results. Accessed September 20, 2023.
11. Zapata-Diomedi, B., Boulangé, C., Giles-Corti, B., Phelan, K., Washington, S., Veerman, L.J., & Gunn, L. (2019). Physical activity-related health and economic benefits of building walkable neighbourhoods: A modelled comparison between brownfield and greenfield developments. International Journal of Behavioural Nutrition and Physical Activity.
12. Khorasani, E., Davari, M., Kebriaeezadeh, A., Fatemi, F., Akbari Sari, A., & Varahrami, V. (2022). A comprehensive review of official discount rates in guidelines of health economic evaluations over time: the trends and roots. The European Journal of Health Economics, 23(9), 1577-1590.

Scenario: replacing car trips under 2km with cycling for all trip purposes

This scenario shows the results of replacing car trips under 2km for leisure, shopping, work, education or other purposes with cycling trips for all adults of all ages.

This implies that the selected scenario results in a mode shift in cycling from 1.3% to 13.4% and from 74.7% to 62.6% for car trips taken as either a driver or passenger.

Increases in cycling translate into a shift from 47.9% to 54.7% of the population accumulating the required minutes spent being moderately (150 – 300 mins) or vigorously physically active (75 – 150 mins) or an equivalent combination of both contributing to recommended levels as detailed in the Physical Activity Guidelines.

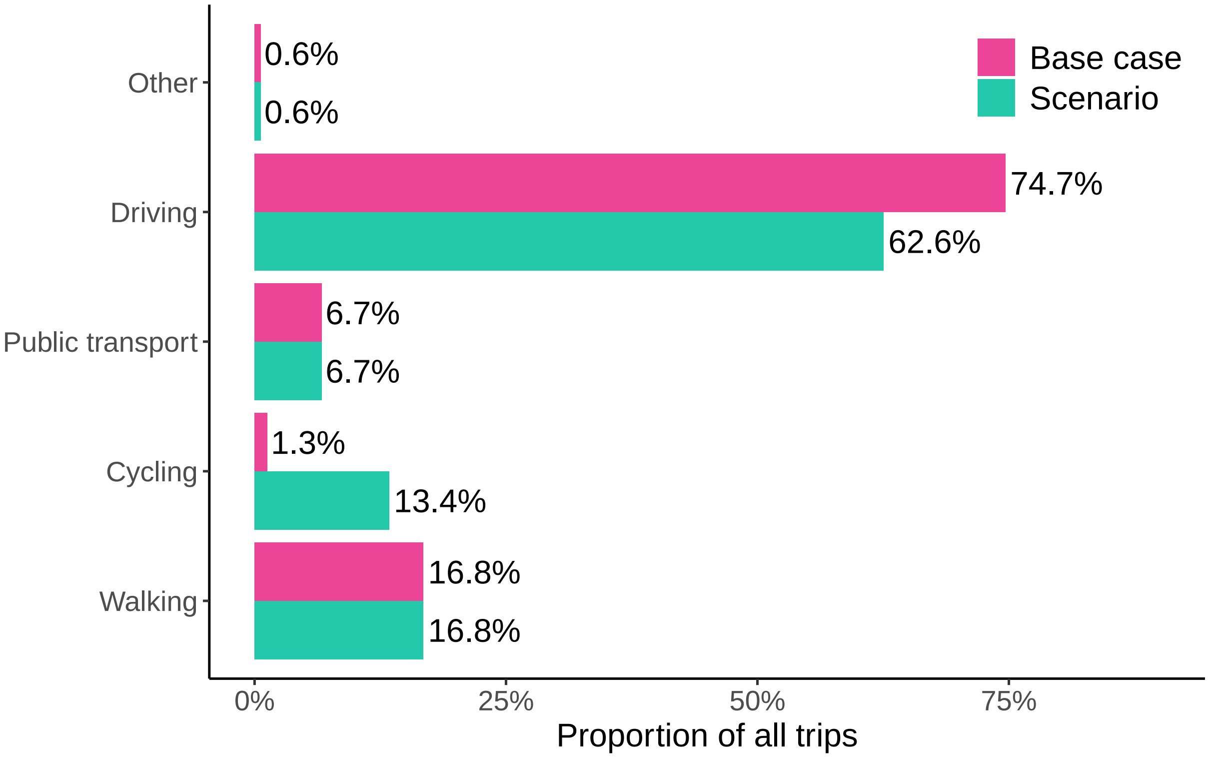

Figure 1: Distribution of base case and scenario trips.

Incidence

Incidence describes the rate of occurrence of new cases of a disease over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of disease prevented, due to increases in physical activity associated with the scenario. Figure 2 presents the change (%) in the disease incidence across the life course. Figure 3 presents how the difference in disease incidence changes over time, by year, using a snapshot of the population from 2019.

Table 1 shows how the scenario impacts the incidence of chronic diseases as both as a percentage and total number of prevented cases.

Table 1. Chronic disease incidence reduction and total number of prevented cases of disease measured across the years of the simulation

Disease*	Incidence of disease is reduced by	Total number of prevented cases of disease aggregated across the simulation
Alzheimer's disease and other dementias	0.53%	3,351
Breast cancer	0.38%	281
All cancers	0.93%	3,657
Colon cancer	0.40%	524
Chronic myeloid leukemia	1.86%	51
Diabetes type 2	2.43%	8,011
Depression	0.61%	9,751
Head and neck cancer	3.10%	137
Ischemic heart disease	1.33%	11,741
Liver cancer	1.53%	269
Multiple myeloma	2.16%	418
Stomach cancer	1.97%	471
Stroke	1.66%	4,317
Lung cancer	1.25%	1,440
Uterine cancer	0.77%	65

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

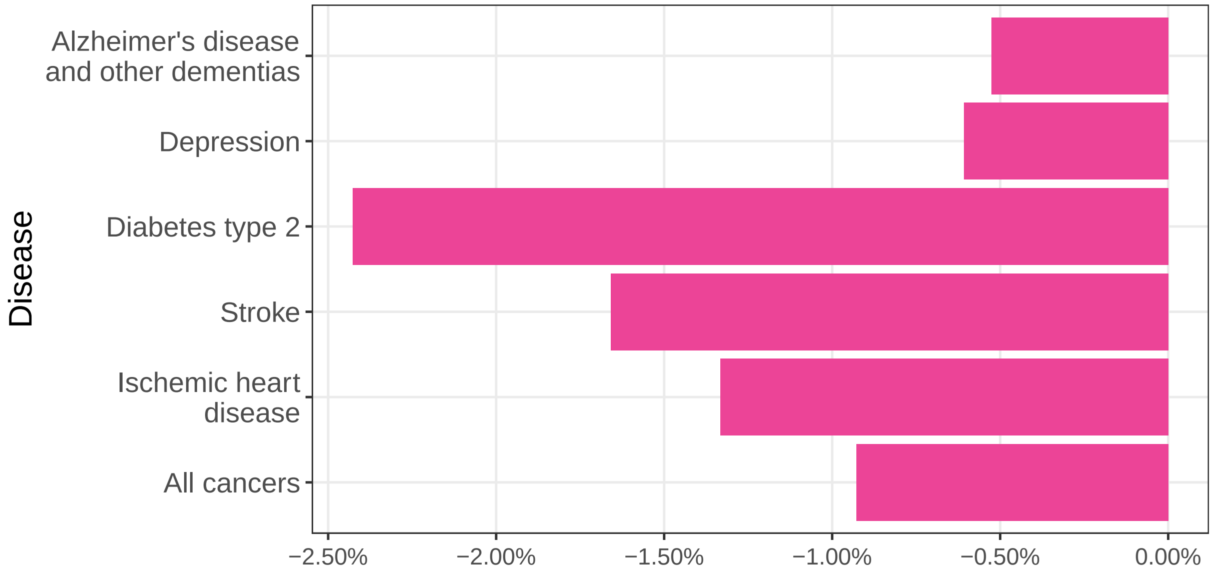

Figure 2.a: Percentage change in incidence by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

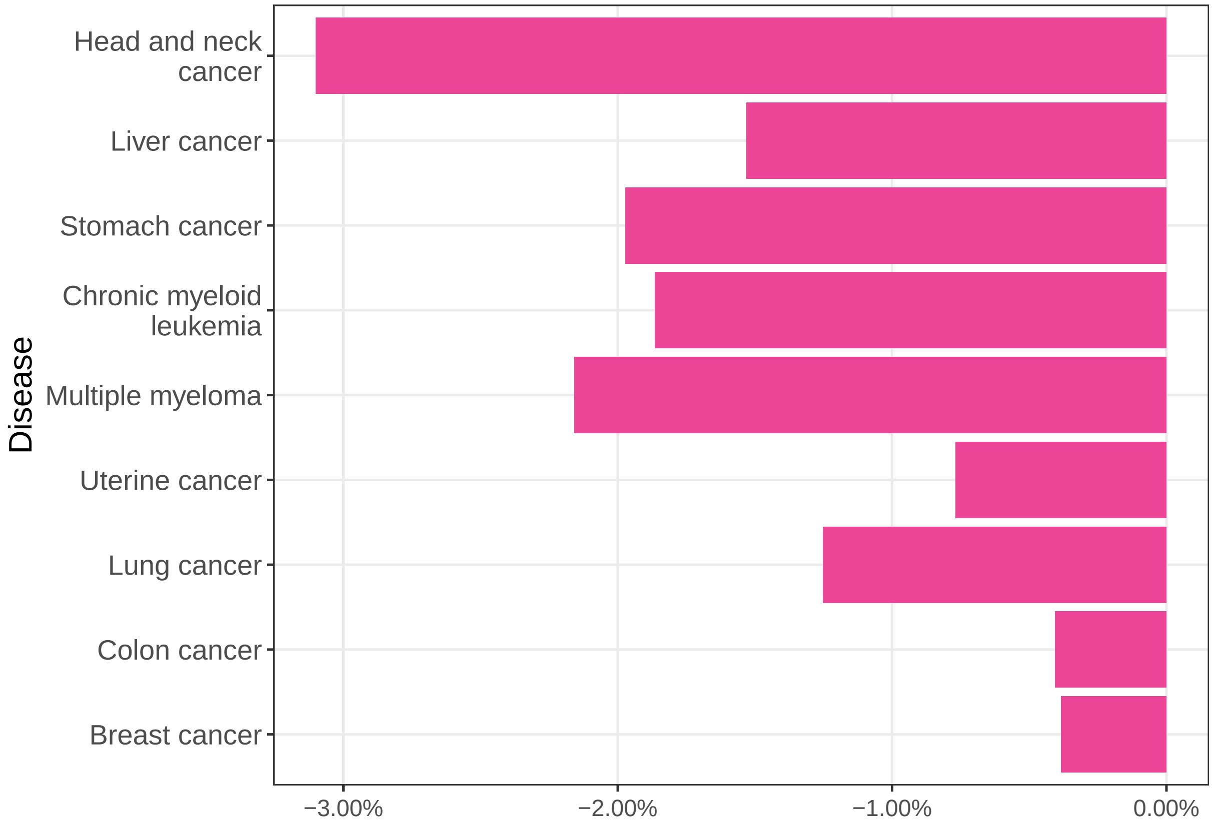

Figure 2.b: Percentage change in incidence for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

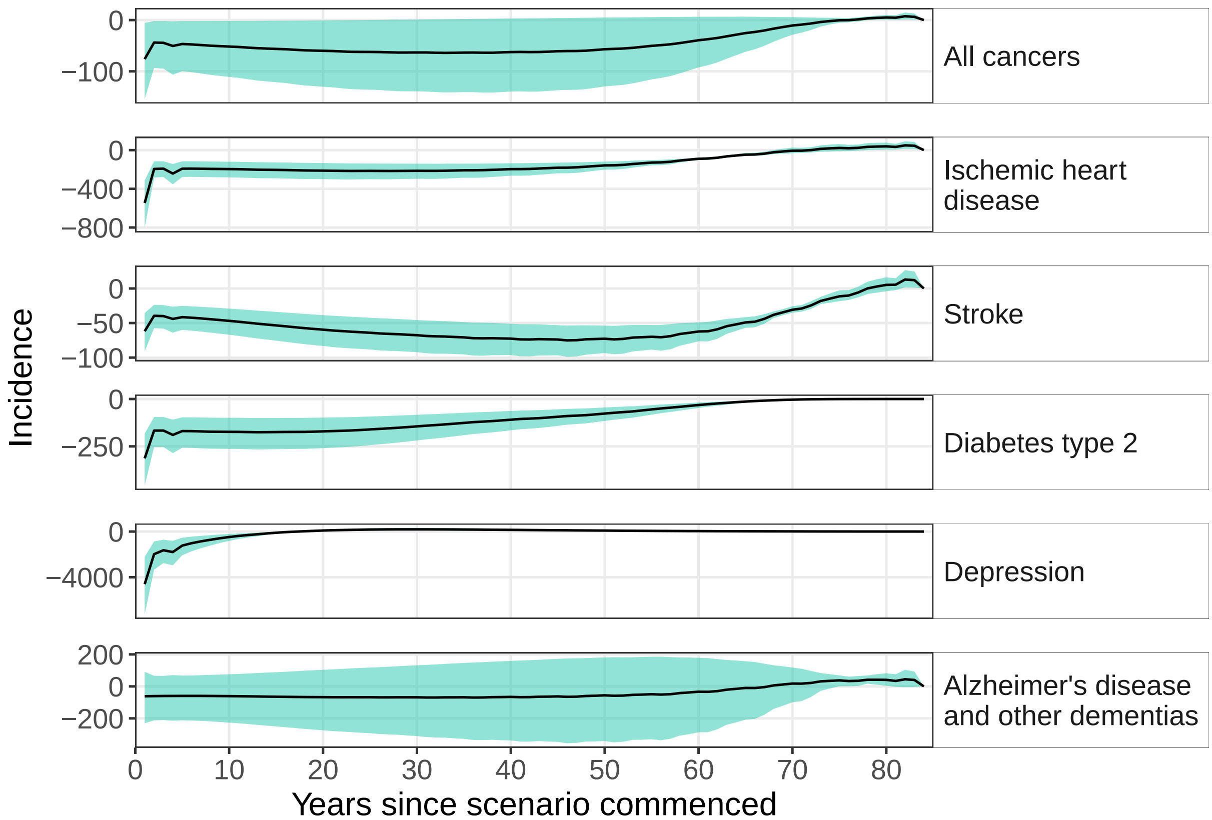

Figure 3.a: The change in incidence over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

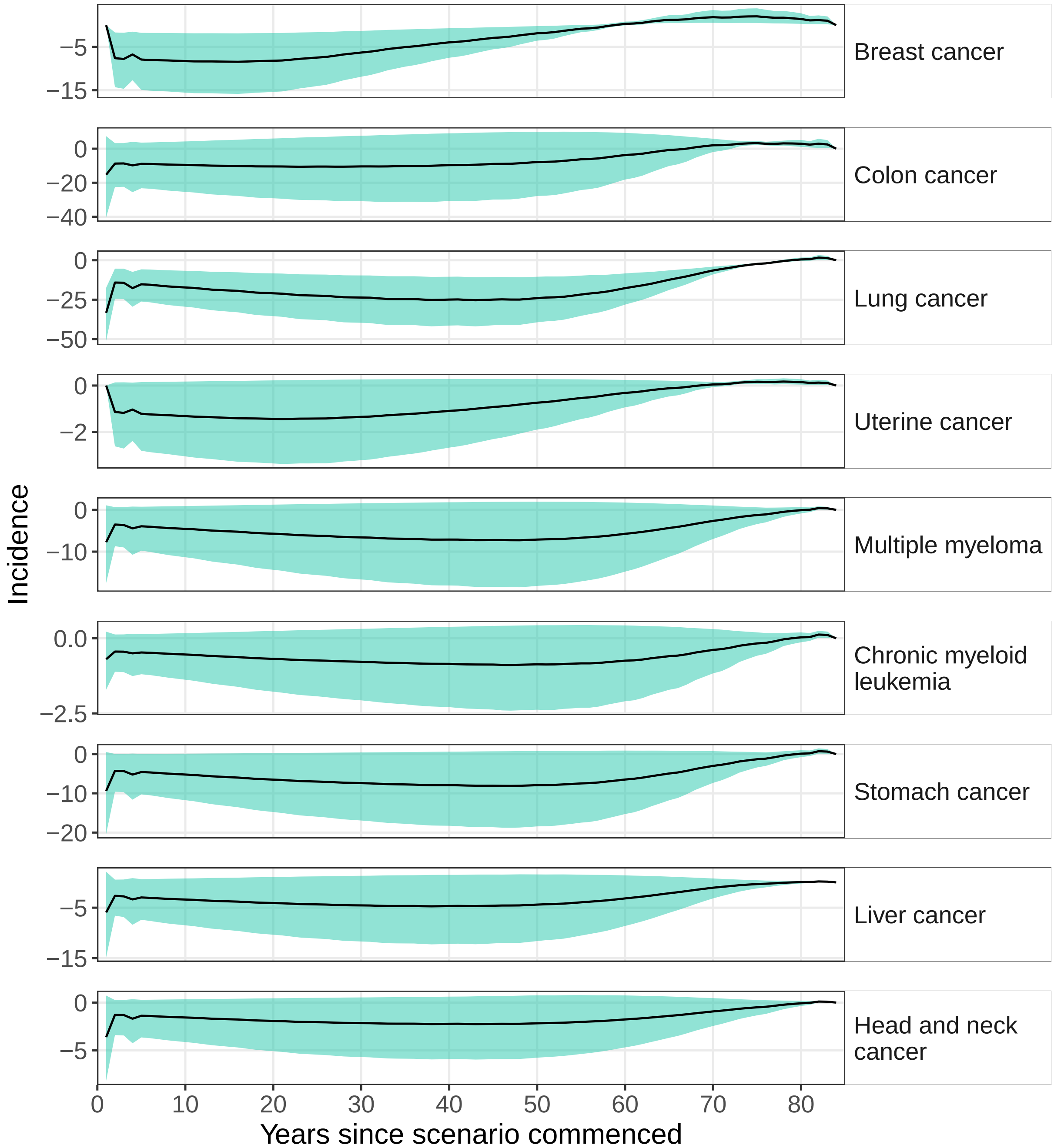

Figure 3.b: Percentage change in incidence for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Mortality

Mortality is the number of deaths due to a given disease over over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of prevented deaths due to increases in physical activity associated with the scenario. Figure 4 presents the total change in mortality over the life course. Figure 5 presents the difference in the number of deaths by year using a snapshot of the population from 2019.

Table 2 shows how the scenario impacts reductions in mortality presented as a percentage and total number of prevented deaths caused by chronic diseases.

Table 2. Percentage reduction in mortality and total number of prevented deaths by chronic disease measured across the years of the simulation.

Disease*	Mortality is reduced by	Total number of prevented deaths aggregated across the simulation
Alzheimer's disease and other dementias	0.18%	430
Breast cancer	0.14%	45
All cancers	1.07%	2,701
Colon cancer	0.18%	78
Chronic myeloid leukemia	1.75%	36
Diabetes type 2	1.72%	852
Depression	0.00%	0
Head and neck cancer	3.06%	122
Ischemic heart disease	1.18%	4,414
Liver cancer	1.52%	260
Multiple myeloma	2.10%	366
Stomach cancer	1.92%	407
Stroke	1.55%	2,709
Lung cancer	1.23%	1,341
Uterine cancer	0.62%	45

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

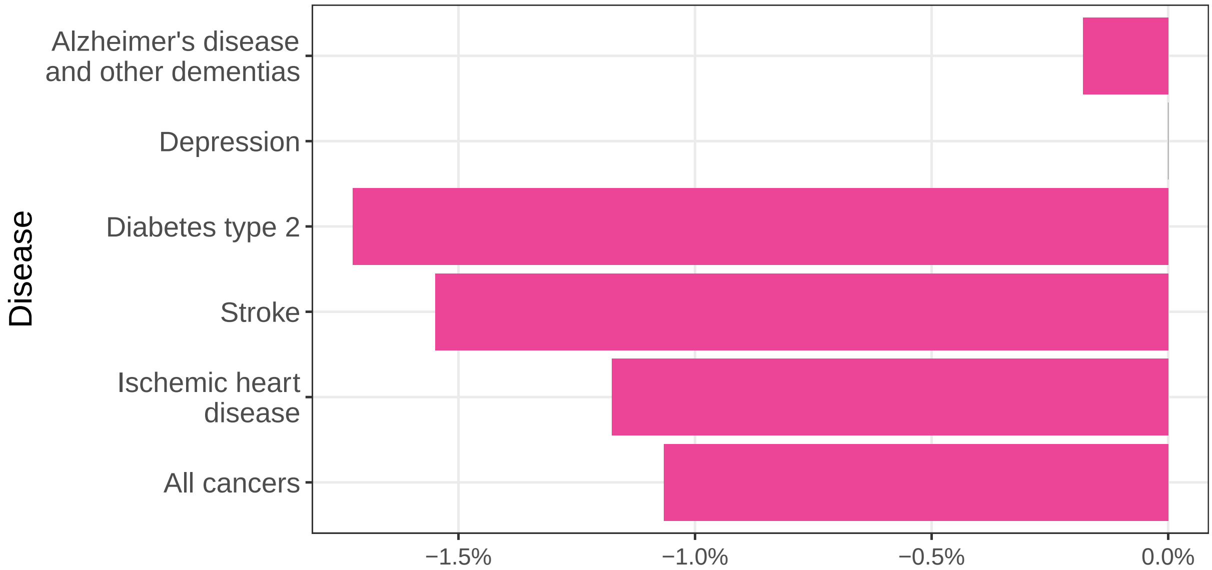

Figure 4.a: Percentage change in mortality by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

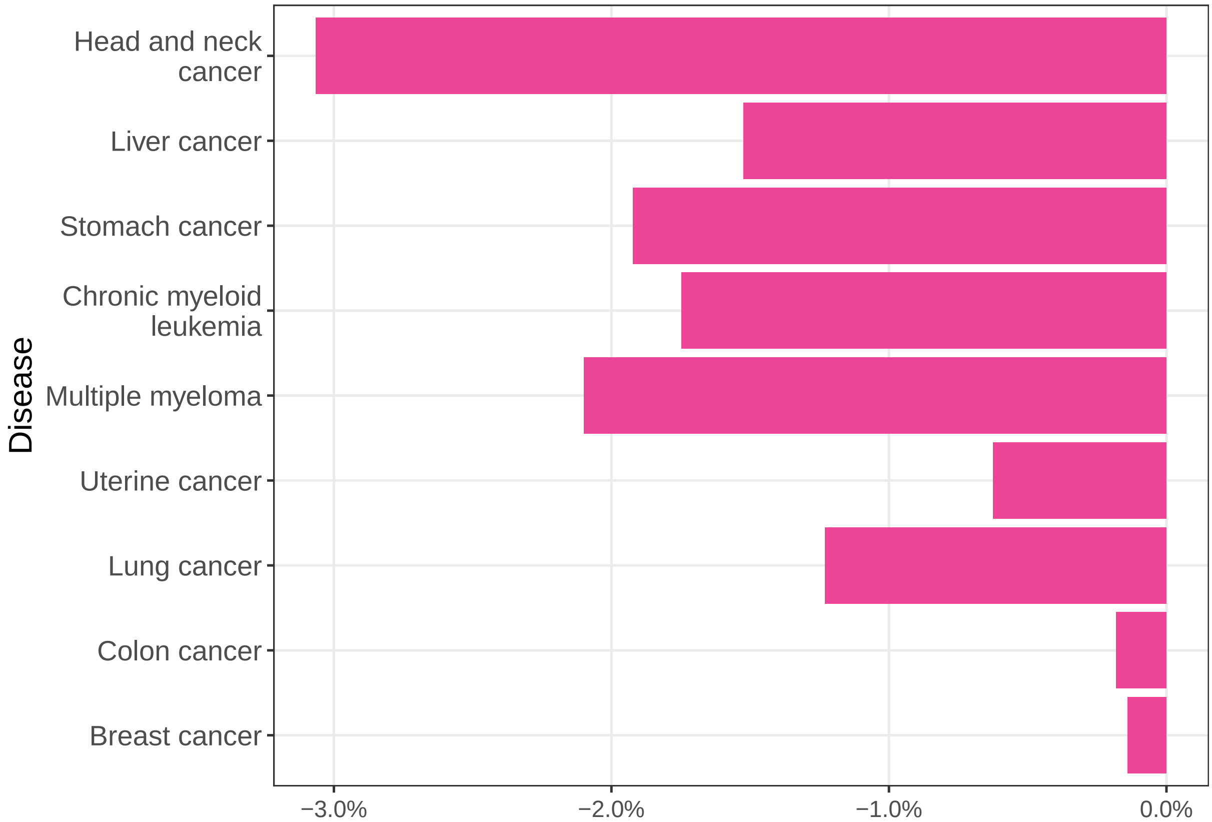

Figure 4.b: Percentage change in mortality for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

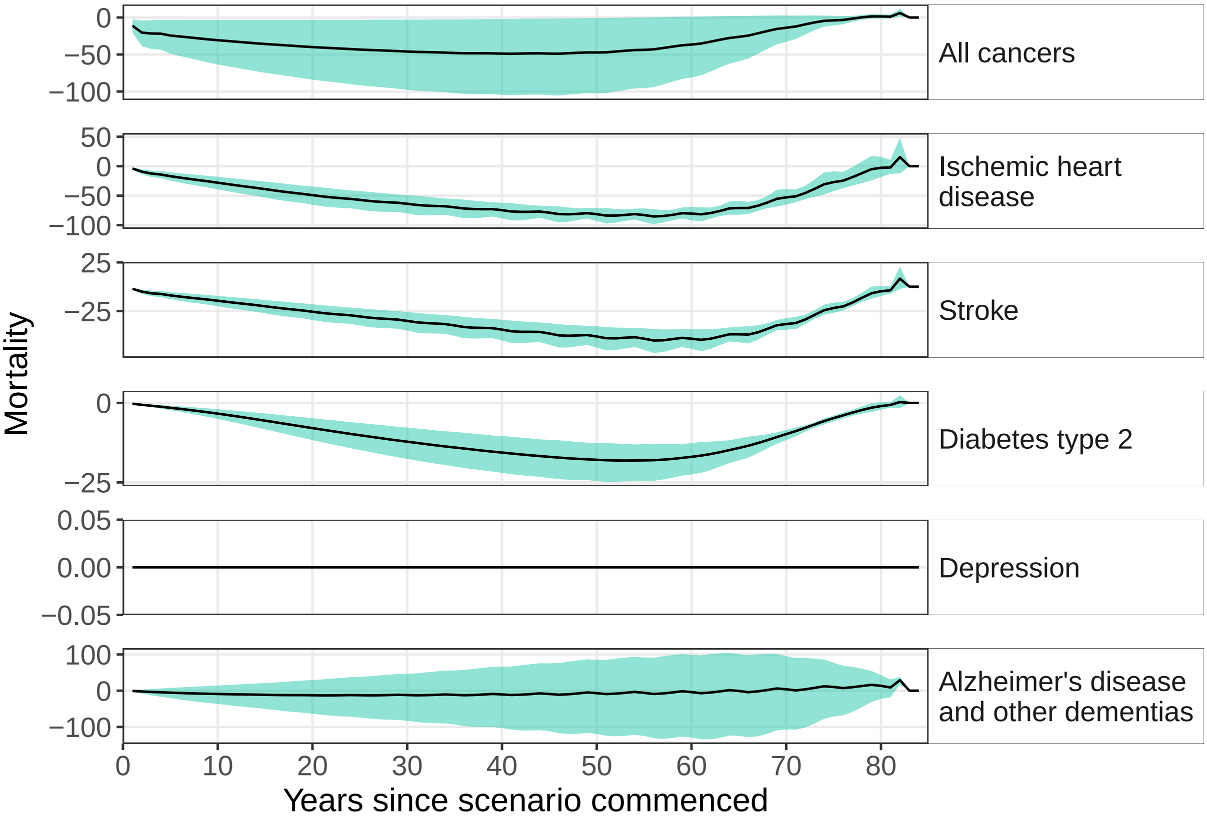

Figure 5.a: The change in mortality over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

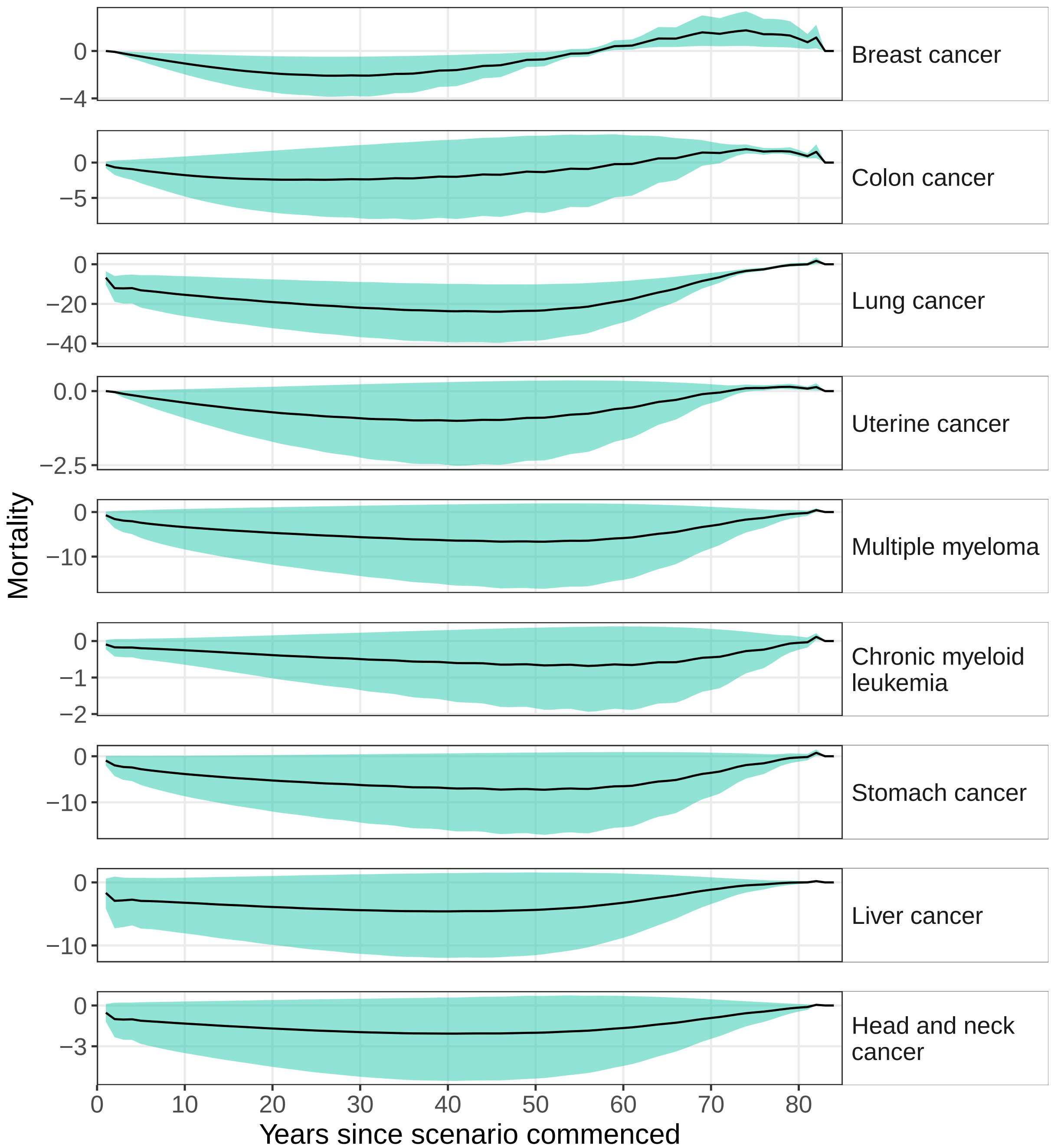

Figure 5.b: Percentage change in mortality for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Health

Figures 6 and 7 below show the change in Health Adjusted Life Years (HALYs)[1] and Life Years[2] for a snapshot of the population from 2019 for the scenario. Both figures show that the greatest gains from increasing physical activity occur midway through the life cycle with most of the gains occurring cumulatively in the long term. The decline from the mid-point onwards is due to individuals dying from natural causes within the model.

HALYS

The model estimates a total of **288,320** HALYs for the scenario population, which is **143** HALYs per 1,000 members of the population.

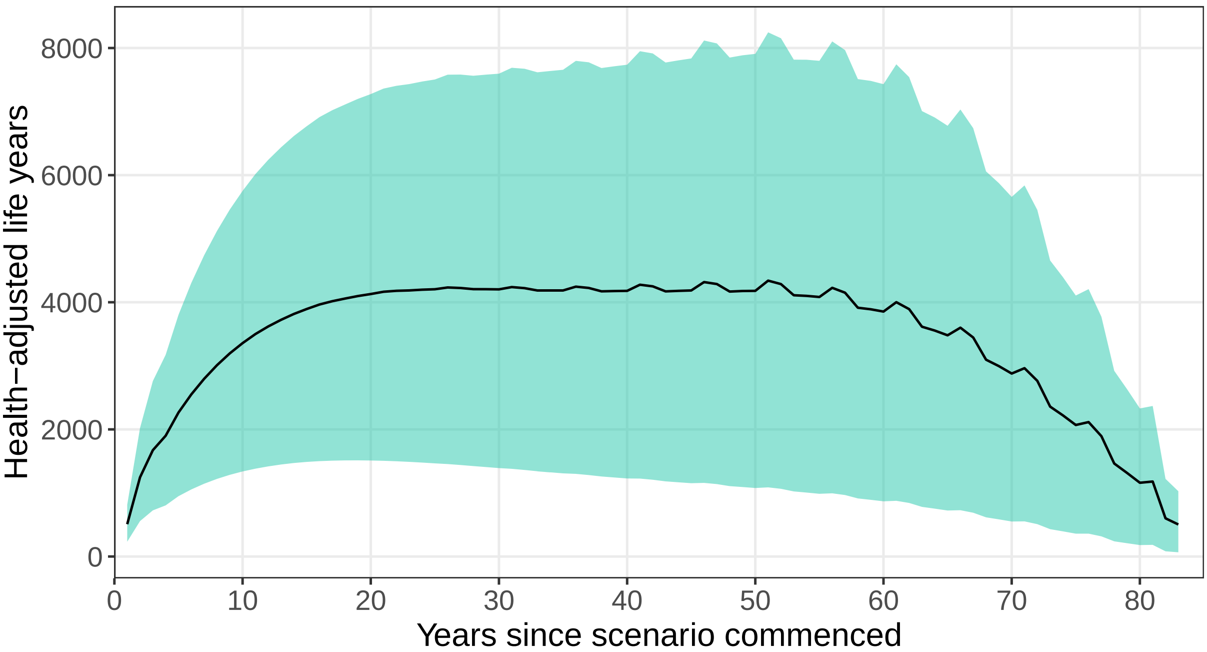

Figure 6. Total health-adjusted life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

[1]Health Adjusted Life Years are holistic measures of health that account for morbidity, mortality and quality of life.

[2]Life Years are similar to a HALYs however they exclude the quality of life component.

Life Years

The model estimates a total of **177,785** Life Years for the scenario population, which is **88** Life Years per 1,000 members of the population.

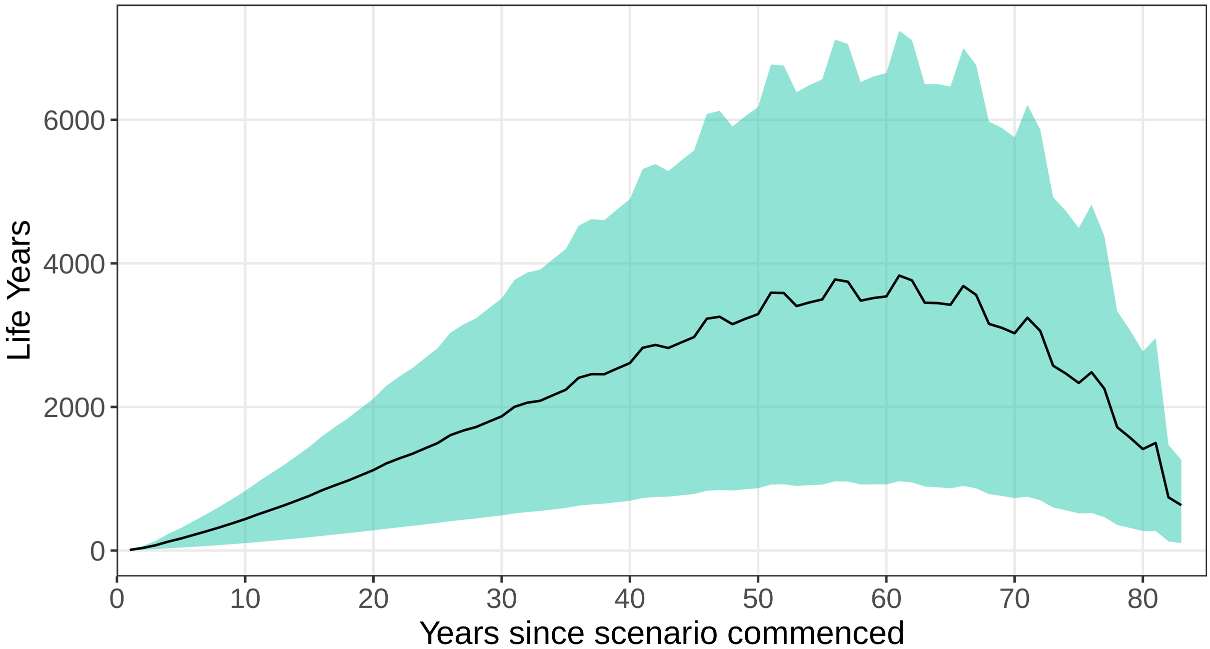

Figure 7. Total life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Value

The value of improvements to community health can be calculated**[a]** by translating the Health Adjusted Life Years (HALYs) from each scenario into dollar terms using the value of a statistical life year**[b]**. The value of a statistical life year is an estimate of the amount a society is willing to trade to reduce the risk of death for one year.

In the simulation model, HALYs are generated across time and are cumulative. Thus, to help us understand the value of HALYs across time in present day terms, it is necessary to use discounting**[c]** to reduce HALYs generated at the future point in time. Discounted HALYs from these future points can be added up to give the aggregate value of HALYs in today's terms as a measure of the value of improvements to community health arising from the chosen scenario.

The size of the discount rate can impact the aggregated value of HALYs and there is considerable debate on what discount rates should be used (with some arguing that health should not be discounted at all).[2] Hence, it is common to use a variety of discount rates to allow for differing risks, preferences and sensitivity when valuing health. The figures presented below were calculated using discount rates of 3%, 5% and 7% based on recent recommendations [3, 4] and represent the value of HALYs in present day terms resulting from an increase in physical activity from the chosen scenario.

The value of improvements to community health

The model estimates a total of **HALYs,** Health Adjusted Life Years (HALYs) gained for the scenario population, which is **143** HALYs per 1,000 members of the scenario population. The figures below represent the value of improvements to community health from the chosen scenario. These figures can be used in summary reports and for advocacy purposes**[d]**.

The HALYs gained in this scenario have a statistical value of:

- **11,161,726** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **6,846,716** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **4,657,764** per 1,000 members of the population, when calculated using a discount rate of 7%.

a. What is meant by value and how can it be measured?

Value is conceptual and measures a sense of worth or usefulness of something to individuals or to a society. Measuring the value of something, such as health, enables it to be included in assessments or analyses such as cost-benefit analyses to recognise its relative importance.

Value can be derived in many ways and a common approach is to use monetary terms, such as dollars. Valuing something using dollars is not the same as equating it with its price. Prices represent the amount at which something can be traded, prices therefore represent the amount of money for buying or selling something such as food, clothing or to pay bills. One way is to evaluate health in dollar terms is to use the Value of a Statistical Life and Value of a Statistical Life Year**[b]**.

b. What is the Value of a Statistical Life and Value of a Statistical Life Year?

The value of a **statistical life** is the estimated amount that a society is willing to trade to reduce the risk of death. The word 'Statistical' refers to the average value for life and therefore means the value of a statistical life doesn't relate to any specific individual. This value can change across risk factors and different societies who may value life differently. There are various ways of measuring the value of a statistical life with most approaches using revealed or stated preference approaches.[3] In Australia, the Office of Best Practice Regulation estimates a statistical life at $5.3M in 2022 dollar terms, and assumes that the life is of a young person with at least another 40 years to live.[5, 6]

Value of a Statistical Life Year

The value of a statistical life year is the estimated amount that a society is willing to trade to reduce the risk of death over **one year.** It can be derived from the value of a statistical life or measured directly using surveys or willingness to pay techniques.[5] The current value of a **statistical life year** is $227,000 in 2022 dollars based on current estimates from the Office of Best Practice Regulation.[6] The value of a statistical life year is useful for evaluating small increases in life years instead of evaluating full life expectancy. It is appropriate for valuing the Health Adjusted Life Years estimated from the scenarios and modelling presented in this tool. For the modelling and results presented here, the value of $227,000 was converted to 2019 dollars based on the Wage Price Index for Brisbane.

c. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

d. Application in advocacy and reporting

This section uses figures to show how the value of community health (estimated from HALYs and the value of statistical life year) can be used for reporting and advocacy purposes.

The simulation model uses **population-based estimates** for disease morbidity and mortality and is best applied to larger groups of people. It also assumes that the people of interest have similar characteristics and behaviours to the population data used in the simulation model and scenarios. The **example** below shows results from a scenario that replaces car trips with walking trips for distances of 0-2 km for All age groups.

Example:

The HALYs gained in this scenario have a statistical value of:

- **$10,859,605** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **$6,662,541** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **$4,533,392** per 1,000 members of the population, when calculated using a discount rate of 7%.

This **example** shows that the HALYs gained in this scenario have a statistical value of $10,859,605 per 1,000 members of the population using a discount of 3%.

This figure can be divided by 1,000 to give a per person figure. Once a per person figure is established, it can be multiplied by the number of people in any population size of interest for use in reports or as evidence to advocate for benefits associated with shifts to active transport modes.

$10,859,605 / 1,000 = $10,859.61 per person value

A good example of how this model can be applied links to previous research that investigated the impact of new more walkable development in Altona North on a population of 21,000 people [11]. If we assume that these people have similar characteristics to the underlying population based estimates and behaviours based on the travel survey data in the simulation model underlying this tool, then the value of community health according to the chosen scenario can be calculated as:

21,000 (people) x $10,859 (statistical value from HALYs gained) = $228 M.

Savings

An increase in physical activity due to the chosen scenario reduces chronic disease cases across a lifetime and reduces spending for each disease within the health care system resulting in overall health care cost savings**[a]**.

Table 3 provides estimated health care cost savings associated with the prevented cases of chronic diseases per 1,000 members of the population according to the selected scenario. These figures are based on applying average health care system costs per prevalent case of disease and using three alternative discount rates**[b]**:

Table 3. Total health care cost savings by disease per 1,000 members of the population.

Disease	3% discount rate	5% discount rate	7% discount rate
Alzheimer's disease and other dementias	$8,538	$5,156	$3,409
Breast cancer	$60,179	$38,061	$25,394
All cancers	$170,411	$108,734	$74,248
Colon cancer	$37,542	$25,297	$17,848
Chronic myeloid leukemia	$11,497	$6,745	$4,350
Diabetes type 2	$49,486	$29,473	$19,103
Depression	$275,052	$207,405	$160,448
Head and neck cancer	$1,871	$1,209	$853
Ischemic heart disease	$111,628	$67,309	$44,517
Liver cancer	$1,547	$1,029	$744
Multiple myeloma	$27,689	$17,318	$11,845
Stomach cancer	$10,522	$6,580	$4,506
Stroke	$17,110	$9,960	$6,377
Lung cancer	$15,924	$10,284	$7,247
Uterine cancer	$3,657	$2,236	$1,466

a. What do we mean by health care cost savings?

To calculate health care cost savings for each disease, the annual costs for each disease in each year is multiplied by the number of prevented cases of each disease for each scenario. This results in a total saving in spending for each disease by year. The savings in spending for future years are discounted**[b]** with annual savings aggregated to give a total amount saved for each disease. Total savings are presented as the amount saved per 1,000 members of the population to enable comparisons against populations of different sizes.

We use the term **health care cost saving** because it represents a reduction in health spending. However, the Australian Institute of Health and Welfare (AIHW) stress that the term cost is broad and not representative of the full cost experienced by individuals, families, or the health system, consequently AIHW use the term spending.[8]

These figures use AIHW estimates of the amounts spent through the health system in 2018-19 for each case of disease. This is extracted from Health system spending per case of disease and for certain risk factors, Table 1 – Estimates of health system spending per case, by burden of disease group, condition and sex, Australia 2018-2019.[9]. For head and neck cancers, supplementary figures were obtained from the Global Burden of Disease incidence data.[10]

b. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

References

1. Gold, M. R., Stevenson, D., & Fryback, D. G. (2002). *HALYS and QALYS and DALYS, Oh My: similarities and differences in summary measures of population Health.* Annual review of public health, 23(1), 115-134.
2. Attema, A.E., Brouwer, W.B. & Claxton, K. (2018). *Discounting in economic evaluations.* Pharmacoeconomics. 36: p. 745-758.
3. Ananthapavan, J., Moodie, M., Milat, A.J., & Carter, R. (2021). *Systematic review to update 'value of a statistical life' estimates for Australia.* International journal of environmental research and public health, 2021. 18(11): p. 6168.
4. Terrill, M. & Batrouney, H. (2018). *Unfreezing discount rates: Transport infrastructure for tomorrow.* Grattan Institute.
5. Abelson, P. (2008). *Establishing a monetary value for lives saved: issues and controversies.* Canberra: Office of Best Practice Regulation, Department of Finance and Deregulation.
6. Department of the Prime Minister and Cabinet. (2022). *Best practice regulation guidance note: Value of statistical life.* Australian Government.
7. Haacker, M., Hallett, T.B. & Atun, R. (2020). *On discount rates for economic evaluations in global health.* Health Policy and Planning, 2020. 35(1): p. 107-114.
8. Australian Institute of Health and Welfare (2023). Technical Notes: Estimating Spending per prevalent case of disease. Health system spending per case of disease and for certain risk factors, Estimating the spending per prevalent case of disease - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
9. Australian Institute of Health and Welfare (2023). Health system spending per case of disease and for certain risk factors. Health system spending per case of disease and for certain risk factors, Data - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
10. Global Burden of Disease (2019). Global Health Data Exchange. https://vizhub.healthdata.org/gbd-results. Accessed September 20, 2023.
11. Zapata-Diomedi, B., Boulangé, C., Giles-Corti, B., Phelan, K., Washington, S., Veerman, L.J., & Gunn, L. (2019). Physical activity-related health and economic benefits of building walkable neighbourhoods: A modelled comparison between brownfield and greenfield developments. International Journal of Behavioural Nutrition and Physical Activity.
12. Khorasani, E., Davari, M., Kebriaeezadeh, A., Fatemi, F., Akbari Sari, A., & Varahrami, V. (2022). A comprehensive review of official discount rates in guidelines of health economic evaluations over time: the trends and roots. The European Journal of Health Economics, 23(9), 1577-1590.

Scenario: replacing car trips under 5km with cycling for all trip purposes

This scenario shows the results of replacing car trips under 5km for leisure, shopping, work, education or other purposes with cycling trips for all adults of all ages.

This implies that the selected scenario results in a mode shift in cycling from 1.3% to 33.6% and from 74.7% to 42.3% for car trips taken as either a driver or passenger.

Increases in cycling translate into a shift from 47.9% to 67.3% of the population accumulating the required minutes spent being moderately (150 – 300 mins) or vigorously physically active (75 – 150 mins) or an equivalent combination of both contributing to recommended levels as detailed in the Physical Activity Guidelines.

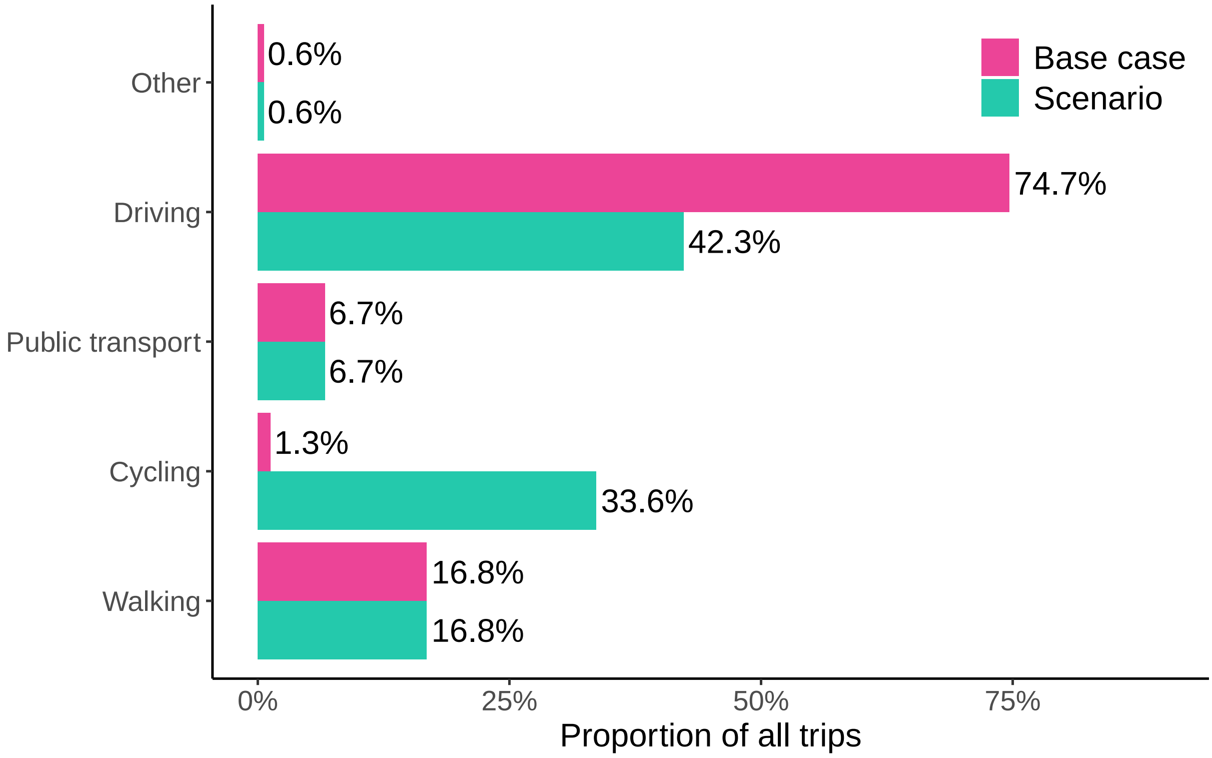

Figure 1: Distribution of base case and scenario trips.

Incidence

Incidence describes the rate of occurrence of new cases of a disease over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of disease prevented, due to increases in physical activity associated with the scenario. Figure 2 presents the change (%) in the disease incidence across the life course. Figure 3 presents how the difference in disease incidence changes over time, by year, using a snapshot of the population from 2019.

Table 1 shows how the scenario impacts the incidence of chronic diseases as both as a percentage and total number of prevented cases.

Table 1. Chronic disease incidence reduction and total number of prevented cases of disease measured across the years of the simulation

Disease*	Incidence of disease is reduced by	Total number of prevented cases of disease aggregated across the simulation
Alzheimer's disease and other dementias	1.17%	7,432
Breast cancer	1.46%	1,071
All cancers	2.24%	8,838
Colon cancer	1.06%	1,377
Chronic myeloid leukemia	3.53%	97
Diabetes type 2	6.90%	22,764
Depression	1.50%	23,975
Head and neck cancer	6.58%	290
Ischemic heart disease	3.26%	28,706
Liver cancer	4.13%	727
Multiple myeloma	4.46%	865
Stomach cancer	4.56%	1,089
Stroke	3.71%	9,647
Lung cancer	2.72%	3,125
Uterine cancer	2.30%	195

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

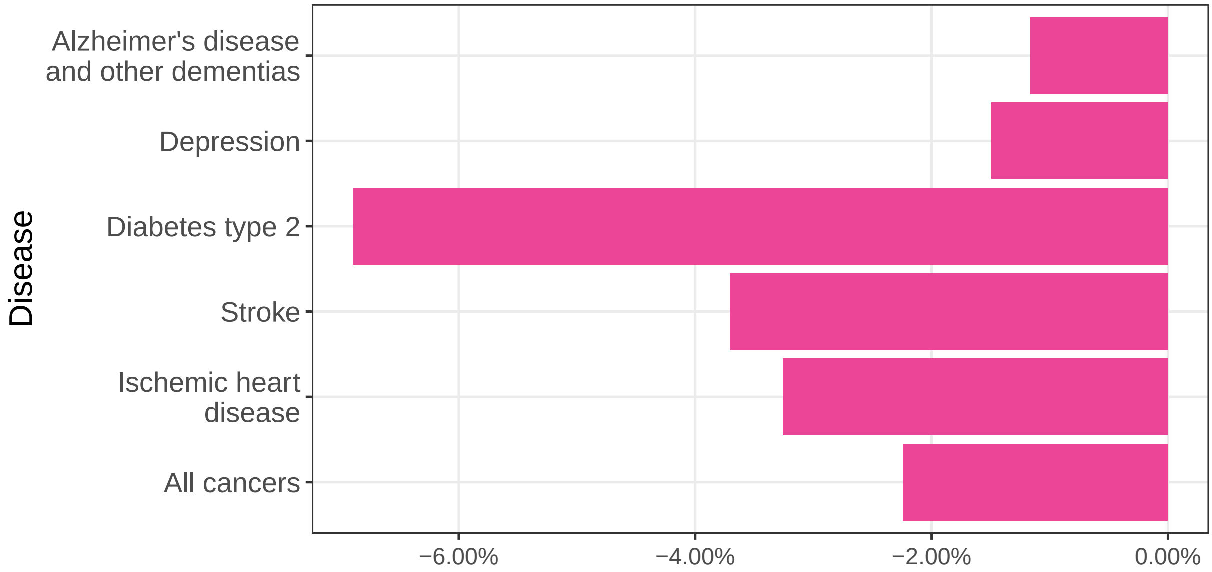

Figure 2.a: Percentage change in incidence by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

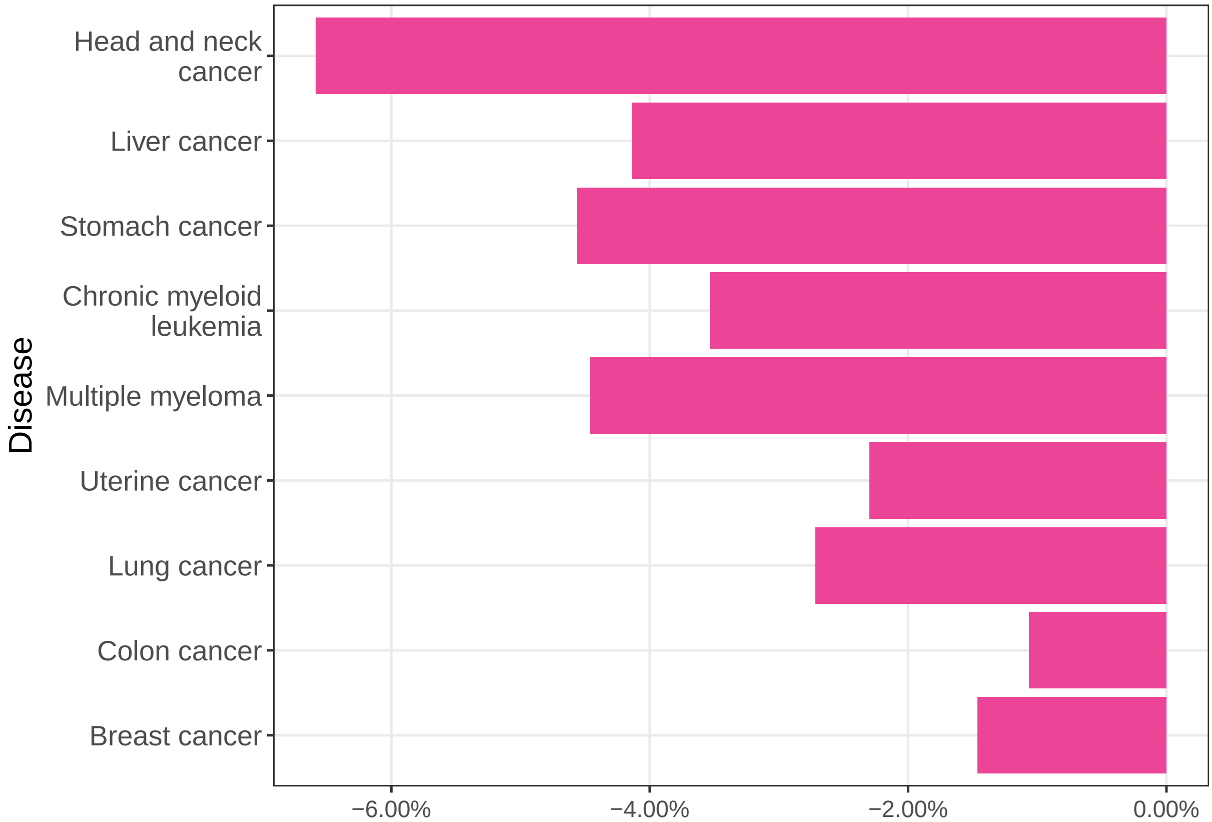

Figure 2.b: Percentage change in incidence for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

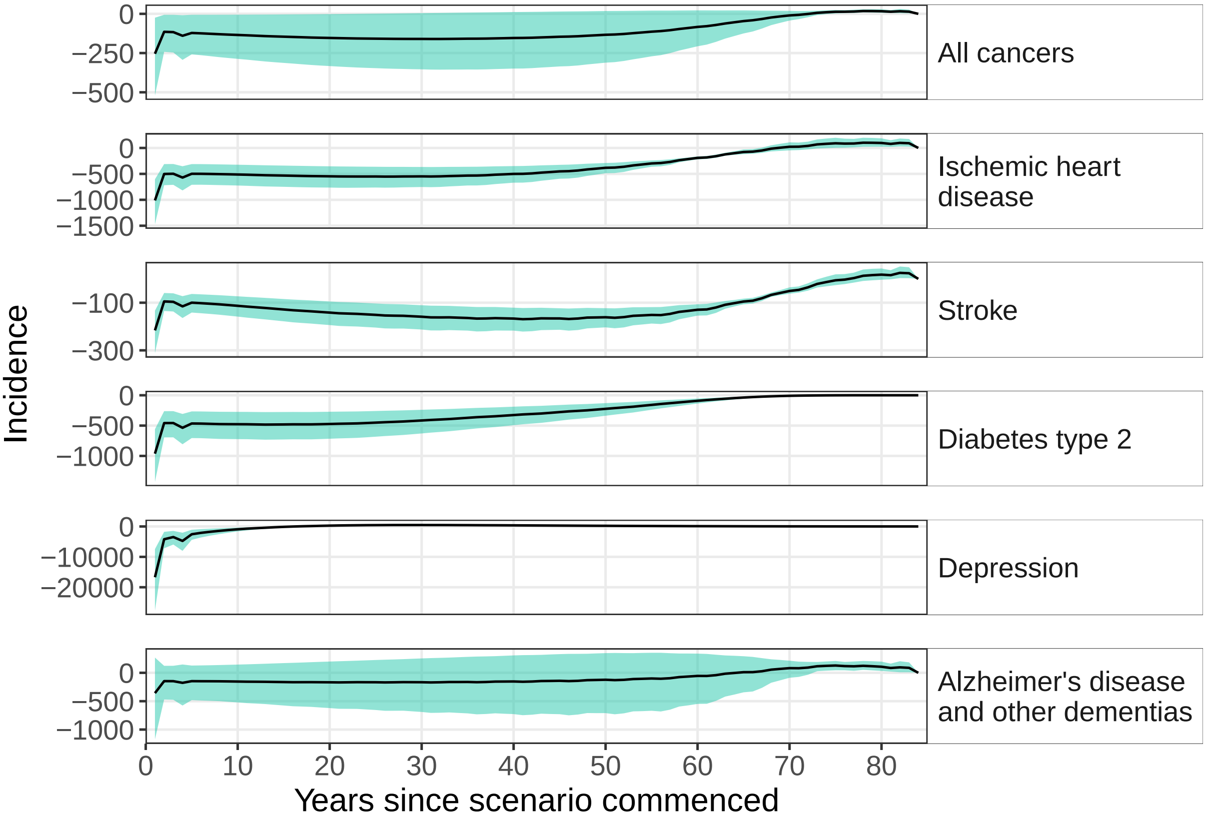

Figure 3.a: The change in incidence over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

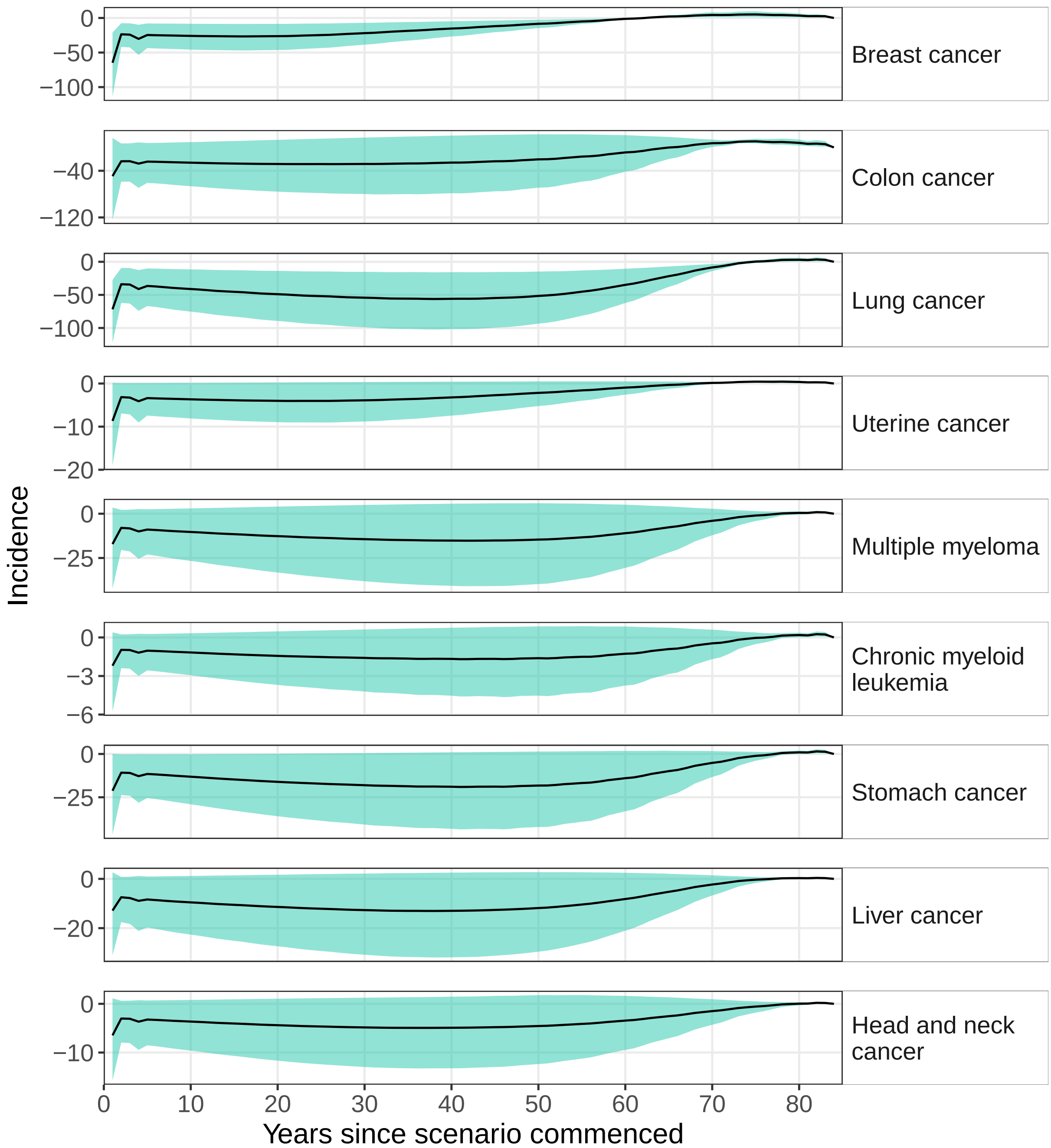

Figure 3.b: Percentage change in incidence for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Mortality

Mortality is the number of deaths due to a given disease over over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of prevented deaths due to increases in physical activity associated with the scenario. Figure 4 presents the total change in mortality over the life course. Figure 5 presents the difference in the number of deaths by year using a snapshot of the population from 2019.

Table 2 shows how the scenario impacts reductions in mortality presented as a percentage and total number of prevented deaths caused by chronic diseases.

Table 2. Percentage reduction in mortality and total number of prevented deaths by chronic disease measured across the years of the simulation.

Disease*	Mortality is reduced by	Total number of prevented deaths aggregated across the simulation
Alzheimer's disease and other dementias	0.30%	720
Breast cancer	0.87%	280
All cancers	2.49%	6,317
Colon cancer	0.61%	263
Chronic myeloid leukemia	3.12%	64
Diabetes type 2	5.22%	2,581
Depression	0.00%	0
Head and neck cancer	6.61%	263
Ischemic heart disease	2.98%	11,181
Liver cancer	4.12%	704
Multiple myeloma	4.33%	754
Stomach cancer	4.44%	939
Stroke	3.36%	5,875
Lung cancer	2.67%	2,912
Uterine cancer	1.91%	138

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

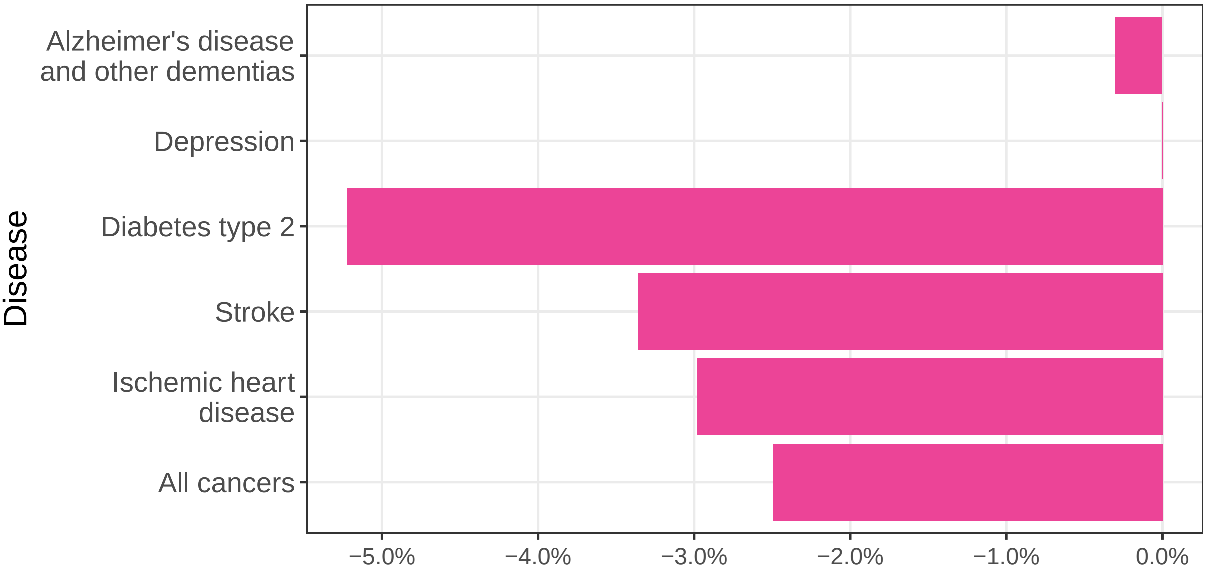

Figure 4.a: Percentage change in mortality by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

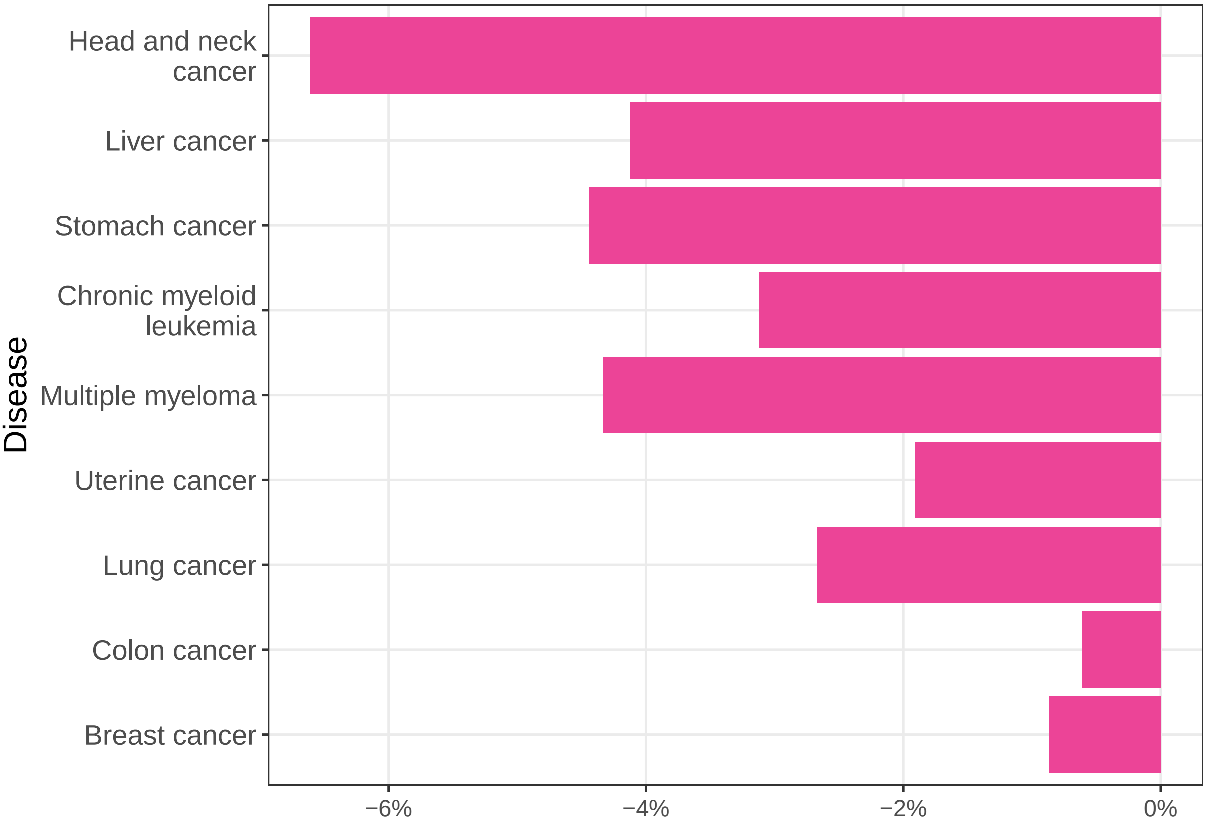

Figure 4.b: Percentage change in mortality for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

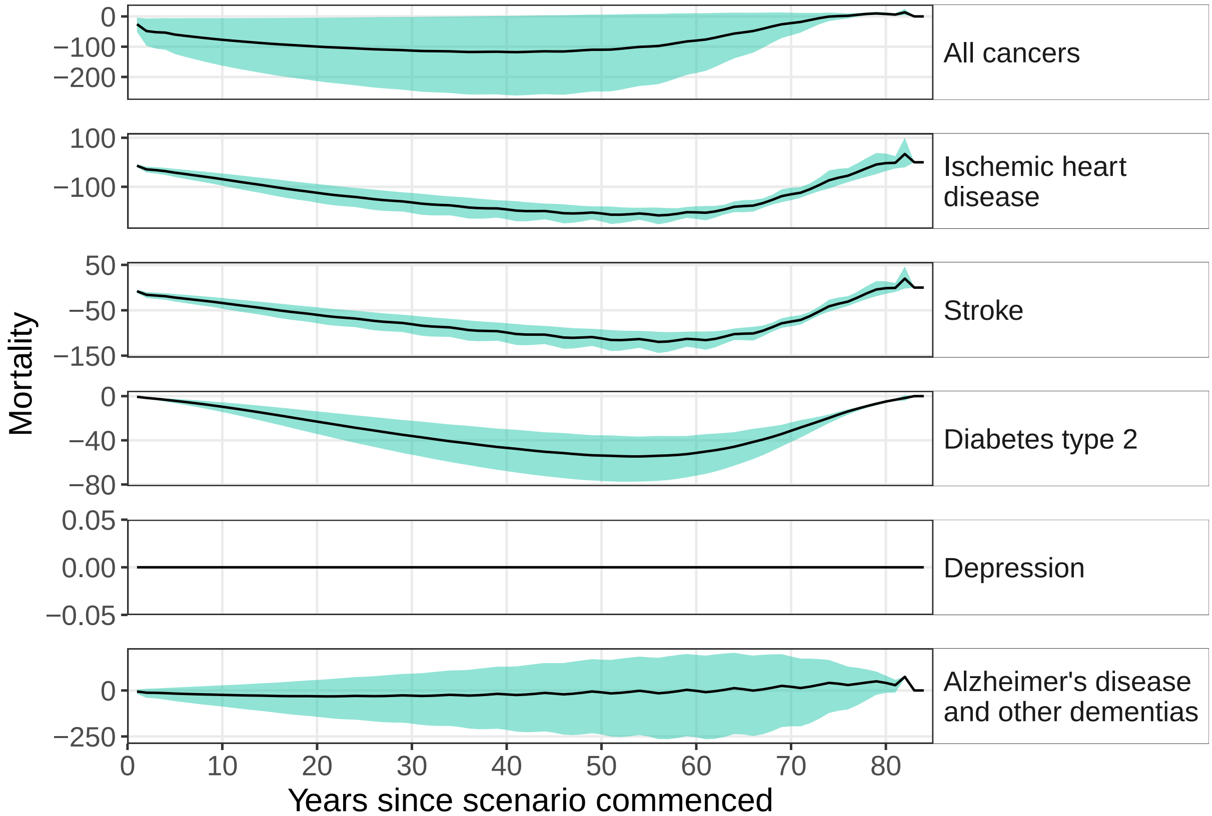

Figure 5.a: The change in mortality over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

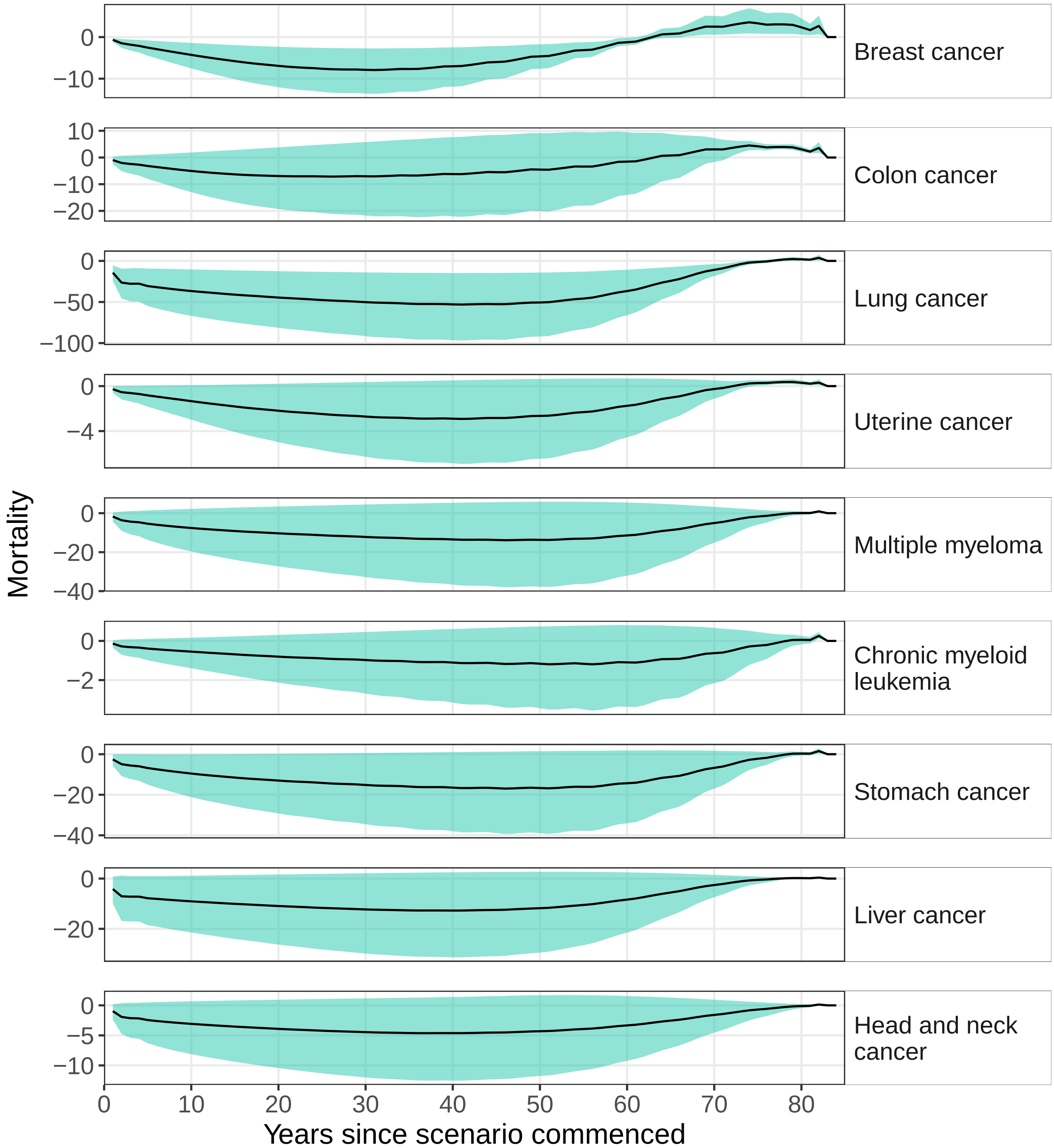

Figure 5.b: Percentage change in mortality for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Health

Figures 6 and 7 below show the change in Health Adjusted Life Years (HALYs)[1] and Life Years[2] for a snapshot of the population from 2019 for the scenario. Both figures show that the greatest gains from increasing physical activity occur midway through the life cycle with most of the gains occurring cumulatively in the long term. The decline from the mid-point onwards is due to individuals dying from natural causes within the model.

HALYS

The model estimates a total of **740,099** HALYs for the scenario population, which is **368** HALYs per 1,000 members of the population.

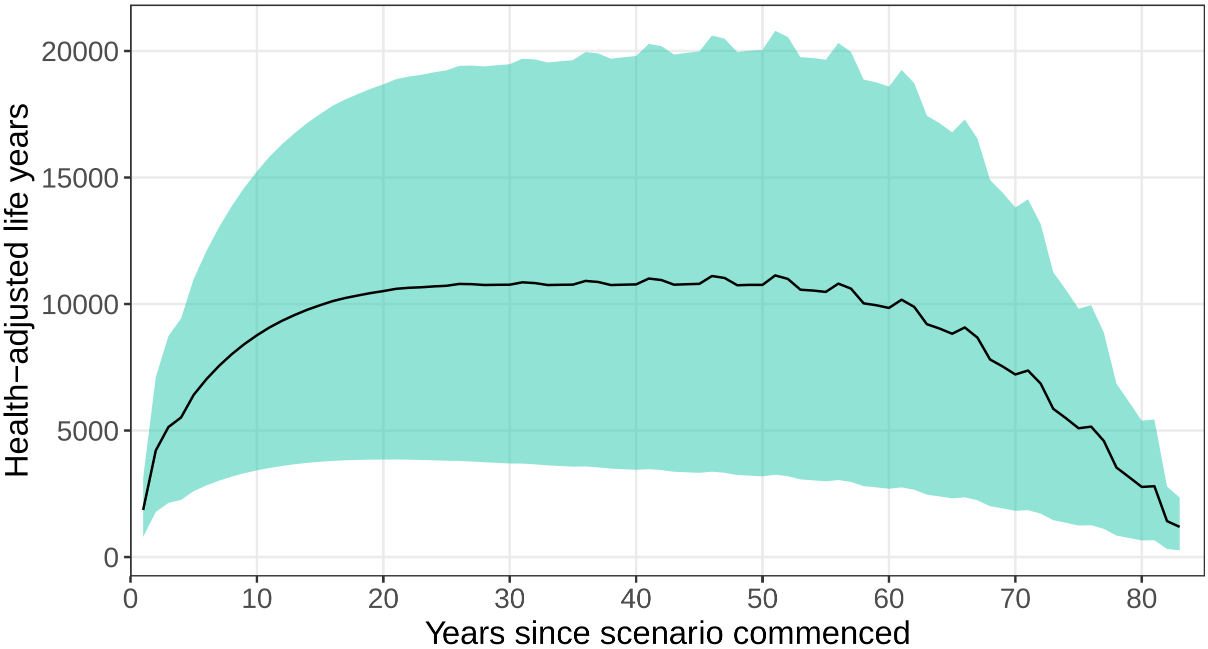

Figure 6. Total health-adjusted life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

[1]Health Adjusted Life Years are holistic measures of health that account for morbidity, mortality and quality of life.

[2]Life Years are similar to a HALYs however they exclude the quality of life component.

Life Years

The model estimates a total of **448,787** Life Years for the scenario population, which is **223** Life Years per 1,000 members of the population.

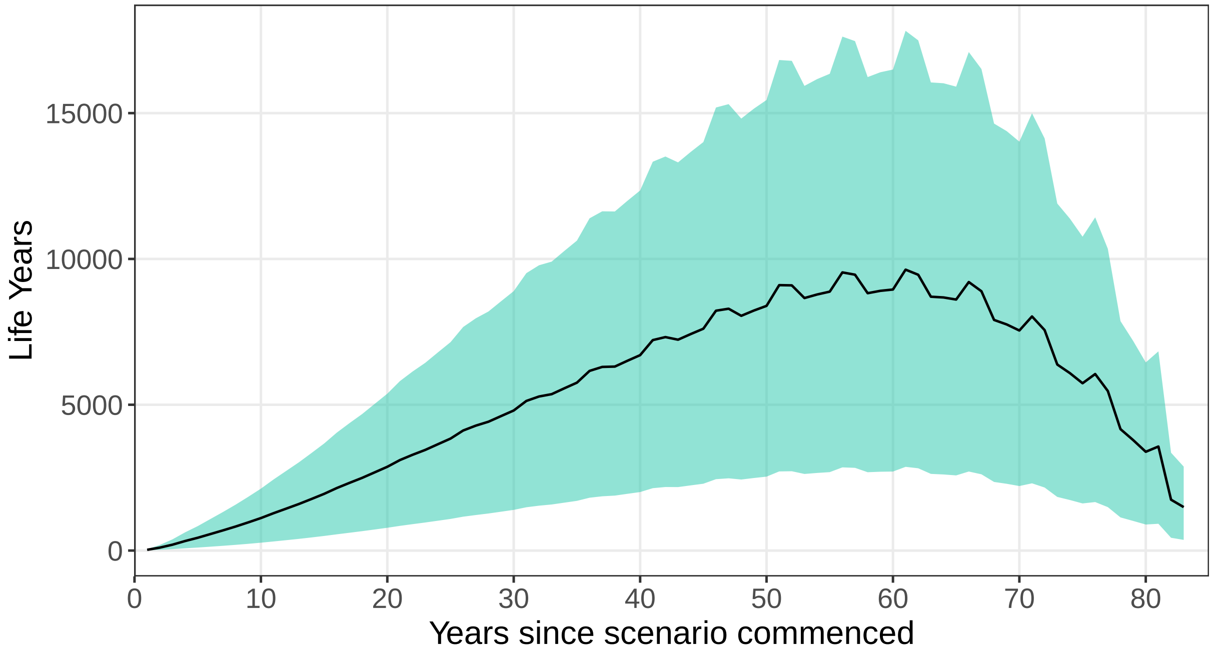

Figure 7. Total life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Value

The value of improvements to community health can be calculated**[a]** by translating the Health Adjusted Life Years (HALYs) from each scenario into dollar terms using the value of a statistical life year**[b]**. The value of a statistical life year is an estimate of the amount a society is willing to trade to reduce the risk of death for one year.

In the simulation model, HALYs are generated across time and are cumulative. Thus, to help us understand the value of HALYs across time in present day terms, it is necessary to use discounting**[c]** to reduce HALYs generated at the future point in time. Discounted HALYs from these future points can be added up to give the aggregate value of HALYs in today's terms as a measure of the value of improvements to community health arising from the chosen scenario.

The size of the discount rate can impact the aggregated value of HALYs and there is considerable debate on what discount rates should be used (with some arguing that health should not be discounted at all).[2] Hence, it is common to use a variety of discount rates to allow for differing risks, preferences and sensitivity when valuing health. The figures presented below were calculated using discount rates of 3%, 5% and 7% based on recent recommendations [3, 4] and represent the value of HALYs in present day terms resulting from an increase in physical activity from the chosen scenario.

The value of improvements to community health

The model estimates a total of **HALYs,** Health Adjusted Life Years (HALYs) gained for the scenario population, which is **368** HALYs per 1,000 members of the scenario population. The figures below represent the value of improvements to community health from the chosen scenario. These figures can be used in summary reports and for advocacy purposes**[d]**.

The HALYs gained in this scenario have a statistical value of:

- **29,030,974** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **17,972,591** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **12,341,492** per 1,000 members of the population, when calculated using a discount rate of 7%.

a. What is meant by value and how can it be measured?

Value is conceptual and measures a sense of worth or usefulness of something to individuals or to a society. Measuring the value of something, such as health, enables it to be included in assessments or analyses such as cost-benefit analyses to recognise its relative importance.

Value can be derived in many ways and a common approach is to use monetary terms, such as dollars. Valuing something using dollars is not the same as equating it with its price. Prices represent the amount at which something can be traded, prices therefore represent the amount of money for buying or selling something such as food, clothing or to pay bills. One way is to evaluate health in dollar terms is to use the Value of a Statistical Life and Value of a Statistical Life Year**[b]**.

b. What is the Value of a Statistical Life and Value of a Statistical Life Year?

The value of a **statistical life** is the estimated amount that a society is willing to trade to reduce the risk of death. The word 'Statistical' refers to the average value for life and therefore means the value of a statistical life doesn't relate to any specific individual. This value can change across risk factors and different societies who may value life differently. There are various ways of measuring the value of a statistical life with most approaches using revealed or stated preference approaches.[3] In Australia, the Office of Best Practice Regulation estimates a statistical life at $5.3M in 2022 dollar terms, and assumes that the life is of a young person with at least another 40 years to live.[5, 6]

Value of a Statistical Life Year

The value of a statistical life year is the estimated amount that a society is willing to trade to reduce the risk of death over **one year.** It can be derived from the value of a statistical life or measured directly using surveys or willingness to pay techniques.[5] The current value of a **statistical life year** is $227,000 in 2022 dollars based on current estimates from the Office of Best Practice Regulation.[6] The value of a statistical life year is useful for evaluating small increases in life years instead of evaluating full life expectancy. It is appropriate for valuing the Health Adjusted Life Years estimated from the scenarios and modelling presented in this tool. For the modelling and results presented here, the value of $227,000 was converted to 2019 dollars based on the Wage Price Index for Brisbane.

c. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

d. Application in advocacy and reporting

This section uses figures to show how the value of community health (estimated from HALYs and the value of statistical life year) can be used for reporting and advocacy purposes.

The simulation model uses **population-based estimates** for disease morbidity and mortality and is best applied to larger groups of people. It also assumes that the people of interest have similar characteristics and behaviours to the population data used in the simulation model and scenarios. The **example** below shows results from a scenario that replaces car trips with walking trips for distances of 0-2 km for All age groups.

Example:

The HALYs gained in this scenario have a statistical value of:

- **$10,859,605** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **$6,662,541** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **$4,533,392** per 1,000 members of the population, when calculated using a discount rate of 7%.

This **example** shows that the HALYs gained in this scenario have a statistical value of $10,859,605 per 1,000 members of the population using a discount of 3%.

This figure can be divided by 1,000 to give a per person figure. Once a per person figure is established, it can be multiplied by the number of people in any population size of interest for use in reports or as evidence to advocate for benefits associated with shifts to active transport modes.

$10,859,605 / 1,000 = $10,859.61 per person value

A good example of how this model can be applied links to previous research that investigated the impact of new more walkable development in Altona North on a population of 21,000 people [11]. If we assume that these people have similar characteristics to the underlying population based estimates and behaviours based on the travel survey data in the simulation model underlying this tool, then the value of community health according to the chosen scenario can be calculated as:

21,000 (people) x $10,859 (statistical value from HALYs gained) = $228 M.

Savings

An increase in physical activity due to the chosen scenario reduces chronic disease cases across a lifetime and reduces spending for each disease within the health care system resulting in overall health care cost savings**[a]**.

Table 3 provides estimated health care cost savings associated with the prevented cases of chronic diseases per 1,000 members of the population according to the selected scenario. These figures are based on applying average health care system costs per prevalent case of disease and using three alternative discount rates**[b]**:

Table 3. Total health care cost savings by disease per 1,000 members of the population.

Disease	3% discount rate	5% discount rate	7% discount rate
Alzheimer's disease and other dementias	$23,105	$14,138	$9,458
Breast cancer	$229,566	$146,147	$99,375
All cancers	$515,299	$329,472	$226,129
Colon cancer	$112,334	$74,271	$51,882
Chronic myeloid leukemia	$26,482	$15,935	$10,523
Diabetes type 2	$138,700	$82,298	$53,222
Depression	$740,456	$565,952	$443,897
Head and neck cancer	$4,274	$2,778	$1,964
Ischemic heart disease	$281,483	$167,055	$108,613
Liver cancer	$4,222	$2,777	$1,982
Multiple myeloma	$62,783	$39,385	$26,960
Stomach cancer	$26,673	$16,661	$11,375
Stroke	$43,306	$25,516	$16,537
Lung cancer	$37,711	$24,456	$17,254
Uterine cancer	$11,292	$7,115	$4,826

a. What do we mean by health care cost savings?

To calculate health care cost savings for each disease, the annual costs for each disease in each year is multiplied by the number of prevented cases of each disease for each scenario. This results in a total saving in spending for each disease by year. The savings in spending for future years are discounted**[b]** with annual savings aggregated to give a total amount saved for each disease. Total savings are presented as the amount saved per 1,000 members of the population to enable comparisons against populations of different sizes.

We use the term **health care cost saving** because it represents a reduction in health spending. However, the Australian Institute of Health and Welfare (AIHW) stress that the term cost is broad and not representative of the full cost experienced by individuals, families, or the health system, consequently AIHW use the term spending.[8]

These figures use AIHW estimates of the amounts spent through the health system in 2018-19 for each case of disease. This is extracted from Health system spending per case of disease and for certain risk factors, Table 1 – Estimates of health system spending per case, by burden of disease group, condition and sex, Australia 2018-2019.[9]. For head and neck cancers, supplementary figures were obtained from the Global Burden of Disease incidence data.[10]

b. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

References

1. Gold, M. R., Stevenson, D., & Fryback, D. G. (2002). *HALYS and QALYS and DALYS, Oh My: similarities and differences in summary measures of population Health.* Annual review of public health, 23(1), 115-134.
2. Attema, A.E., Brouwer, W.B. & Claxton, K. (2018). *Discounting in economic evaluations.* Pharmacoeconomics. 36: p. 745-758.
3. Ananthapavan, J., Moodie, M., Milat, A.J., & Carter, R. (2021). *Systematic review to update 'value of a statistical life' estimates for Australia.* International journal of environmental research and public health, 2021. 18(11): p. 6168.
4. Terrill, M. & Batrouney, H. (2018). *Unfreezing discount rates: Transport infrastructure for tomorrow.* Grattan Institute.
5. Abelson, P. (2008). *Establishing a monetary value for lives saved: issues and controversies.* Canberra: Office of Best Practice Regulation, Department of Finance and Deregulation.
6. Department of the Prime Minister and Cabinet. (2022). *Best practice regulation guidance note: Value of statistical life.* Australian Government.
7. Haacker, M., Hallett, T.B. & Atun, R. (2020). *On discount rates for economic evaluations in global health.* Health Policy and Planning, 2020. 35(1): p. 107-114.
8. Australian Institute of Health and Welfare (2023). Technical Notes: Estimating Spending per prevalent case of disease. Health system spending per case of disease and for certain risk factors, Estimating the spending per prevalent case of disease - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
9. Australian Institute of Health and Welfare (2023). Health system spending per case of disease and for certain risk factors. Health system spending per case of disease and for certain risk factors, Data - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
10. Global Burden of Disease (2019). Global Health Data Exchange. https://vizhub.healthdata.org/gbd-results. Accessed September 20, 2023.
11. Zapata-Diomedi, B., Boulangé, C., Giles-Corti, B., Phelan, K., Washington, S., Veerman, L.J., & Gunn, L. (2019). Physical activity-related health and economic benefits of building walkable neighbourhoods: A modelled comparison between brownfield and greenfield developments. International Journal of Behavioural Nutrition and Physical Activity.
12. Khorasani, E., Davari, M., Kebriaeezadeh, A., Fatemi, F., Akbari Sari, A., & Varahrami, V. (2022). A comprehensive review of official discount rates in guidelines of health economic evaluations over time: the trends and roots. The European Journal of Health Economics, 23(9), 1577-1590.

Scenario: replacing car trips under 10km with cycling for all trip purposes

This scenario shows the results of replacing car trips under 10km for leisure, shopping, work, education or other purposes with cycling trips for all adults of all ages.

This implies that the selected scenario results in a mode shift in cycling from 1.3% to 50.9% and from 74.7% to 25.0% for car trips taken as either a driver or passenger.

Increases in cycling translate into a shift from 47.9% to 74.9% of the population accumulating the required minutes spent being moderately (150 – 300 mins) or vigorously physically active (75 – 150 mins) or an equivalent combination of both contributing to recommended levels as detailed in the Physical Activity Guidelines.

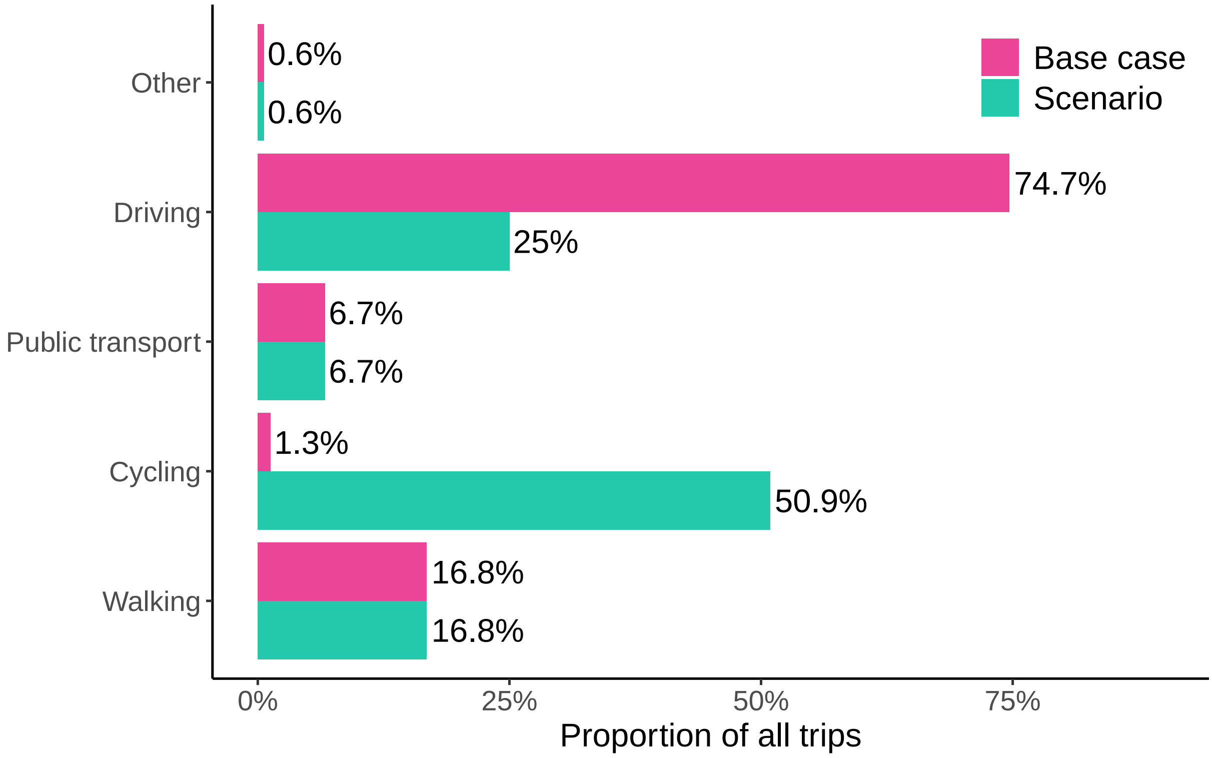

Figure 1: Distribution of base case and scenario trips.

Incidence

Incidence describes the rate of occurrence of new cases of a disease over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of disease prevented, due to increases in physical activity associated with the scenario. Figure 2 presents the change (%) in the disease incidence across the life course. Figure 3 presents how the difference in disease incidence changes over time, by year, using a snapshot of the population from 2019.

Table 1 shows how the scenario impacts the incidence of chronic diseases as both as a percentage and total number of prevented cases.

Table 1. Chronic disease incidence reduction and total number of prevented cases of disease measured across the years of the simulation

Disease*	Incidence of disease is reduced by	Total number of prevented cases of disease aggregated across the simulation
Alzheimer's disease and other dementias	1.67%	10,613
Breast cancer	2.15%	1,573
All cancers	3.02%	11,906
Colon cancer	1.46%	1,896
Chronic myeloid leukemia	4.64%	127
Diabetes type 2	9.46%	31,227
Depression	1.98%	31,801
Head and neck cancer	8.75%	385
Ischemic heart disease	4.59%	40,426
Liver cancer	5.70%	1,003
Multiple myeloma	5.68%	1,100
Stomach cancer	6.14%	1,465
Stroke	5.07%	13,201
Lung cancer	3.55%	4,085
Uterine cancer	3.16%	268

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

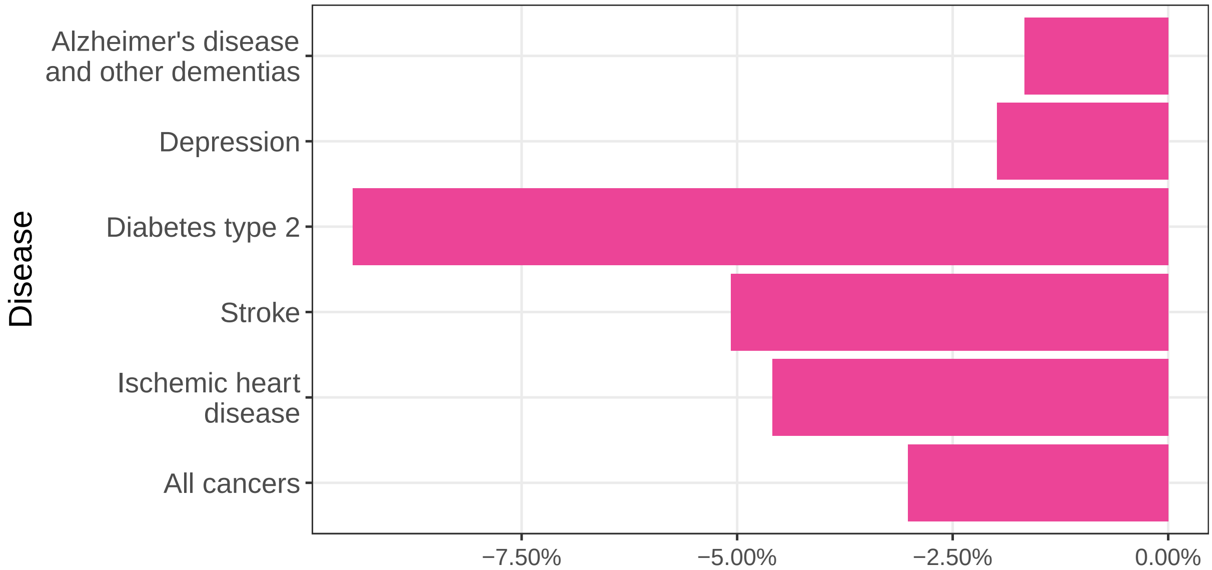

Figure 2.a: Percentage change in incidence by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

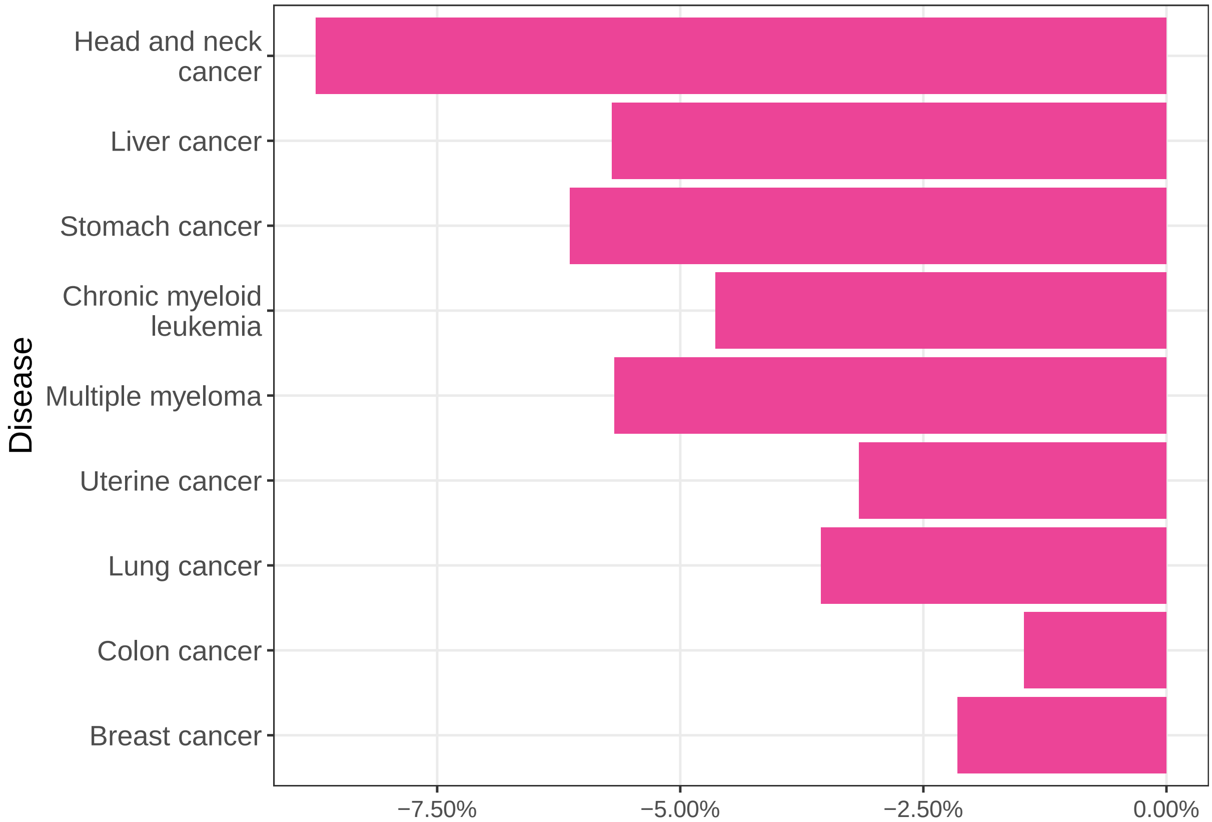

Figure 2.b: Percentage change in incidence for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

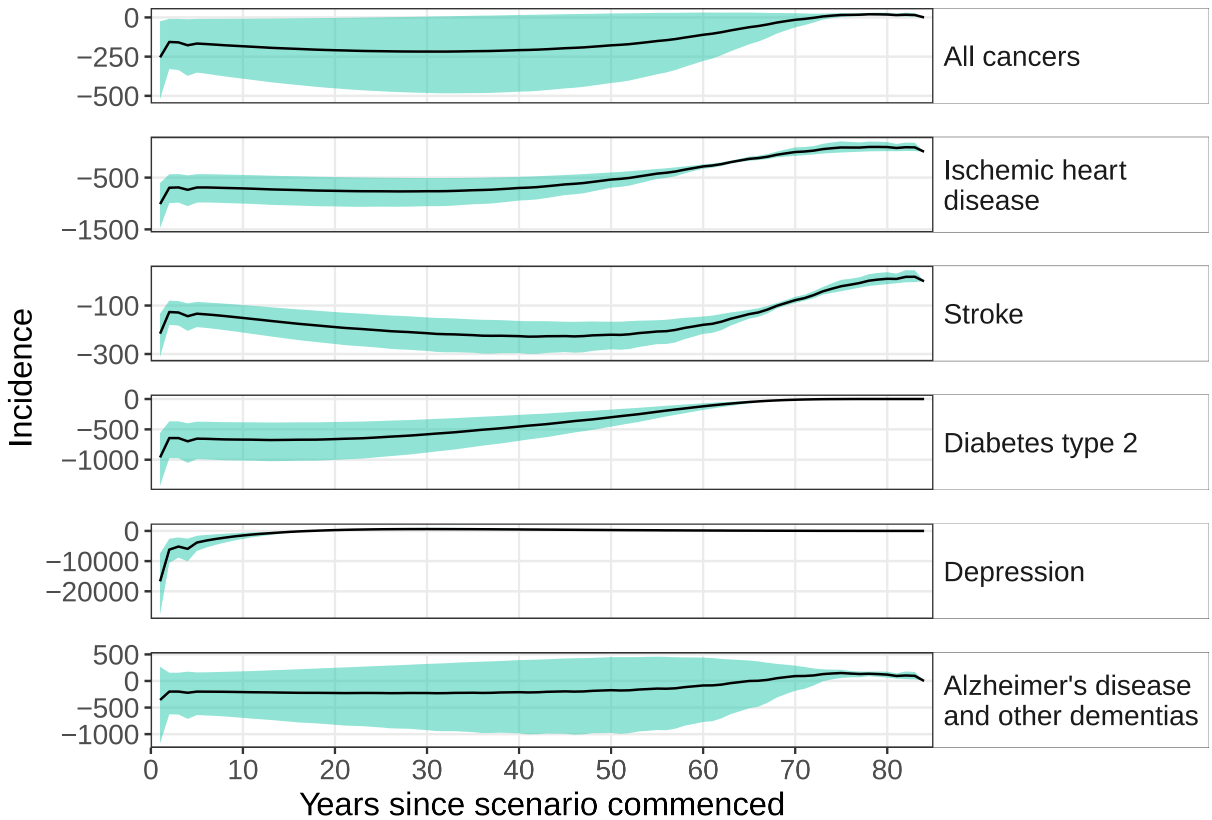

Figure 3.a: The change in incidence over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

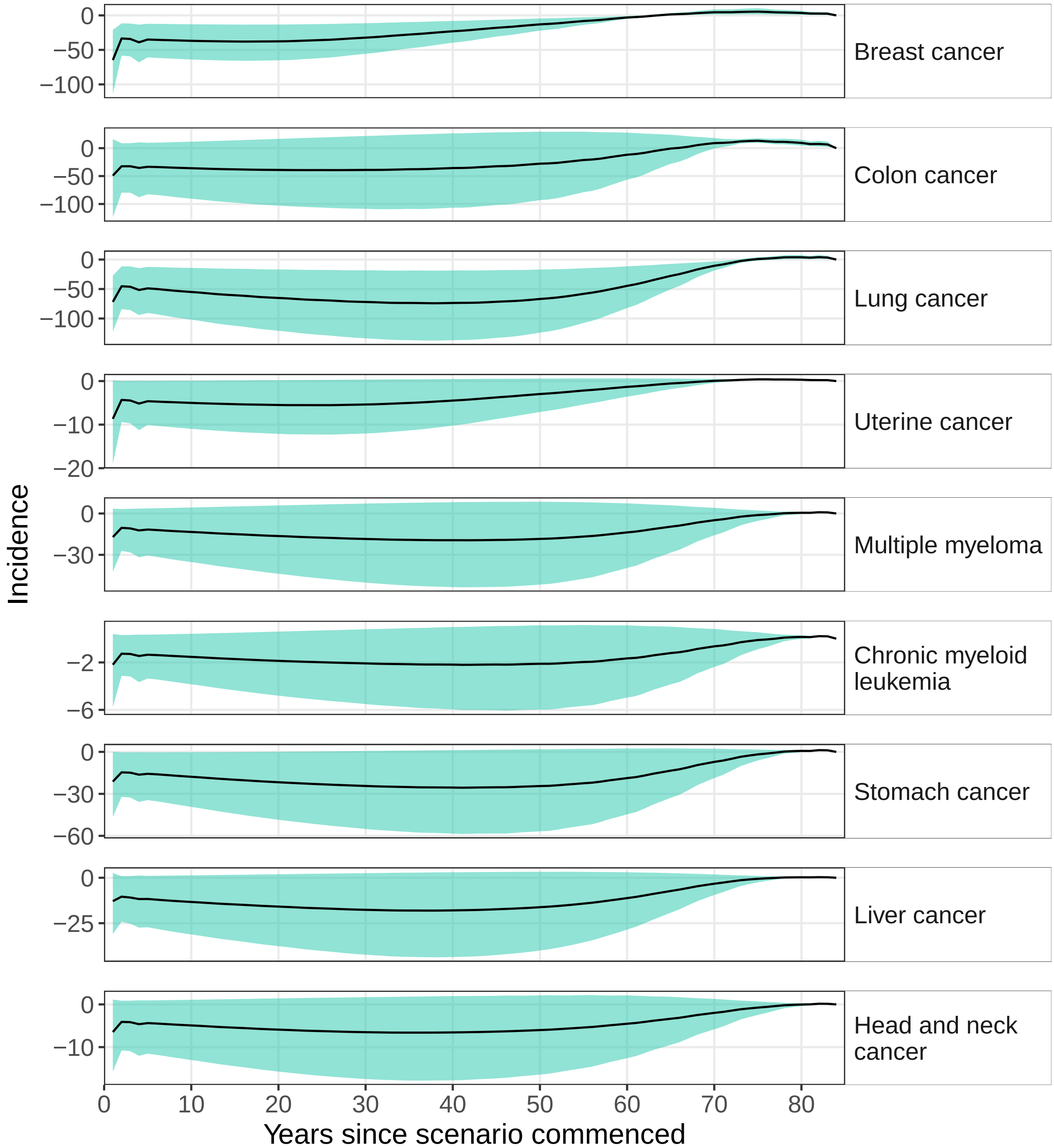

Figure 3.b: Percentage change in incidence for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Mortality

Mortality is the number of deaths due to a given disease over over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of prevented deaths due to increases in physical activity associated with the scenario. Figure 4 presents the total change in mortality over the life course. Figure 5 presents the difference in the number of deaths by year using a snapshot of the population from 2019.

Table 2 shows how the scenario impacts reductions in mortality presented as a percentage and total number of prevented deaths caused by chronic diseases.

Table 2. Percentage reduction in mortality and total number of prevented deaths by chronic disease measured across the years of the simulation.

Disease*	Mortality is reduced by	Total number of prevented deaths aggregated across the simulation
Alzheimer's disease and other dementias	0.38%	907
Breast cancer	1.35%	435
All cancers	3.32%	8,400
Colon cancer	0.84%	364
Chronic myeloid leukemia	4.02%	83
Diabetes type 2	7.31%	3,612
Depression	0.00%	0
Head and neck cancer	8.76%	348
Ischemic heart disease	4.11%	15,427
Liver cancer	5.68%	970
Multiple myeloma	5.48%	955
Stomach cancer	5.94%	1,256
Stroke	4.48%	7,839
Lung cancer	3.48%	3,798
Uterine cancer	2.64%	191

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

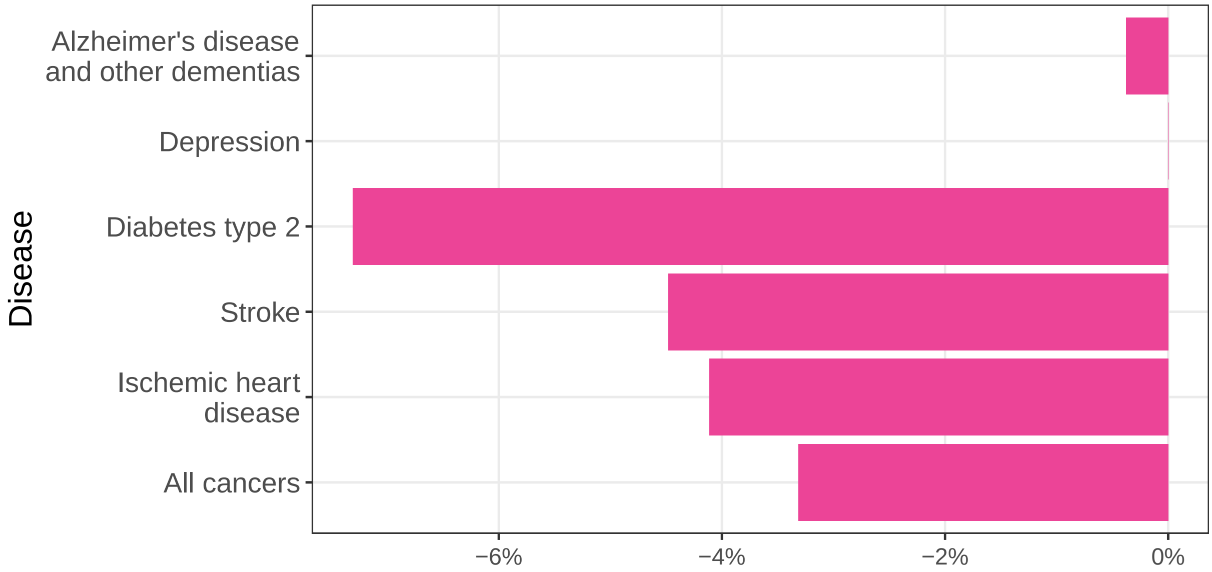

Figure 4.a: Percentage change in mortality by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

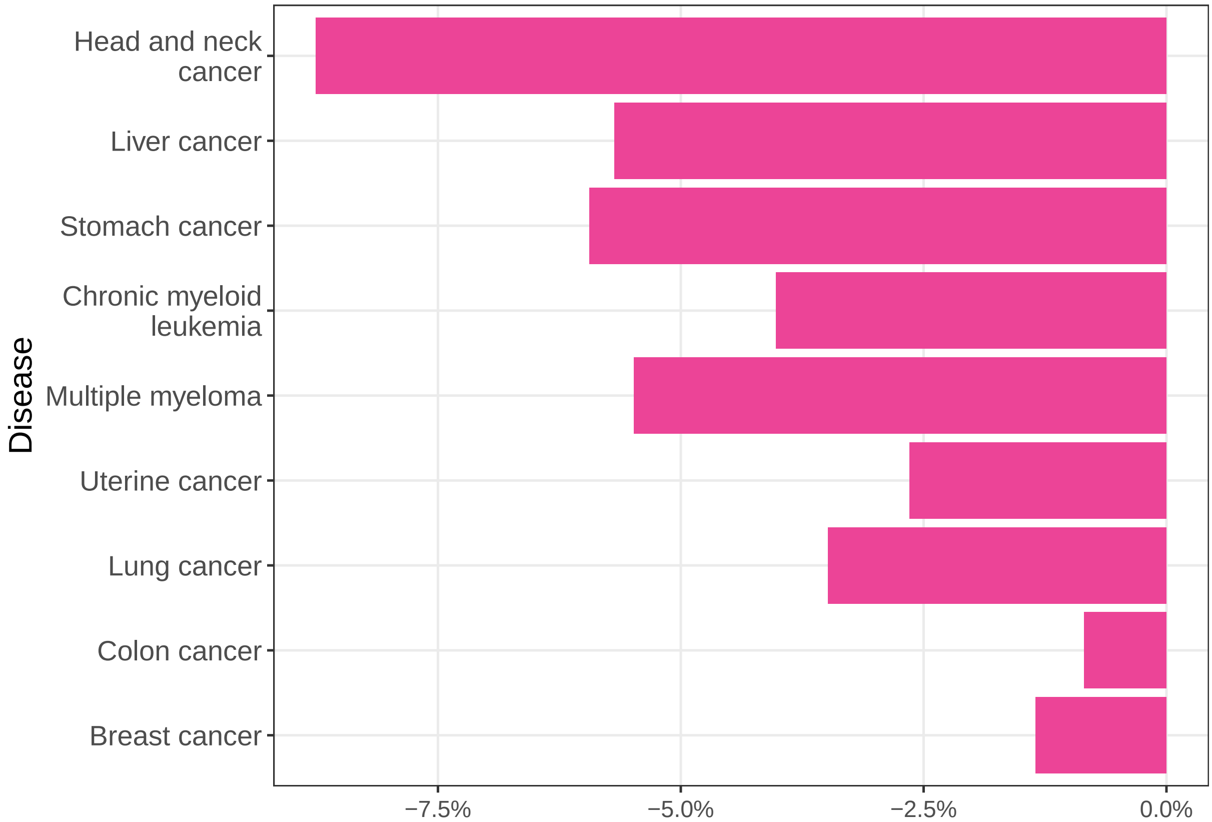

Figure 4.b: Percentage change in mortality for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

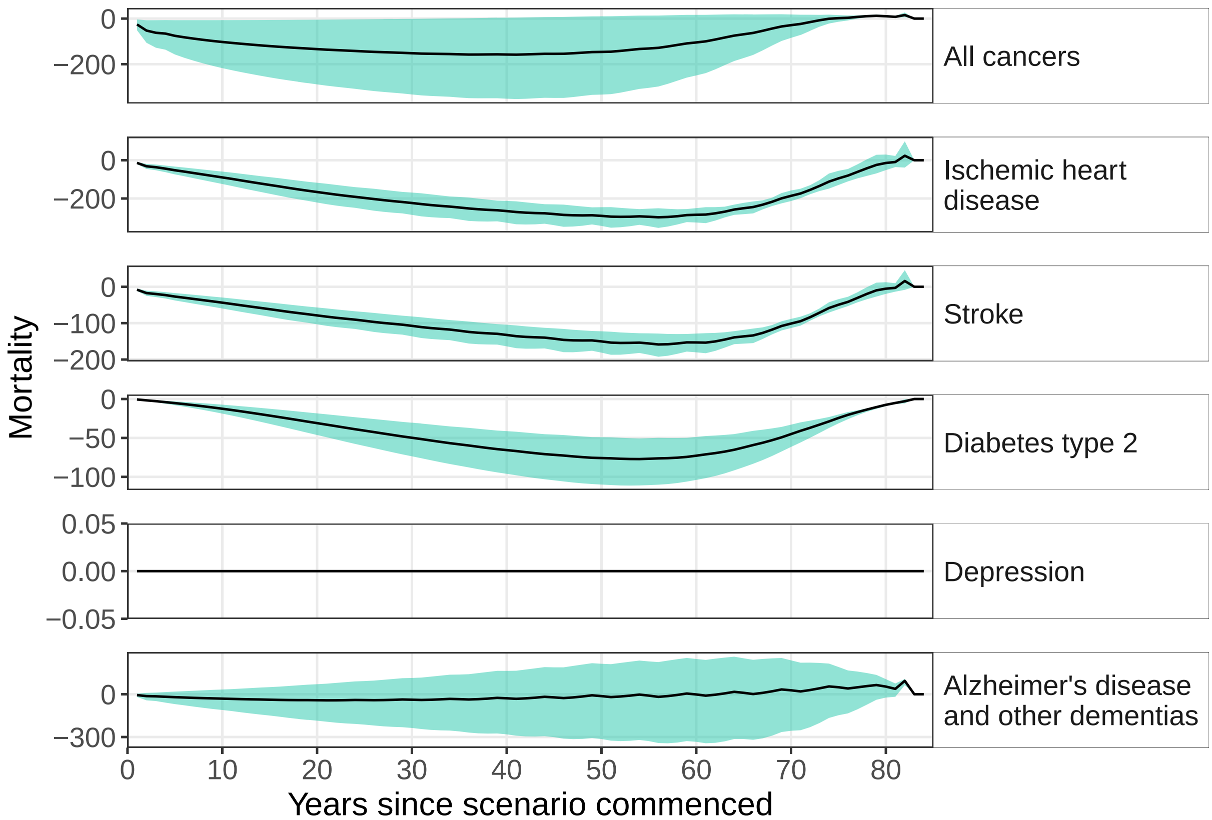

Figure 5.a: The change in mortality over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

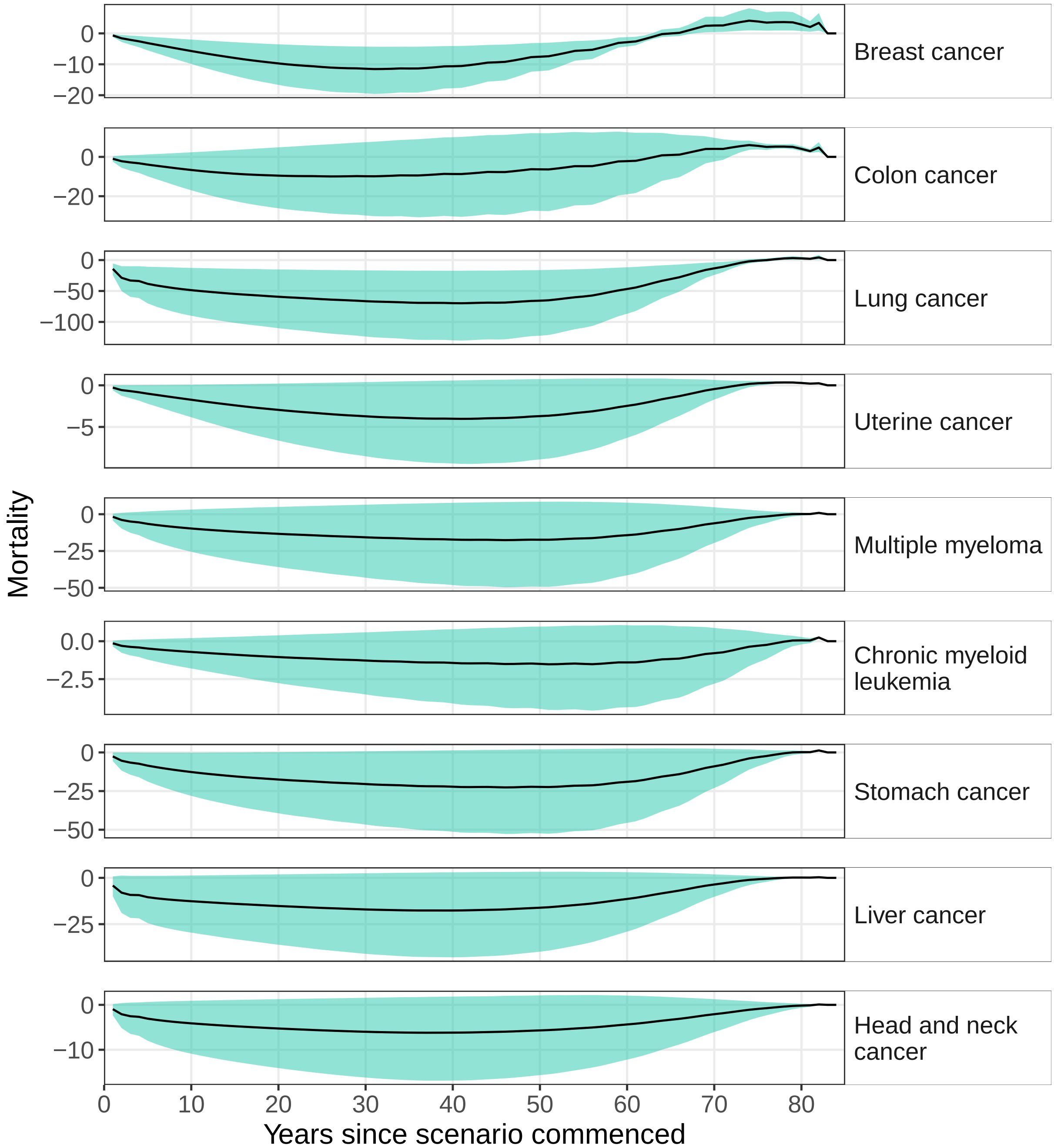

Figure 5.b: Percentage change in mortality for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Health

Figures 6 and 7 below show the change in Health Adjusted Life Years (HALYs)[1] and Life Years[2] for a snapshot of the population from 2019 for the scenario. Both figures show that the greatest gains from increasing physical activity occur midway through the life cycle with most of the gains occurring cumulatively in the long term. The decline from the mid-point onwards is due to individuals dying from natural causes within the model.

HALYS

The model estimates a total of **990,320** HALYs for the scenario population, which is **492** HALYs per 1,000 members of the population.

Figure 6. Total health-adjusted life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

[1]Health Adjusted Life Years are holistic measures of health that account for morbidity, mortality and quality of life.

[2]Life Years are similar to a HALYs however they exclude the quality of life component.

Life Years

The model estimates a total of **604,840** Life Years for the scenario population, which is **300** Life Years per 1,000 members of the population.

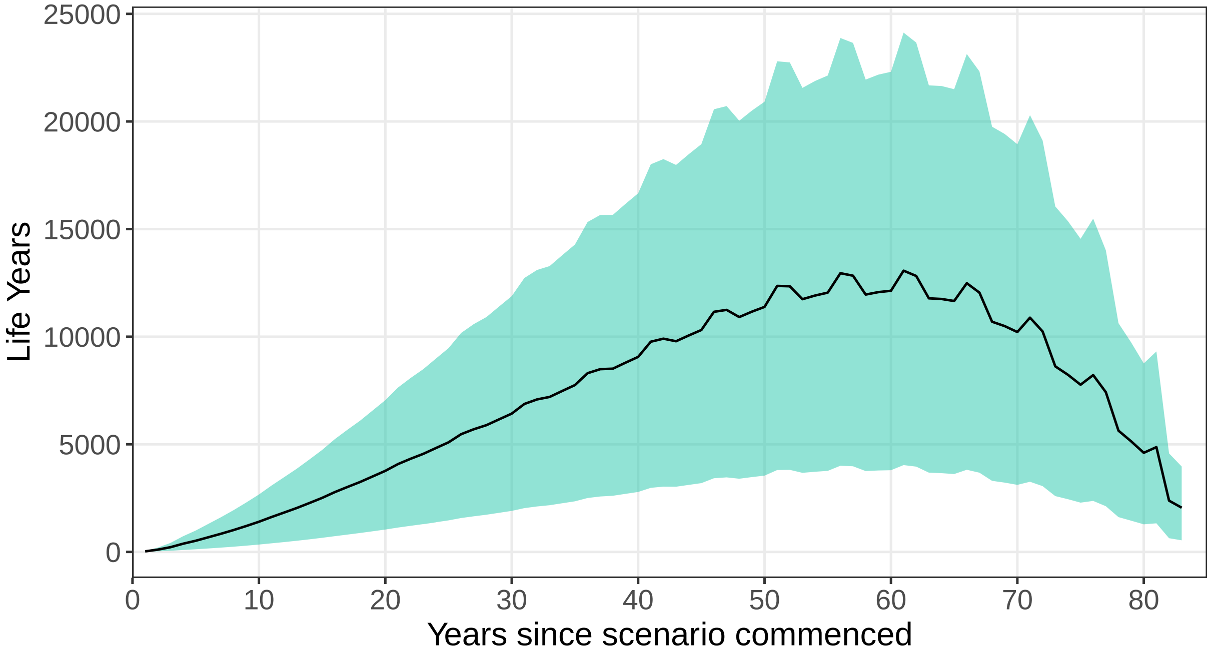

Figure 7. Total life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Value

The value of improvements to community health can be calculated**[a]** by translating the Health Adjusted Life Years (HALYs) from each scenario into dollar terms using the value of a statistical life year**[b]**. The value of a statistical life year is an estimate of the amount a society is willing to trade to reduce the risk of death for one year.

In the simulation model, HALYs are generated across time and are cumulative. Thus, to help us understand the value of HALYs across time in present day terms, it is necessary to use discounting**[c]** to reduce HALYs generated at the future point in time. Discounted HALYs from these future points can be added up to give the aggregate value of HALYs in today's terms as a measure of the value of improvements to community health arising from the chosen scenario.

The size of the discount rate can impact the aggregated value of HALYs and there is considerable debate on what discount rates should be used (with some arguing that health should not be discounted at all).[2] Hence, it is common to use a variety of discount rates to allow for differing risks, preferences and sensitivity when valuing health. The figures presented below were calculated using discount rates of 3%, 5% and 7% based on recent recommendations [3, 4] and represent the value of HALYs in present day terms resulting from an increase in physical activity from the chosen scenario.

The value of improvements to community health

The model estimates a total of **HALYs,** Health Adjusted Life Years (HALYs) gained for the scenario population, which is **492** HALYs per 1,000 members of the scenario population. The figures below represent the value of improvements to community health from the chosen scenario. These figures can be used in summary reports and for advocacy purposes**[d]**.

The HALYs gained in this scenario have a statistical value of:

- **38,176,100** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **23,333,670** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **15,827,582** per 1,000 members of the population, when calculated using a discount rate of 7%.

a. What is meant by value and how can it be measured?

Value is conceptual and measures a sense of worth or usefulness of something to individuals or to a society. Measuring the value of something, such as health, enables it to be included in assessments or analyses such as cost-benefit analyses to recognise its relative importance.

Value can be derived in many ways and a common approach is to use monetary terms, such as dollars. Valuing something using dollars is not the same as equating it with its price. Prices represent the amount at which something can be traded, prices therefore represent the amount of money for buying or selling something such as food, clothing or to pay bills. One way is to evaluate health in dollar terms is to use the Value of a Statistical Life and Value of a Statistical Life Year**[b]**.

b. What is the Value of a Statistical Life and Value of a Statistical Life Year?

The value of a **statistical life** is the estimated amount that a society is willing to trade to reduce the risk of death. The word 'Statistical' refers to the average value for life and therefore means the value of a statistical life doesn't relate to any specific individual. This value can change across risk factors and different societies who may value life differently. There are various ways of measuring the value of a statistical life with most approaches using revealed or stated preference approaches.[3] In Australia, the Office of Best Practice Regulation estimates a statistical life at $5.3M in 2022 dollar terms, and assumes that the life is of a young person with at least another 40 years to live.[5, 6]

Value of a Statistical Life Year

The value of a statistical life year is the estimated amount that a society is willing to trade to reduce the risk of death over **one year.** It can be derived from the value of a statistical life or measured directly using surveys or willingness to pay techniques.[5] The current value of a **statistical life year** is $227,000 in 2022 dollars based on current estimates from the Office of Best Practice Regulation.[6] The value of a statistical life year is useful for evaluating small increases in life years instead of evaluating full life expectancy. It is appropriate for valuing the Health Adjusted Life Years estimated from the scenarios and modelling presented in this tool. For the modelling and results presented here, the value of $227,000 was converted to 2019 dollars based on the Wage Price Index for Brisbane.

c. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

d. Application in advocacy and reporting

This section uses figures to show how the value of community health (estimated from HALYs and the value of statistical life year) can be used for reporting and advocacy purposes.

The simulation model uses **population-based estimates** for disease morbidity and mortality and is best applied to larger groups of people. It also assumes that the people of interest have similar characteristics and behaviours to the population data used in the simulation model and scenarios. The **example** below shows results from a scenario that replaces car trips with walking trips for distances of 0-2 km for All age groups.

Example:

The HALYs gained in this scenario have a statistical value of:

- **$10,859,605** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **$6,662,541** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **$4,533,392** per 1,000 members of the population, when calculated using a discount rate of 7%.

This **example** shows that the HALYs gained in this scenario have a statistical value of $10,859,605 per 1,000 members of the population using a discount of 3%.

This figure can be divided by 1,000 to give a per person figure. Once a per person figure is established, it can be multiplied by the number of people in any population size of interest for use in reports or as evidence to advocate for benefits associated with shifts to active transport modes.

$10,859,605 / 1,000 = $10,859.61 per person value

A good example of how this model can be applied links to previous research that investigated the impact of new more walkable development in Altona North on a population of 21,000 people [11]. If we assume that these people have similar characteristics to the underlying population based estimates and behaviours based on the travel survey data in the simulation model underlying this tool, then the value of community health according to the chosen scenario can be calculated as:

21,000 (people) x $10,859 (statistical value from HALYs gained) = $228 M.

Savings

An increase in physical activity due to the chosen scenario reduces chronic disease cases across a lifetime and reduces spending for each disease within the health care system resulting in overall health care cost savings**[a]**.

Table 3 provides estimated health care cost savings associated with the prevented cases of chronic diseases per 1,000 members of the population according to the selected scenario. These figures are based on applying average health care system costs per prevalent case of disease and using three alternative discount rates**[b]**:

Table 3. Total health care cost savings by disease per 1,000 members of the population.

Disease	3% discount rate	5% discount rate	7% discount rate
Alzheimer's disease and other dementias	$30,556	$18,585	$12,343
Breast cancer	$322,060	$201,883	$135,422
All cancers	$701,618	$444,021	$301,698
Colon cancer	$152,971	$100,246	$69,403
Chronic myeloid leukemia	$33,787	$20,228	$13,277
Diabetes type 2	$191,048	$112,459	$72,126
Depression	$944,468	$715,205	$555,962
Head and neck cancer	$5,642	$3,651	$2,565
Ischemic heart disease	$385,529	$227,151	$146,482
Liver cancer	$5,871	$3,846	$2,731
Multiple myeloma	$80,787	$50,494	$34,385
Stomach cancer	$35,677	$22,181	$15,053
Stroke	$56,985	$33,334	$21,435
Lung cancer	$49,740	$32,122	$22,532
Uterine cancer	$15,129	$9,450	$6,350

a. What do we mean by health care cost savings?

To calculate health care cost savings for each disease, the annual costs for each disease in each year is multiplied by the number of prevented cases of each disease for each scenario. This results in a total saving in spending for each disease by year. The savings in spending for future years are discounted**[b]** with annual savings aggregated to give a total amount saved for each disease. Total savings are presented as the amount saved per 1,000 members of the population to enable comparisons against populations of different sizes.

We use the term **health care cost saving** because it represents a reduction in health spending. However, the Australian Institute of Health and Welfare (AIHW) stress that the term cost is broad and not representative of the full cost experienced by individuals, families, or the health system, consequently AIHW use the term spending.[8]

These figures use AIHW estimates of the amounts spent through the health system in 2018-19 for each case of disease. This is extracted from Health system spending per case of disease and for certain risk factors, Table 1 – Estimates of health system spending per case, by burden of disease group, condition and sex, Australia 2018-2019.[9]. For head and neck cancers, supplementary figures were obtained from the Global Burden of Disease incidence data.[10]

b. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

References

1. Gold, M. R., Stevenson, D., & Fryback, D. G. (2002). *HALYS and QALYS and DALYS, Oh My: similarities and differences in summary measures of population Health.* Annual review of public health, 23(1), 115-134.
2. Attema, A.E., Brouwer, W.B. & Claxton, K. (2018). *Discounting in economic evaluations.* Pharmacoeconomics. 36: p. 745-758.
3. Ananthapavan, J., Moodie, M., Milat, A.J., & Carter, R. (2021). *Systematic review to update 'value of a statistical life' estimates for Australia.* International journal of environmental research and public health, 2021. 18(11): p. 6168.
4. Terrill, M. & Batrouney, H. (2018). *Unfreezing discount rates: Transport infrastructure for tomorrow.* Grattan Institute.
5. Abelson, P. (2008). *Establishing a monetary value for lives saved: issues and controversies.* Canberra: Office of Best Practice Regulation, Department of Finance and Deregulation.
6. Department of the Prime Minister and Cabinet. (2022). *Best practice regulation guidance note: Value of statistical life.* Australian Government.
7. Haacker, M., Hallett, T.B. & Atun, R. (2020). *On discount rates for economic evaluations in global health.* Health Policy and Planning, 2020. 35(1): p. 107-114.
8. Australian Institute of Health and Welfare (2023). Technical Notes: Estimating Spending per prevalent case of disease. Health system spending per case of disease and for certain risk factors, Estimating the spending per prevalent case of disease - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
9. Australian Institute of Health and Welfare (2023). Health system spending per case of disease and for certain risk factors. Health system spending per case of disease and for certain risk factors, Data - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
10. Global Burden of Disease (2019). Global Health Data Exchange. https://vizhub.healthdata.org/gbd-results. Accessed September 20, 2023.
11. Zapata-Diomedi, B., Boulangé, C., Giles-Corti, B., Phelan, K., Washington, S., Veerman, L.J., & Gunn, L. (2019). Physical activity-related health and economic benefits of building walkable neighbourhoods: A modelled comparison between brownfield and greenfield developments. International Journal of Behavioural Nutrition and Physical Activity.
12. Khorasani, E., Davari, M., Kebriaeezadeh, A., Fatemi, F., Akbari Sari, A., & Varahrami, V. (2022). A comprehensive review of official discount rates in guidelines of health economic evaluations over time: the trends and roots. The European Journal of Health Economics, 23(9), 1577-1590.

Scenario: replacing car trips under 2km with cycling for commuting trip purposes

This scenario shows the results of replacing car trips under 2km for work related or education purposes with cycling trips for all adults of all ages.

This implies that the selected scenario results in a mode shift in cycling from 1.3% to 3.0% and from 74.7% to 72.9% for car trips taken as either a driver or passenger.

Increases in cycling translate into a shift from 47.9% to 48.9% of the population accumulating the required minutes spent being moderately (150 – 300 mins) or vigorously physically active (75 – 150 mins) or an equivalent combination of both contributing to recommended levels as detailed in the Physical Activity Guidelines.

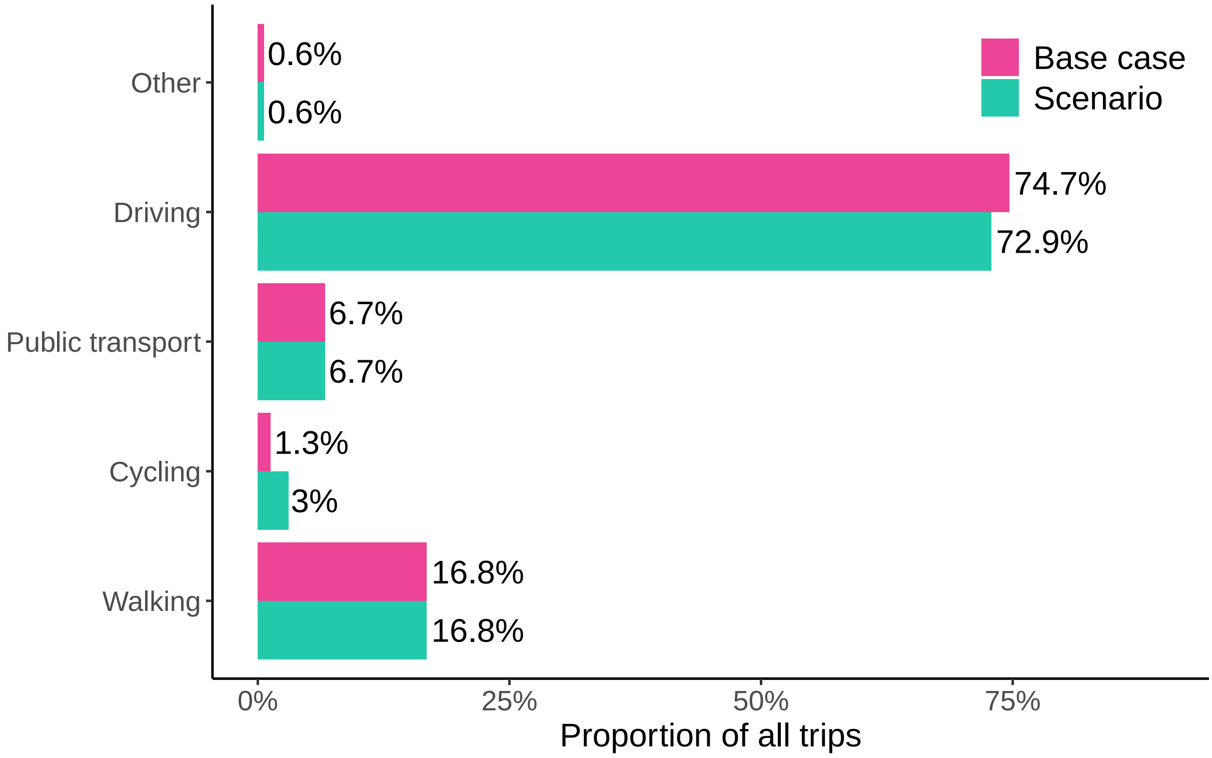

Figure 1: Distribution of base case and scenario trips.

Incidence

Incidence describes the rate of occurrence of new cases of a disease over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of disease prevented, due to increases in physical activity associated with the scenario. Figure 2 presents the change (%) in the disease incidence across the life course. Figure 3 presents how the difference in disease incidence changes over time, by year, using a snapshot of the population from 2019.

Table 1 shows how the scenario impacts the incidence of chronic diseases as both as a percentage and total number of prevented cases.

Table 1. Chronic disease incidence reduction and total number of prevented cases of disease measured across the years of the simulation

Disease*	Incidence of disease is reduced by	Total number of prevented cases of disease aggregated across the simulation
Alzheimer's disease and other dementias	-0.02%	-101
Breast cancer	0.03%	23
All cancers	0.03%	127
Colon cancer	0.01%	7
Chronic myeloid leukemia	0.03%	1
Diabetes type 2	0.22%	727
Depression	0.04%	672
Head and neck cancer	0.13%	6
Ischemic heart disease	0.06%	553
Liver cancer	0.07%	12
Multiple myeloma	0.07%	13
Stomach cancer	0.06%	14
Stroke	0.05%	133
Lung cancer	0.04%	48
Uterine cancer	0.05%	5

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

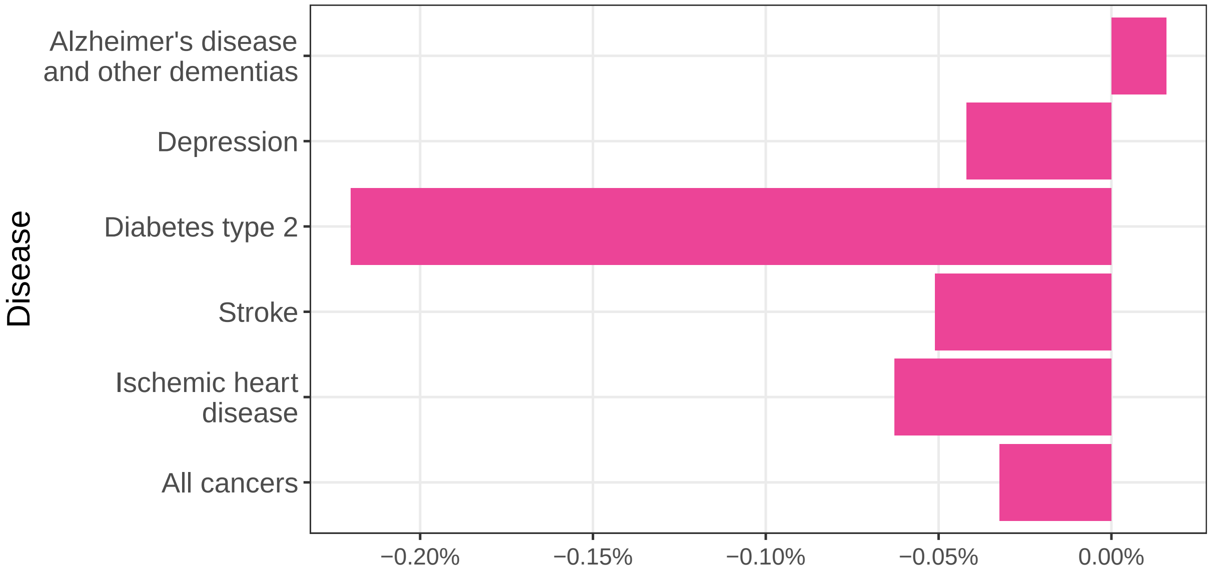

Figure 2.a: Percentage change in incidence by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

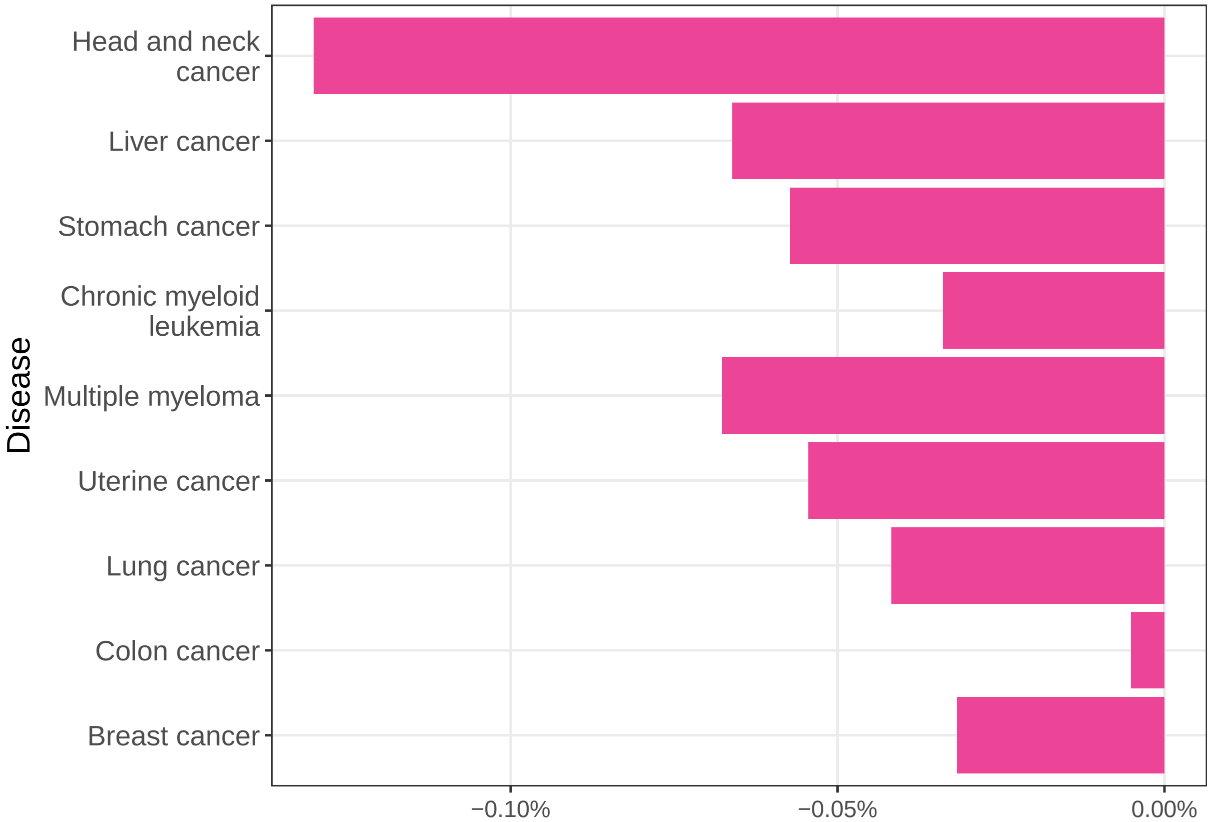

Figure 2.b: Percentage change in incidence for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

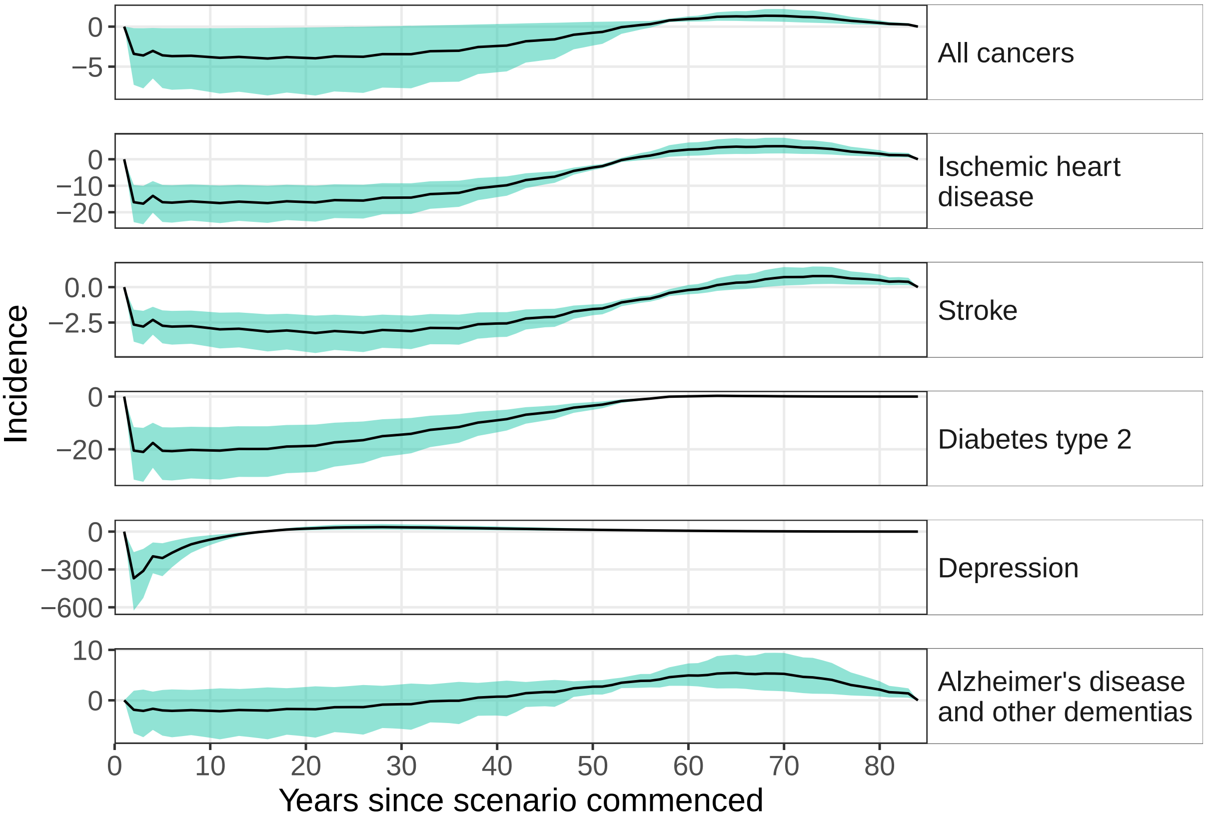

Figure 3.a: The change in incidence over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

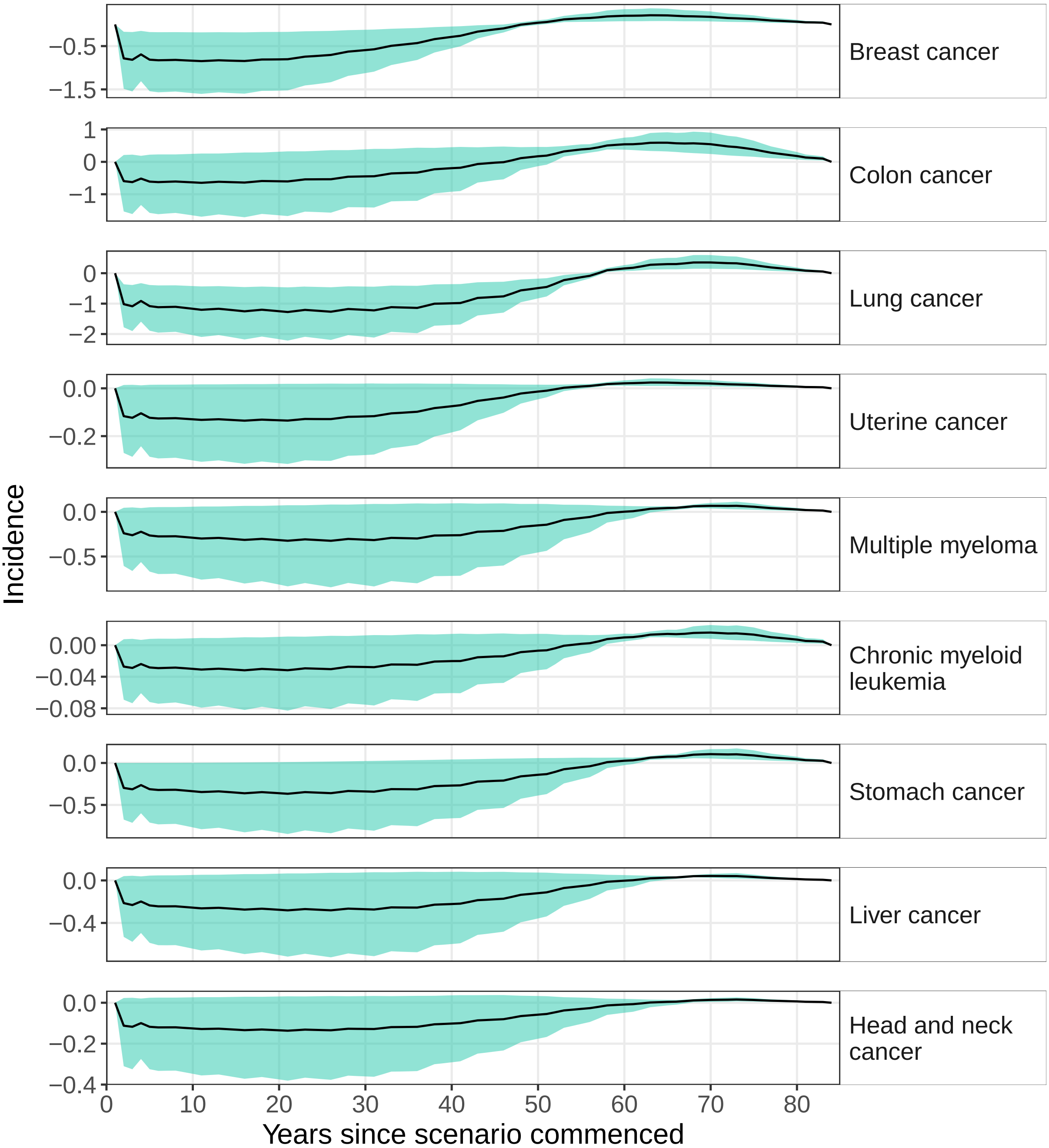

Figure 3.b: Percentage change in incidence for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Mortality

Mortality is the number of deaths due to a given disease over over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of prevented deaths due to increases in physical activity associated with the scenario. Figure 4 presents the total change in mortality over the life course. Figure 5 presents the difference in the number of deaths by year using a snapshot of the population from 2019.

Table 2 shows how the scenario impacts reductions in mortality presented as a percentage and total number of prevented deaths caused by chronic diseases.

Table 2. Percentage reduction in mortality and total number of prevented deaths by chronic disease measured across the years of the simulation.

Disease*	Mortality is reduced by	Total number of prevented deaths aggregated across the simulation
Alzheimer's disease and other dementias	-0.04%	-85
Breast cancer	0.03%	10
All cancers	0.04%	103
Colon cancer	0.01%	3
Chronic myeloid leukemia	0.03%	1
Diabetes type 2	0.19%	96
Depression	0.00%	0
Head and neck cancer	0.14%	6
Ischemic heart disease	0.06%	234
Liver cancer	0.07%	11
Multiple myeloma	0.07%	12
Stomach cancer	0.06%	12
Stroke	0.04%	77
Lung cancer	0.04%	45
Uterine cancer	0.05%	3

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

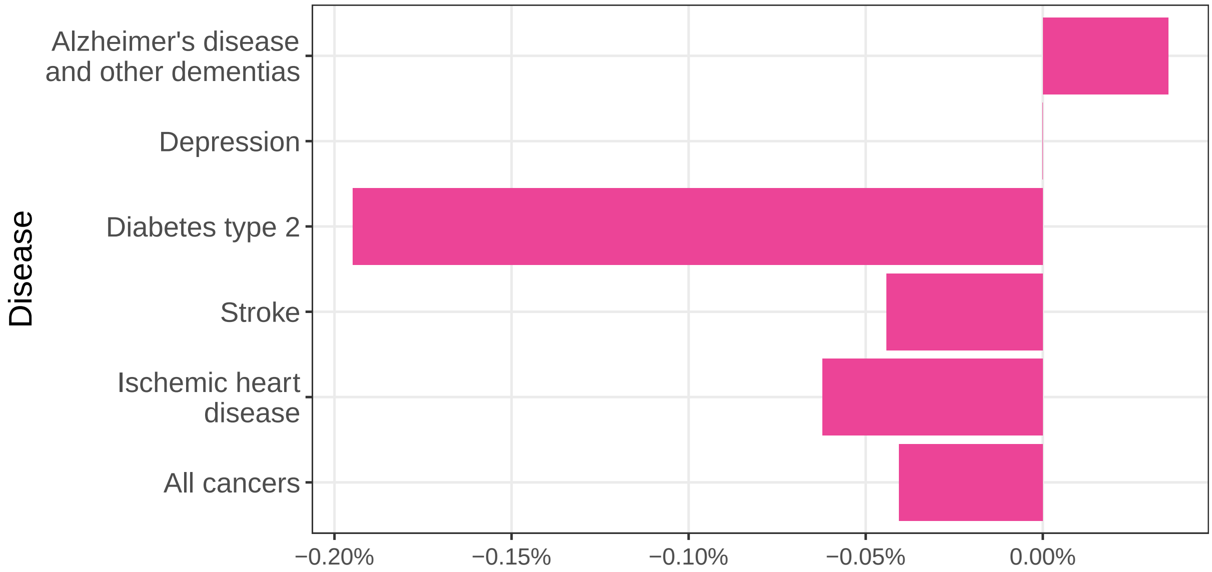

Figure 4.a: Percentage change in mortality by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

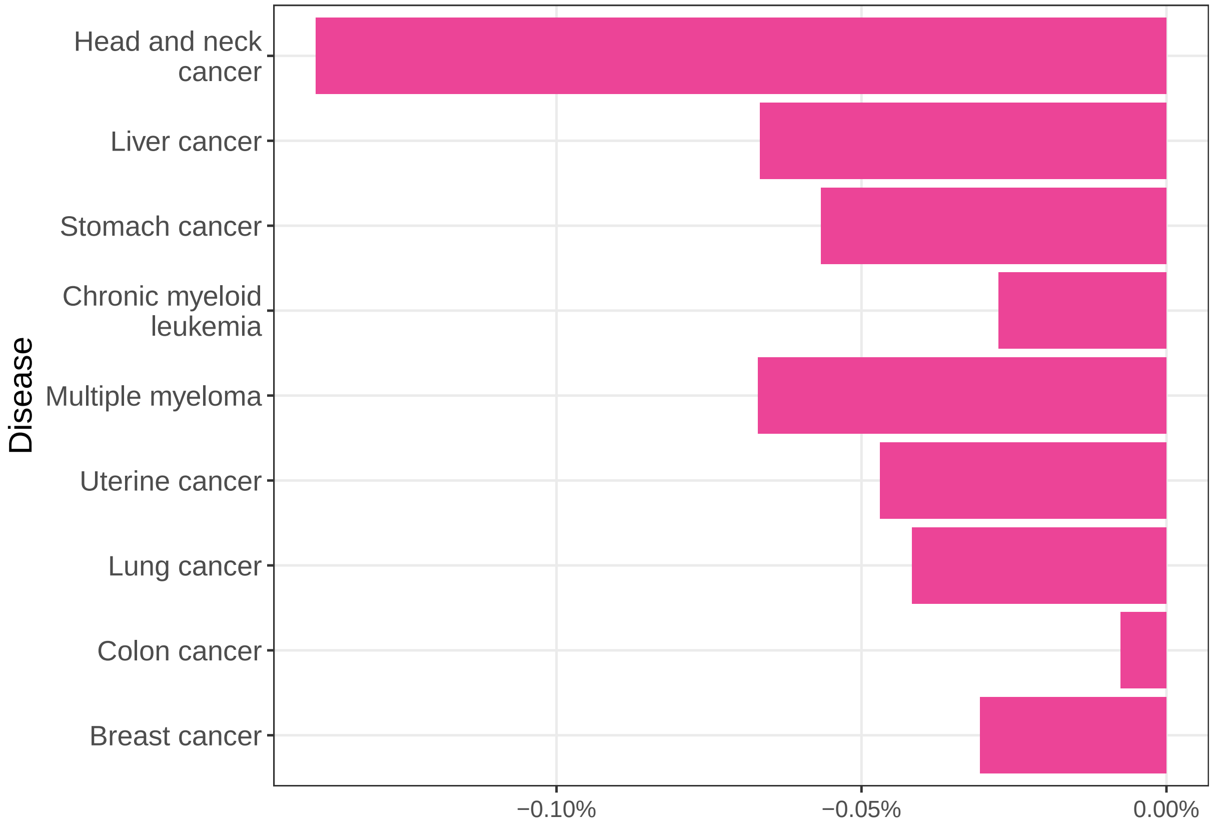

Figure 4.b: Percentage change in mortality for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

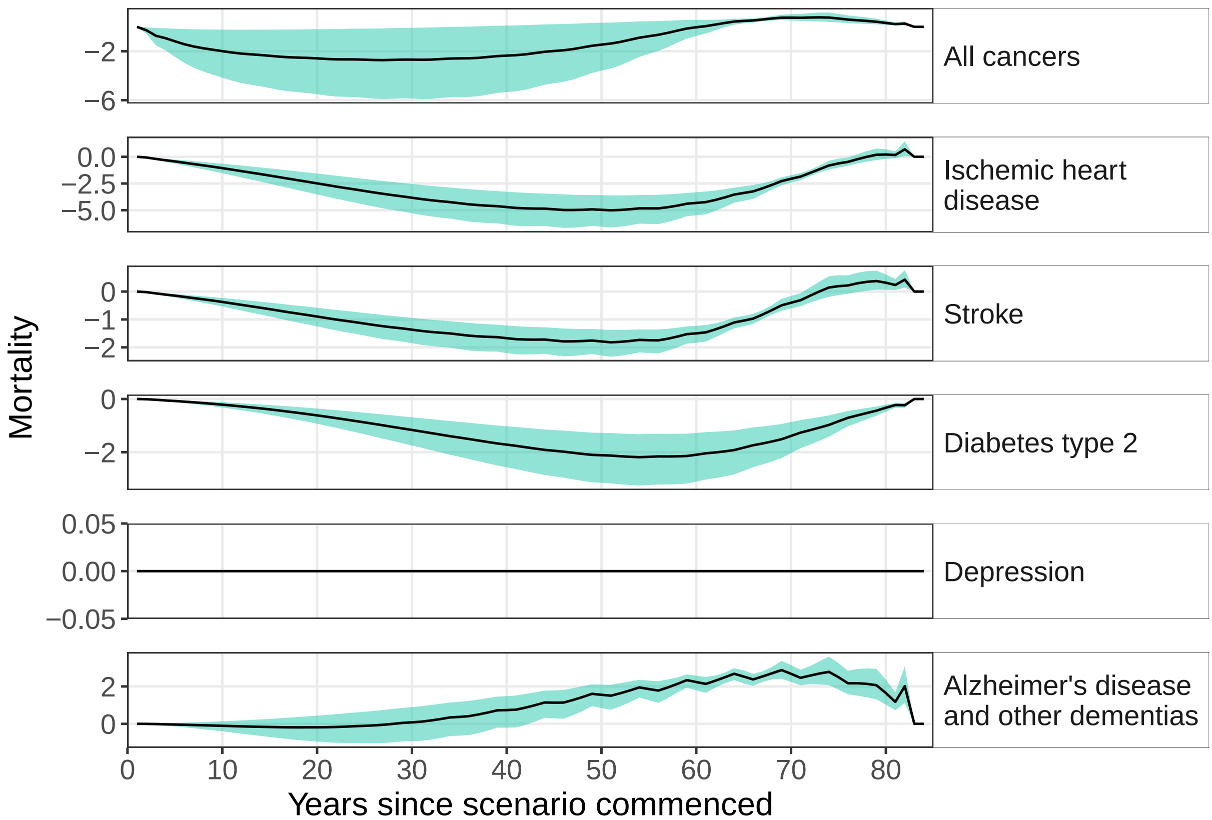

Figure 5.a: The change in mortality over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

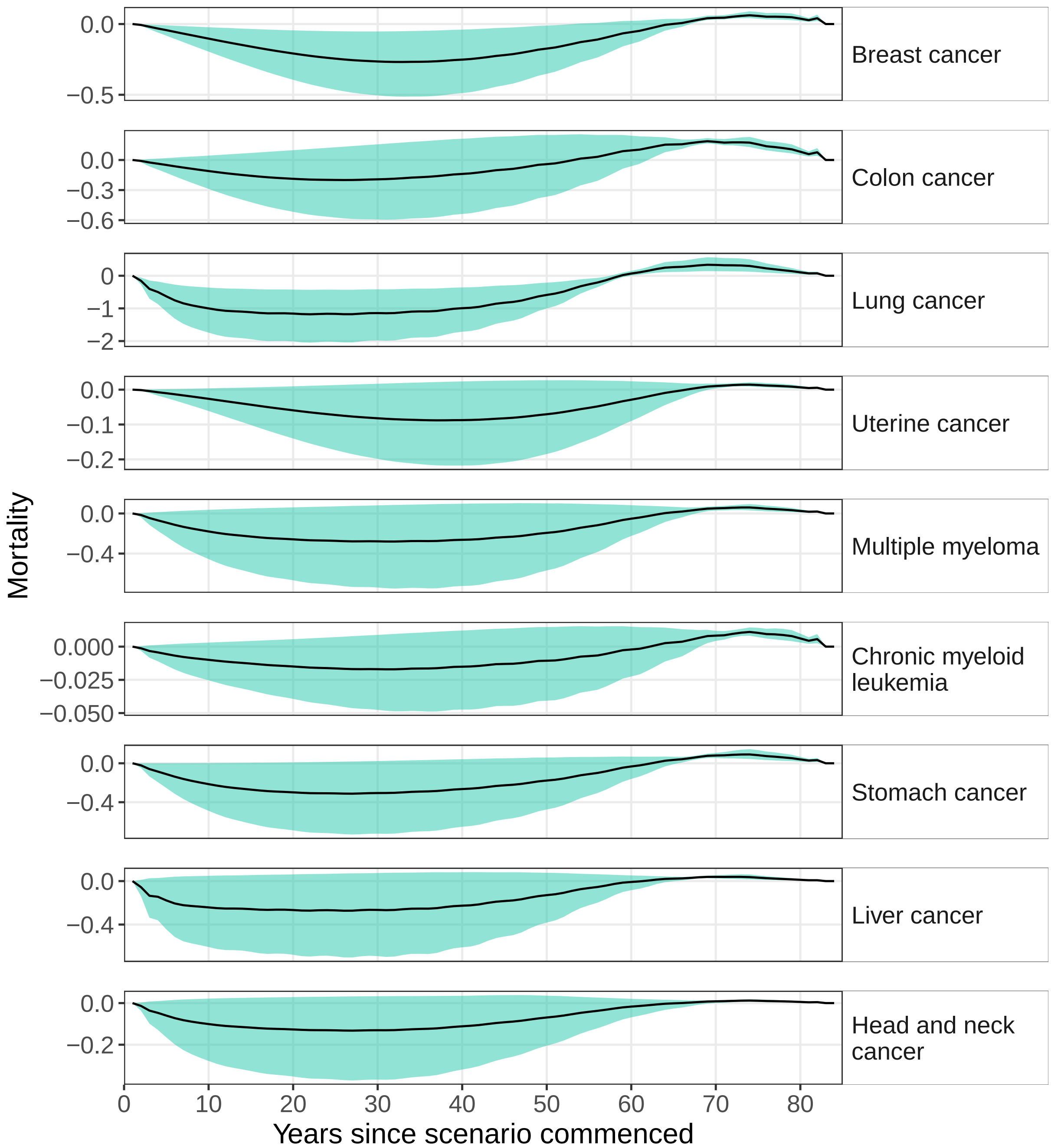

Figure 5.b: Percentage change in mortality for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Health

Figures 6 and 7 below show the change in Health Adjusted Life Years (HALYs)[1] and Life Years[2] for a snapshot of the population from 2019 for the scenario. Both figures show that the greatest gains from increasing physical activity occur midway through the life cycle with most of the gains occurring cumulatively in the long term. The decline from the mid-point onwards is due to individuals dying from natural causes within the model.

HALYS

The model estimates a total of **23,751** HALYs for the scenario population, which is **12** HALYs per 1,000 members of the population.

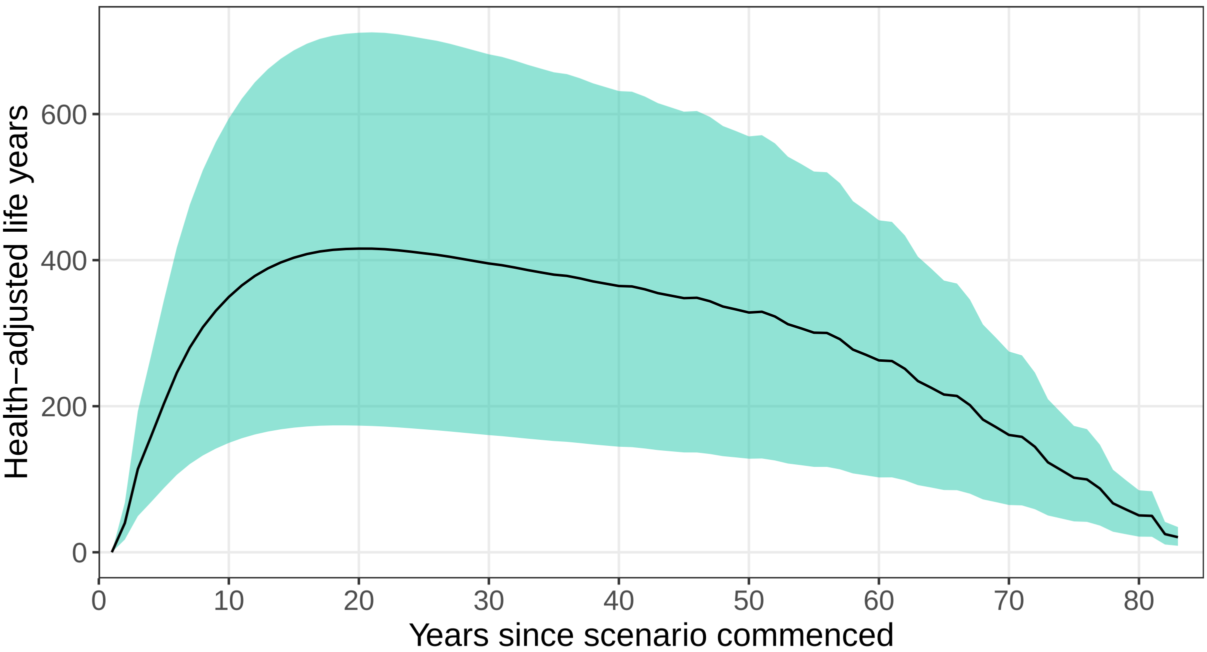

Figure 6. Total health-adjusted life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

[1] Health Adjusted Life Years are holistic measures of health that account for morbidity, mortality and quality of life.

[2] Life Years are similar to a HALYs however they exclude the quality of life component.

Life Years

The model estimates a total of **10,814** Life Years for the scenario population, which is **5.4** Life Years per 1,000 members of the population.

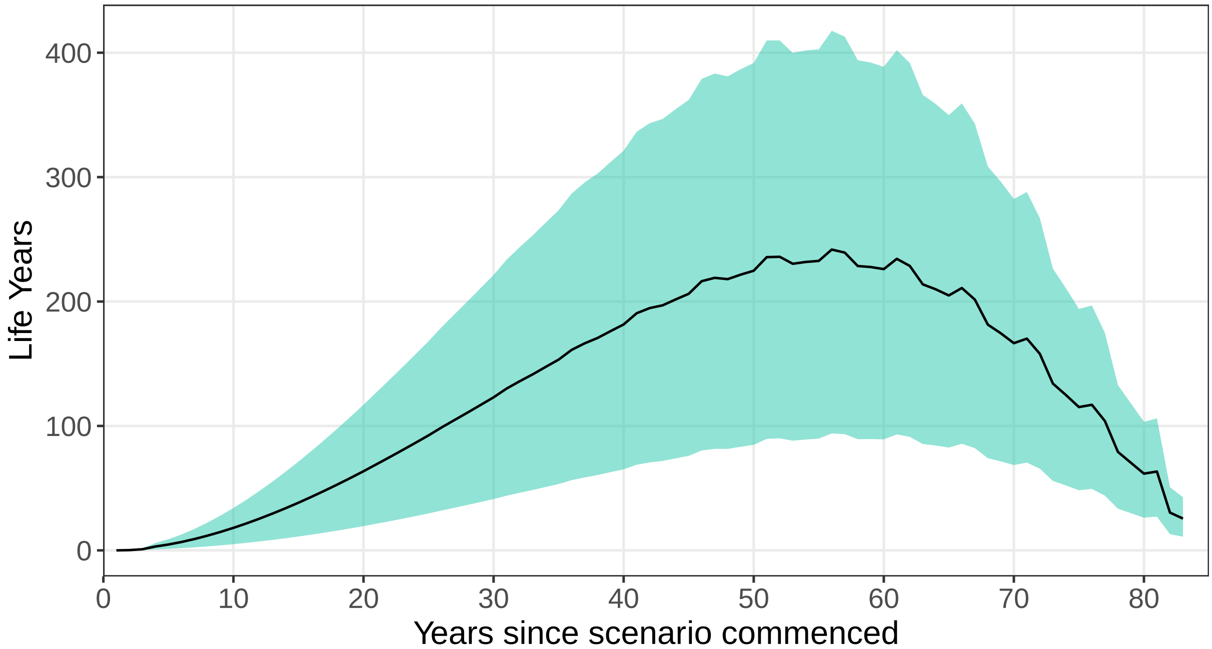

Figure 7. Total life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Value

The value of improvements to community health can be calculated**[a]** by translating the Health Adjusted Life Years (HALYs) from each scenario into dollar terms using the value of a statistical life year**[b]**. The value of a statistical life year is an estimate of the amount a society is willing to trade to reduce the risk of death for one year.

In the simulation model, HALYs are generated across time and are cumulative. Thus, to help us understand the value of HALYs across time in present day terms, it is necessary to use discounting**[c]** to reduce HALYs generated at the future point in time. Discounted HALYs from these future points can be added up to give the aggregate value of HALYs in today's terms as a measure of the value of improvements to community health arising from the chosen scenario.

The size of the discount rate can impact the aggregated value of HALYs and there is considerable debate on what discount rates should be used (with some arguing that health should not be discounted at all).[2] Hence, it is common to use a variety of discount rates to allow for differing risks, preferences and sensitivity when valuing health. The figures presented below were calculated using discount rates of 3%, 5% and 7% based on recent recommendations [3, 4] and represent the value of HALYs in present day terms resulting from an increase in physical activity from the chosen scenario.

The value of improvements to community health

The model estimates a total of **HALYs,** Health Adjusted Life Years (HALYs) gained for the scenario population, which is **12** HALYs per 1,000 members of the scenario population. The figures below represent the value of improvements to community health from the chosen scenario. These figures can be used in summary reports and for advocacy purposes**[d]**.

The HALYs gained in this scenario have a statistical value of:

- **1,006,058** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **635,746** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **437,711** per 1,000 members of the population, when calculated using a discount rate of 7%.

a. What is meant by value and how can it be measured?

Value is conceptual and measures a sense of worth or usefulness of something to individuals or to a society. Measuring the value of something, such as health, enables it to be included in assessments or analyses such as cost-benefit analyses to recognise its relative importance.

Value can be derived in many ways and a common approach is to use monetary terms, such as dollars. Valuing something using dollars is not the same as equating it with its price. Prices represent the amount at which something can be traded, prices therefore represent the amount of money for buying or selling something such as food, clothing or to pay bills. One way is to evaluate health in dollar terms is to use the Value of a Statistical Life and Value of a Statistical Life Year**[b]**.

b. What is the Value of a Statistical Life and Value of a Statistical Life Year?

The value of a **statistical life** is the estimated amount that a society is willing to trade to reduce the risk of death. The word 'Statistical' refers to the average value for life and therefore means the value of a statistical life doesn't relate to any specific individual. This value can change across risk factors and different societies who may value life differently. There are various ways of measuring the value of a statistical life with most approaches using revealed or stated preference approaches.[3] In Australia, the Office of Best Practice Regulation estimates a statistical life at $5.3M in 2022 dollar terms, and assumes that the life is of a young person with at least another 40 years to live.[5, 6]

Value of a Statistical Life Year

The value of a statistical life year is the estimated amount that a society is willing to trade to reduce the risk of death over **one year.** It can be derived from the value of a statistical life or measured directly using surveys or willingness to pay techniques.[5] The current value of a **statistical life year** is $227,000 in 2022 dollars based on current estimates from the Office of Best Practice Regulation.[6] The value of a statistical life year is useful for evaluating small increases in life years instead of evaluating full life expectancy. It is appropriate for valuing the Health Adjusted Life Years estimated from the scenarios and modelling presented in this tool. For the modelling and results presented here, the value of $227,000 was converted to 2019 dollars based on the Wage Price Index for Brisbane.

c. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

d. Application in advocacy and reporting

This section uses figures to show how the value of community health (estimated from HALYs and the value of statistical life year) can be used for reporting and advocacy purposes.

The simulation model uses **population-based estimates** for disease morbidity and mortality and is best applied to larger groups of people. It also assumes that the people of interest have similar characteristics and behaviours to the population data used in the simulation model and scenarios. The **example** below shows results from a scenario that replaces car trips with walking trips for distances of 0-2 km for All age groups.

Example:

The HALYs gained in this scenario have a statistical value of:

- **$10,859,605** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **$6,662,541** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **$4,533,392** per 1,000 members of the population, when calculated using a discount rate of 7%.

This **example** shows that the HALYs gained in this scenario have a statistical value of $10,859,605 per 1,000 members of the population using a discount of 3%.

This figure can be divided by 1,000 to give a per person figure. Once a per person figure is established, it can be multiplied by the number of people in any population size of interest for use in reports or as evidence to advocate for benefits associated with shifts to active transport modes.

$10,859,605 / 1,000 = $10,859.61 per person value

A good example of how this model can be applied links to previous research that investigated the impact of new more walkable development in Altona North on a population of 21,000 people [11]. If we assume that these people have similar characteristics to the underlying population based estimates and behaviours based on the travel survey data in the simulation model underlying this tool, then the value of community health according to the chosen scenario can be calculated as:

21,000 (people) x $10,859 (statistical value from HALYs gained) = $228 M.

Savings

An increase in physical activity due to the chosen scenario reduces chronic disease cases across a lifetime and reduces spending for each disease within the health care system resulting in overall health care cost savings**[a]**.

Table 3 provides estimated health care cost savings associated with the prevented cases of chronic diseases per 1,000 members of the population according to the selected scenario. These figures are based on applying average health care system costs per prevalent case of disease and using three alternative discount rates**[b]**:

Table 3. Total health care cost savings by disease per 1,000 members of the population.

Disease	3% discount rate	5% discount rate	7% discount rate
Alzheimer's disease and other dementias	$270	$190	$133
Breast cancer	$7,330	$4,498	$2,942
All cancers	$15,278	$9,707	$6,530
Colon cancer	$2,695	$1,844	$1,287
Chronic myeloid leukemia	$810	$489	$318
Diabetes type 2	$5,686	$3,301	$2,079
Depression	$33,095	$24,094	$18,170
Head and neck cancer	$140	$95	$68
Ischemic heart disease	$9,864	$5,765	$3,647
Liver cancer	$117	$80	$58
Multiple myeloma	$1,958	$1,253	$855
Stomach cancer	$715	$461	$317
Stroke	$1,354	$792	$501
Lung cancer	$1,094	$731	$518
Uterine cancer	$418	$257	$169

a. What do we mean by health care cost savings?

To calculate health care cost savings for each disease, the annual costs for each disease in each year is multiplied by the number of prevented cases of each disease for each scenario. This results in a total saving in spending for each disease by year. The savings in spending for future years are discounted**[b]** with annual savings aggregated to give a total amount saved for each disease. Total savings are presented as the amount saved per 1,000 members of the population to enable comparisons against populations of different sizes.

We use the term **health care cost saving** because it represents a reduction in health spending. However, the Australian Institute of Health and Welfare (AIHW) stress that the term cost is broad and not representative of the full cost experienced by individuals, families, or the health system, consequently AIHW use the term spending.[8]

These figures use AIHW estimates of the amounts spent through the health system in 2018-19 for each case of disease. This is extracted from Health system spending per case of disease and for certain risk factors, Table 1 – Estimates of health system spending per case, by burden of disease group, condition and sex, Australia 2018-2019.[9]. For head and neck cancers, supplementary figures were obtained from the Global Burden of Disease incidence data.[10]

b. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

References

1. Gold, M. R., Stevenson, D., & Fryback, D. G. (2002). *HALYS and QALYS and DALYS, Oh My: similarities and differences in summary measures of population Health.* Annual review of public health, 23(1), 115-134.
2. Attema, A.E., Brouwer, W.B. & Claxton, K. (2018). *Discounting in economic evaluations.* Pharmacoeconomics. 36: p. 745-758.
3. Ananthapavan, J., Moodie, M., Milat, A.J., & Carter, R. (2021). *Systematic review to update 'value of a statistical life' estimates for Australia.* International journal of environmental research and public health, 2021. 18(11): p. 6168.
4. Terrill, M. & Batrouney, H. (2018). *Unfreezing discount rates: Transport infrastructure for tomorrow.* Grattan Institute.
5. Abelson, P. (2008). *Establishing a monetary value for lives saved: issues and controversies.* Canberra: Office of Best Practice Regulation, Department of Finance and Deregulation.
6. Department of the Prime Minister and Cabinet. (2022). *Best practice regulation guidance note: Value of statistical life.* Australian Government.
7. Haacker, M., Hallett, T.B. & Atun, R. (2020). *On discount rates for economic evaluations in global health.* Health Policy and Planning, 2020. 35(1): p. 107-114.
8. Australian Institute of Health and Welfare (2023). Technical Notes: Estimating Spending per prevalent case of disease. Health system spending per case of disease and for certain risk factors, Estimating the spending per prevalent case of disease - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
9. Australian Institute of Health and Welfare (2023). Health system spending per case of disease and for certain risk factors. Health system spending per case of disease and for certain risk factors, Data - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
10. Global Burden of Disease (2019). Global Health Data Exchange. https://vizhub.healthdata.org/gbd-results. Accessed September 20, 2023.
11. Zapata-Diomedi, B., Boulangé, C., Giles-Corti, B., Phelan, K., Washington, S., Veerman, L.J., & Gunn, L. (2019). Physical activity-related health and economic benefits of building walkable neighbourhoods: A modelled comparison between brownfield and greenfield developments. International Journal of Behavioural Nutrition and Physical Activity.
12. Khorasani, E., Davari, M., Kebriaeezadeh, A., Fatemi, F., Akbari Sari, A., & Varahrami, V. (2022). A comprehensive review of official discount rates in guidelines of health economic evaluations over time: the trends and roots. The European Journal of Health Economics, 23(9), 1577-1590.

Scenario: replacing car trips under 5km with cycling for commuting trip purposes

This scenario shows the results of replacing car trips under 5km for work related or education purposes with cycling trips for all adults of all ages.

This implies that the selected scenario results in a mode shift in cycling from 1.3% to 7.7% and from 74.7% to 68.2% for car trips taken as either a driver or passenger.

Increases in cycling translate into a shift from 47.9% to 53.2% of the population accumulating the required minutes spent being moderately (150 – 300 mins) or vigorously physically active (75 – 150 mins) or an equivalent combination of both contributing to recommended levels as detailed in the Physical Activity Guidelines.

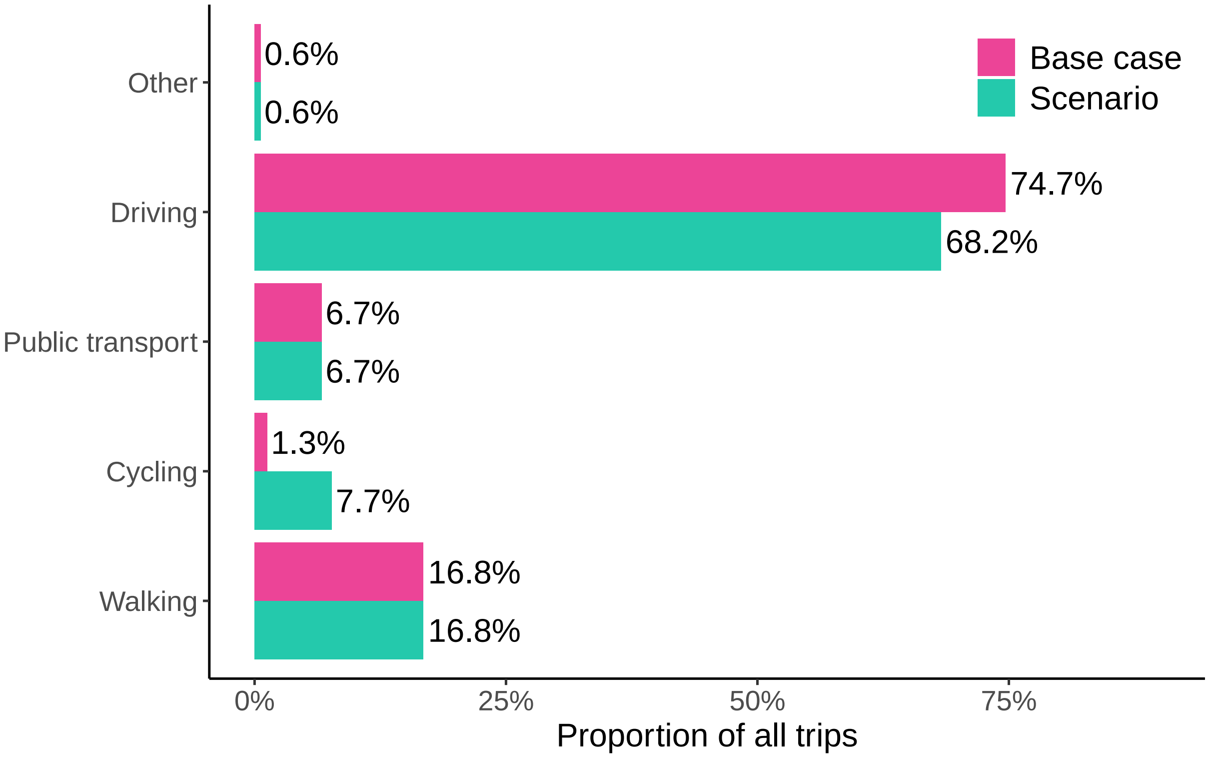

Figure 1: Distribution of base case and scenario trips.

Incidence

Incidence describes the rate of occurrence of new cases of a disease over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of disease prevented, due to increases in physical activity associated with the scenario. Figure 2 presents the change (%) in the disease incidence across the life course. Figure 3 presents how the difference in disease incidence changes over time, by year, using a snapshot of the population from 2019.

Table 1 shows how the scenario impacts the incidence of chronic diseases as both as a percentage and total number of prevented cases.

Table 1. Chronic disease incidence reduction and total number of prevented cases of disease measured across the years of the simulation

Disease*	Incidence of disease is reduced by	Total number of prevented cases of disease aggregated across the simulation
Alzheimer's disease and other dementias	-0.07%	-435
Breast cancer	0.18%	130
All cancers	0.12%	484
Colon cancer	0.02%	21
Chronic myeloid leukemia	0.09%	3
Diabetes type 2	1.01%	3,325
Depression	0.17%	2,735
Head and neck cancer	0.47%	21
Ischemic heart disease	0.27%	2,337
Liver cancer	0.28%	48
Multiple myeloma	0.21%	41
Stomach cancer	0.21%	50
Stroke	0.21%	546
Lung cancer	0.13%	148
Uterine cancer	0.25%	21

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

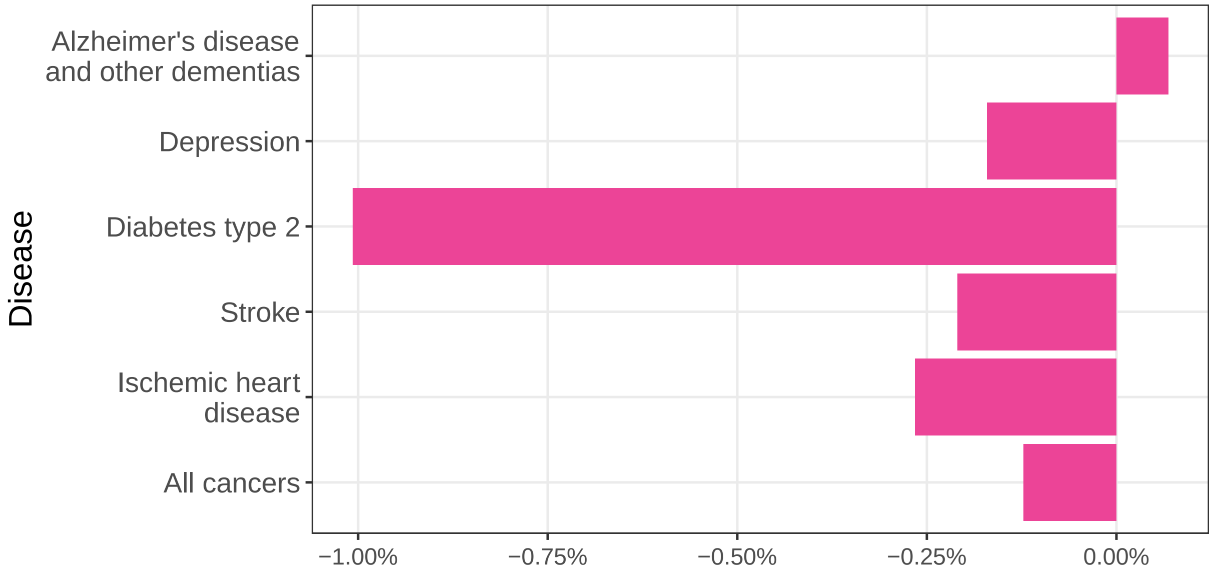

Figure 2.a: Percentage change in incidence by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

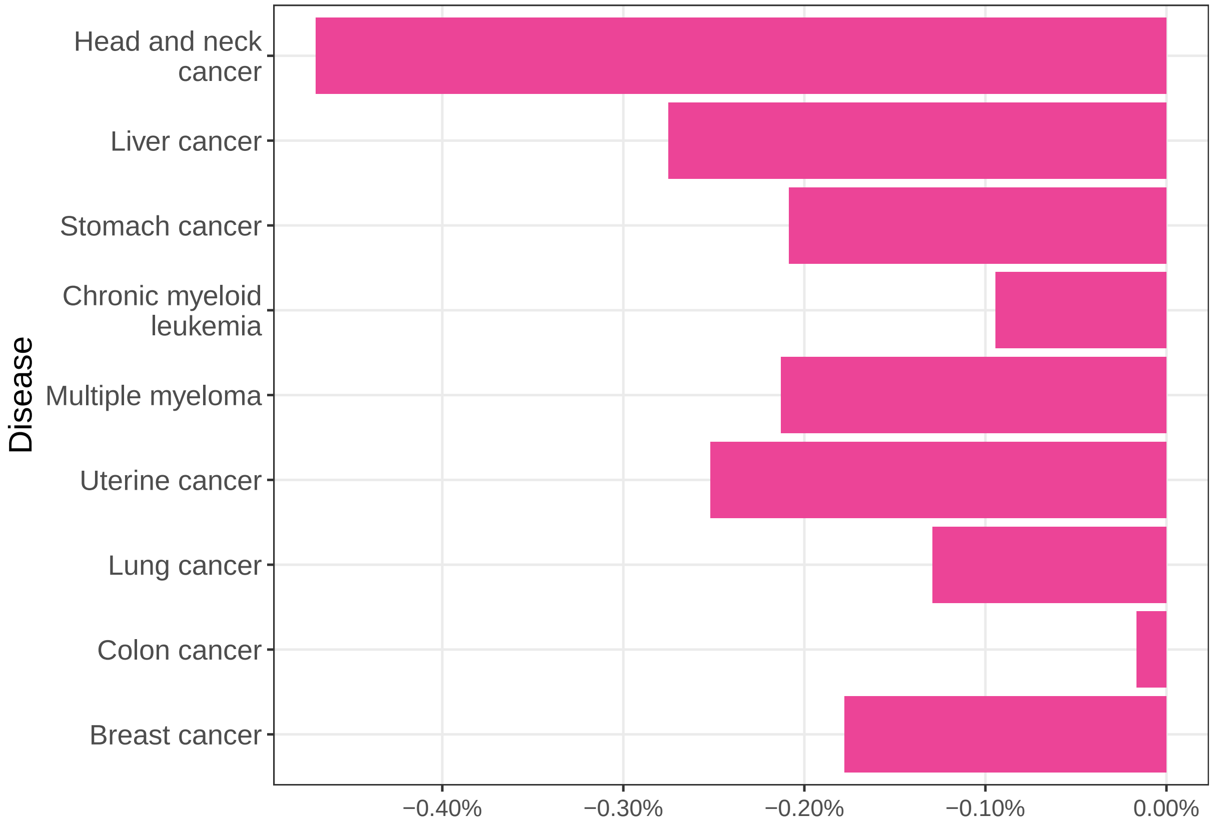

Figure 2.b: Percentage change in incidence for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

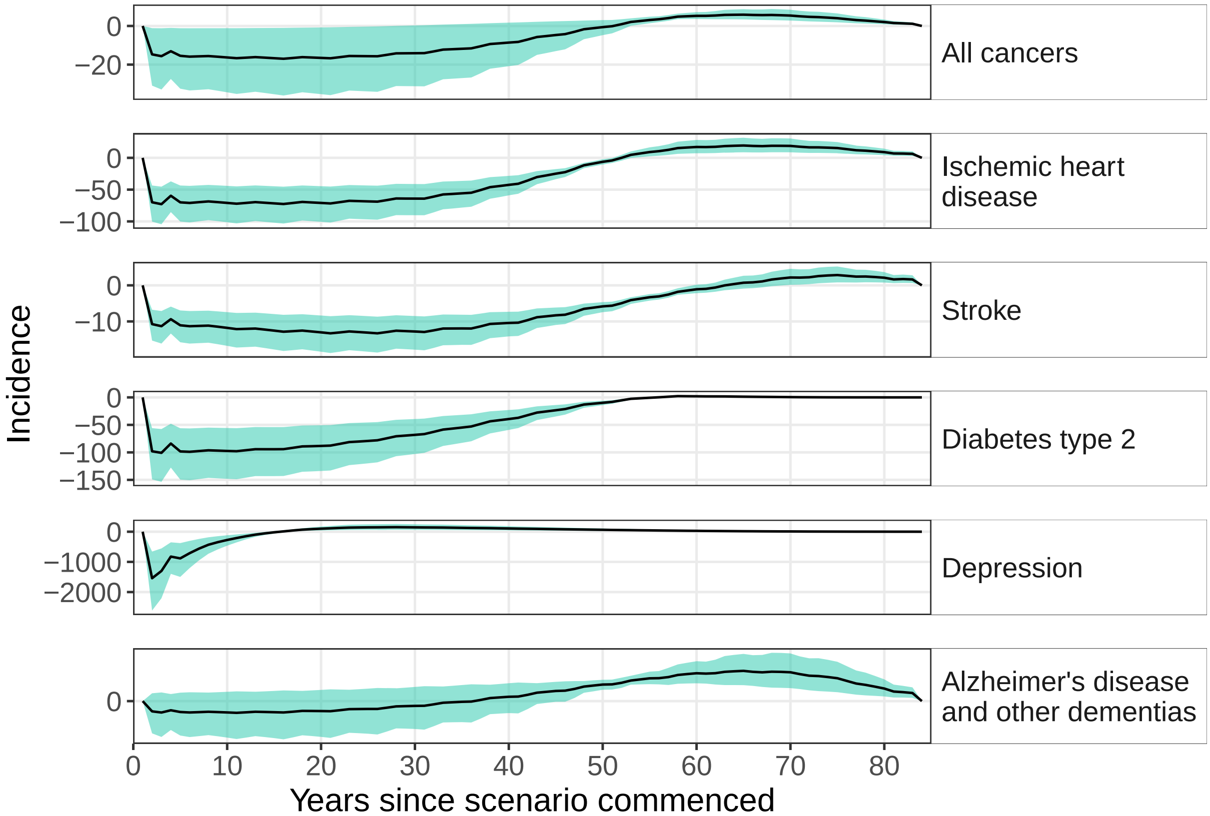

Figure 3.a: The change in incidence over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

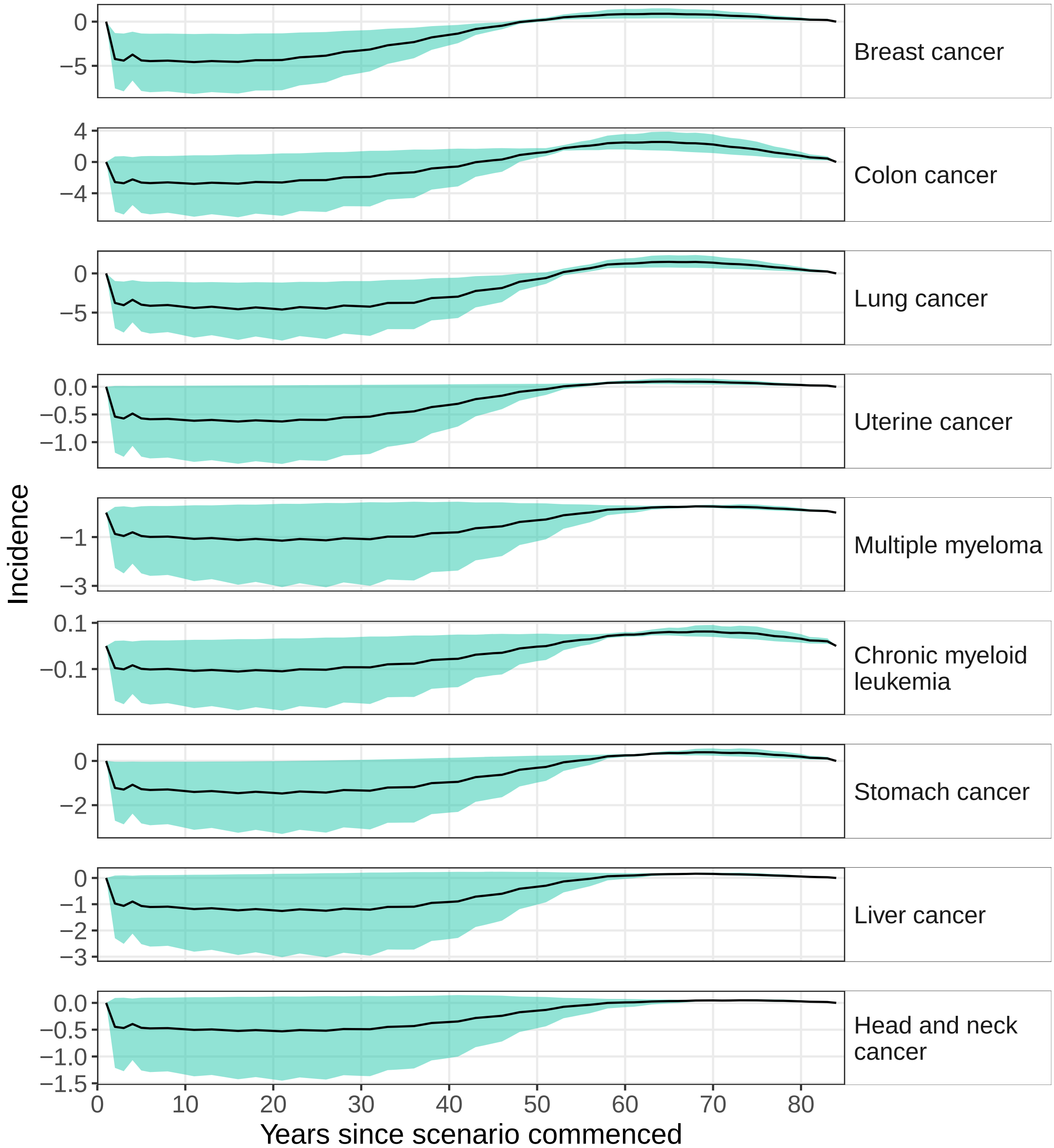

Figure 3.b: Percentage change in incidence for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Mortality

Mortality is the number of deaths due to a given disease over over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of prevented deaths due to increases in physical activity associated with the scenario. Figure 4 presents the total change in mortality over the life course. Figure 5 presents the difference in the number of deaths by year using a snapshot of the population from 2019.

Table 2 shows how the scenario impacts reductions in mortality presented as a percentage and total number of prevented deaths caused by chronic diseases.

Table 2. Percentage reduction in mortality and total number of prevented deaths by chronic disease measured across the years of the simulation.

Disease*	Mortality is reduced by	Total number of prevented deaths aggregated across the simulation
Alzheimer's disease and other dementias	-0.15%	-357
Breast cancer	0.18%	60
All cancers	0.15%	377
Colon cancer	0.03%	13
Chronic myeloid leukemia	0.06%	1
Diabetes type 2	0.92%	453
Depression	0.00%	0
Head and neck cancer	0.50%	20
Ischemic heart disease	0.27%	1,012
Liver cancer	0.28%	47
Multiple myeloma	0.21%	36
Stomach cancer	0.21%	44
Stroke	0.18%	315
Lung cancer	0.13%	139
Uterine cancer	0.22%	16

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

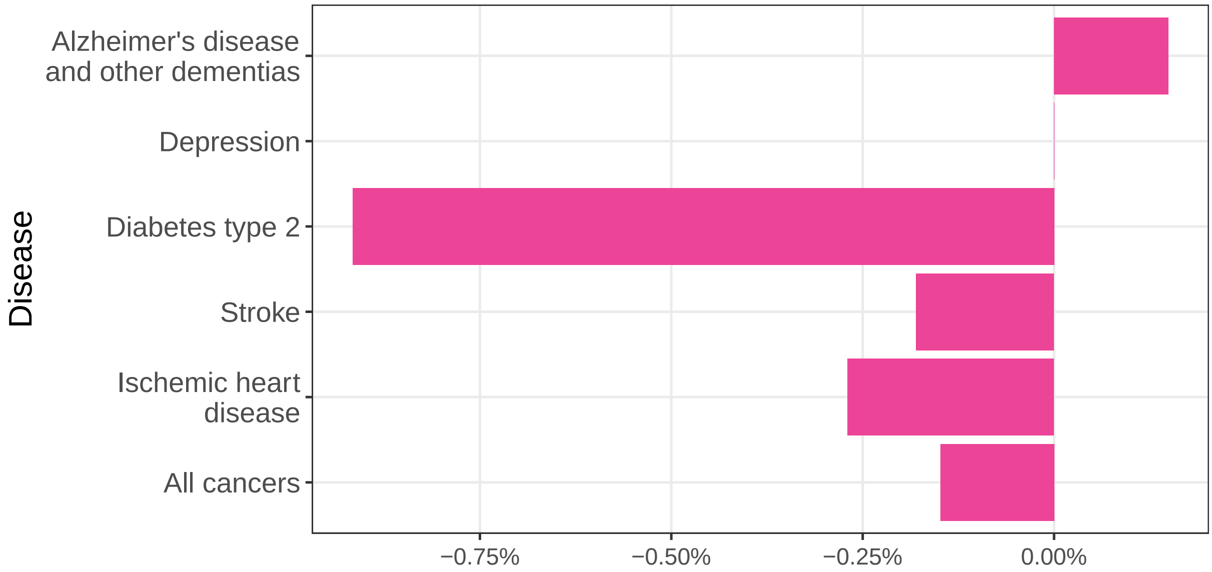

Figure 4.a: Percentage change in mortality by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

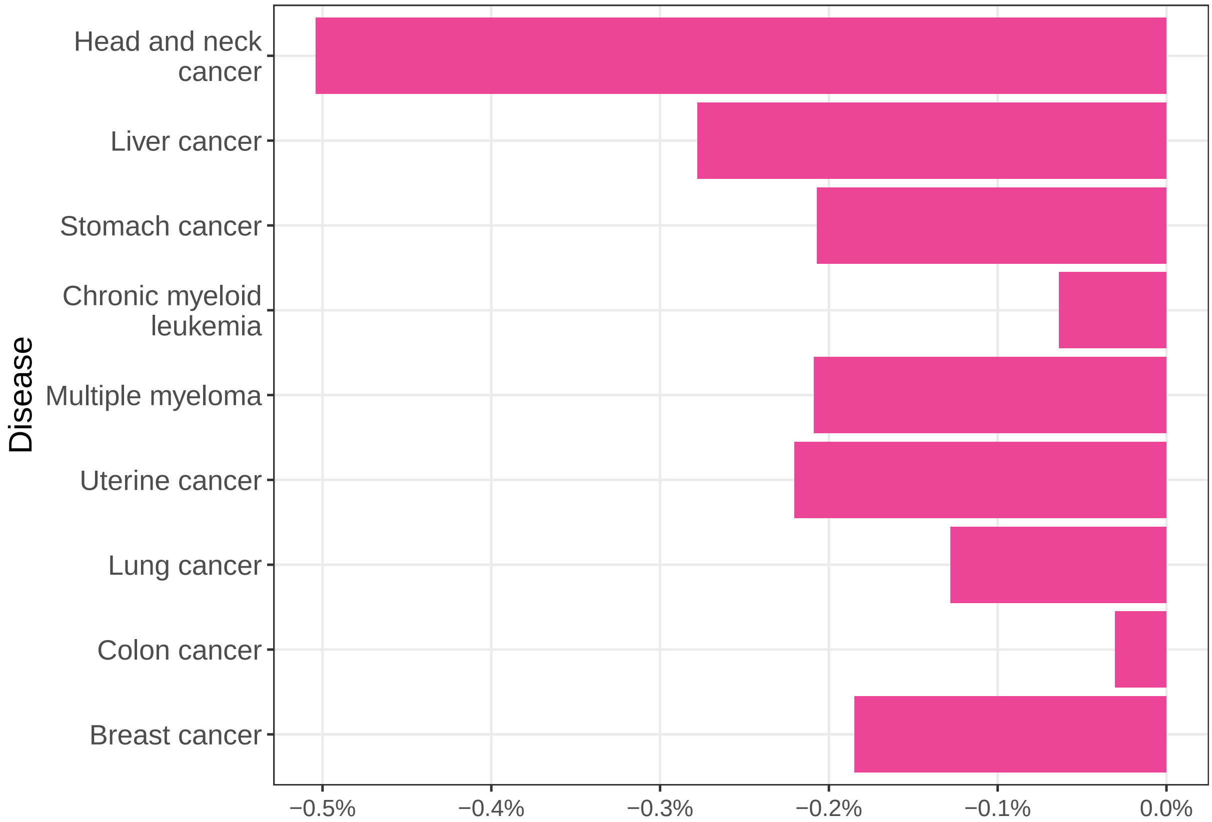

Figure 4.b: Percentage change in mortality for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

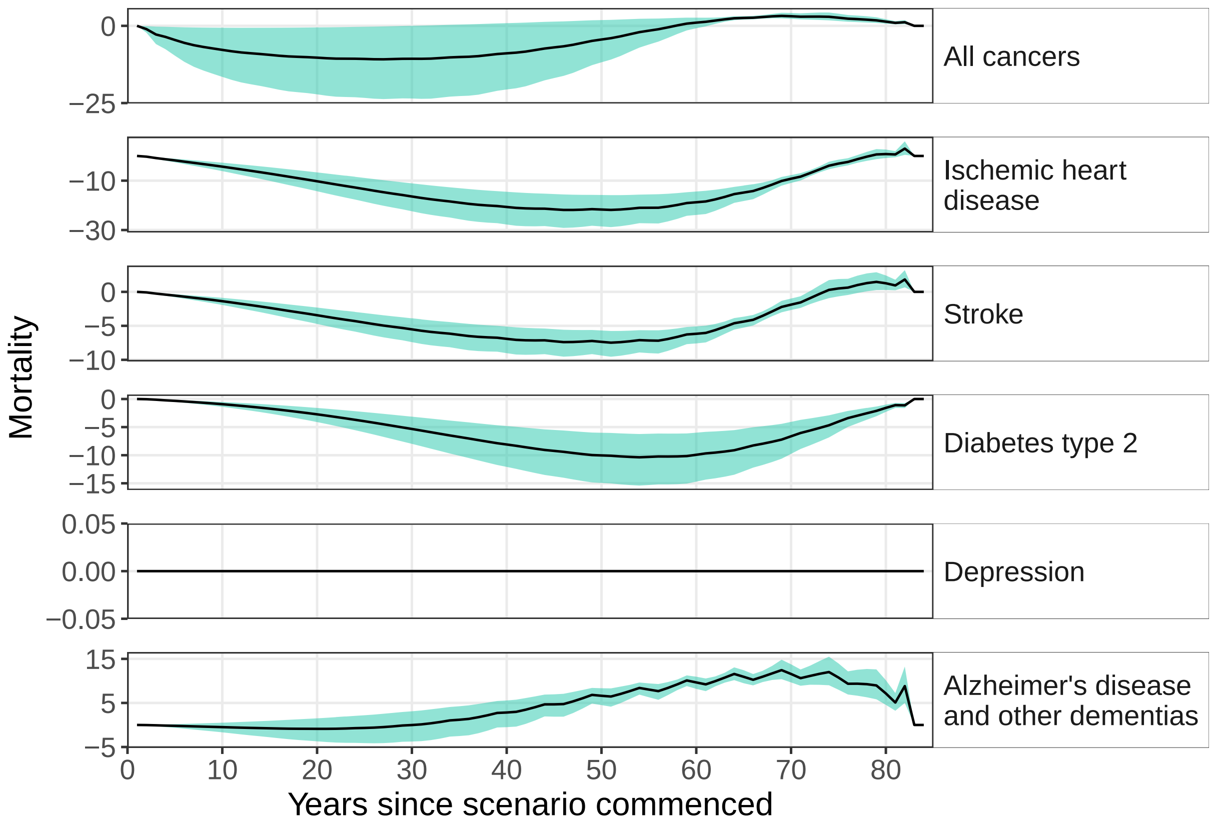

Figure 5.a: The change in mortality over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

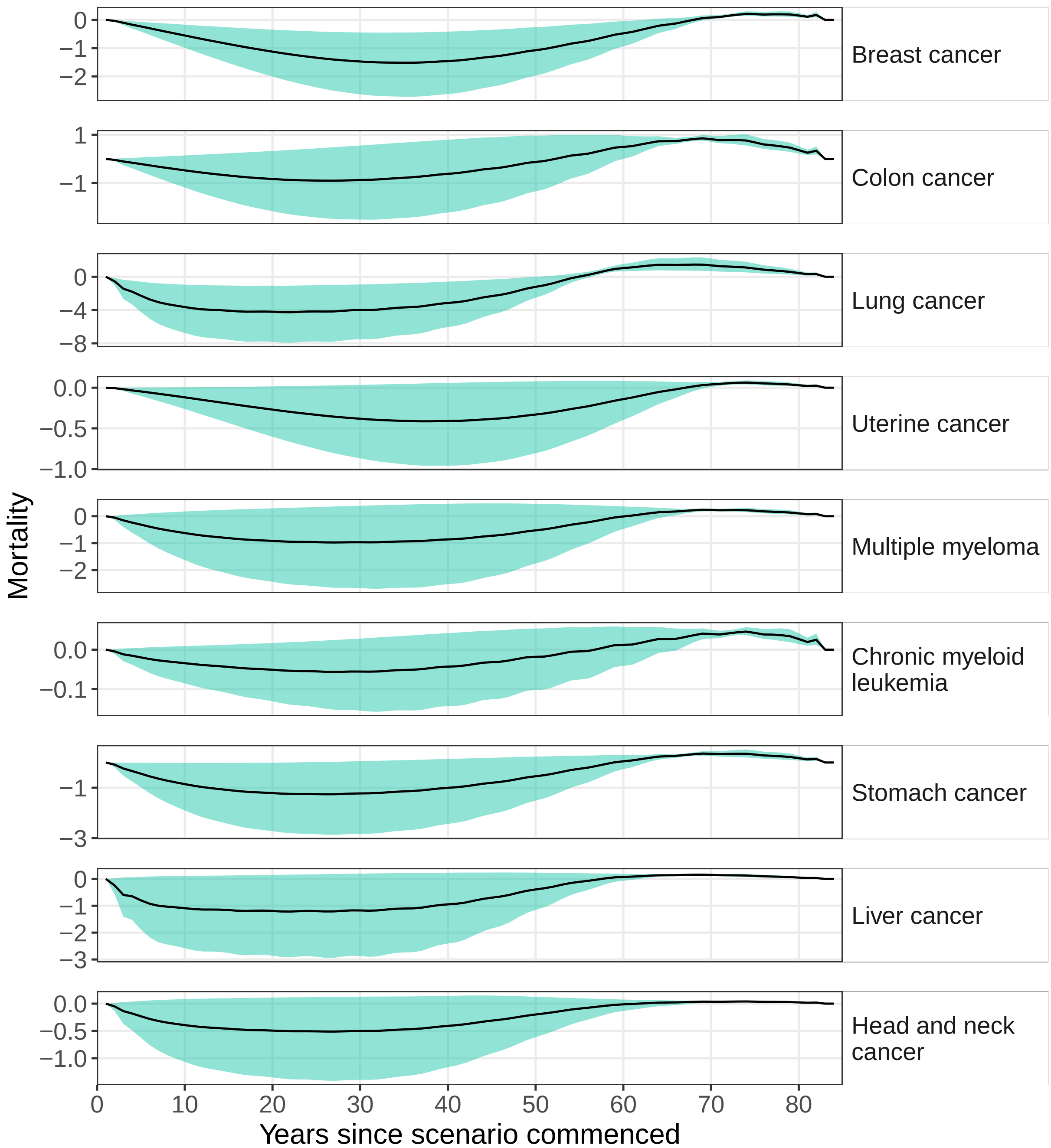

Figure 5.b: Percentage change in mortality for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Health

Figures 6 and 7 below show the change in Health Adjusted Life Years (HALYs)[1] and Life Years[2] for a snapshot of the population from 2019 for the scenario. Both figures show that the greatest gains from increasing physical activity occur midway through the life cycle with most of the gains occurring cumulatively in the long term. The decline from the mid-point onwards is due to individuals dying from natural causes within the model.

HALYS

The model estimates a total of **102,552** HALYs for the scenario population, which is **51** HALYs per 1,000 members of the population.

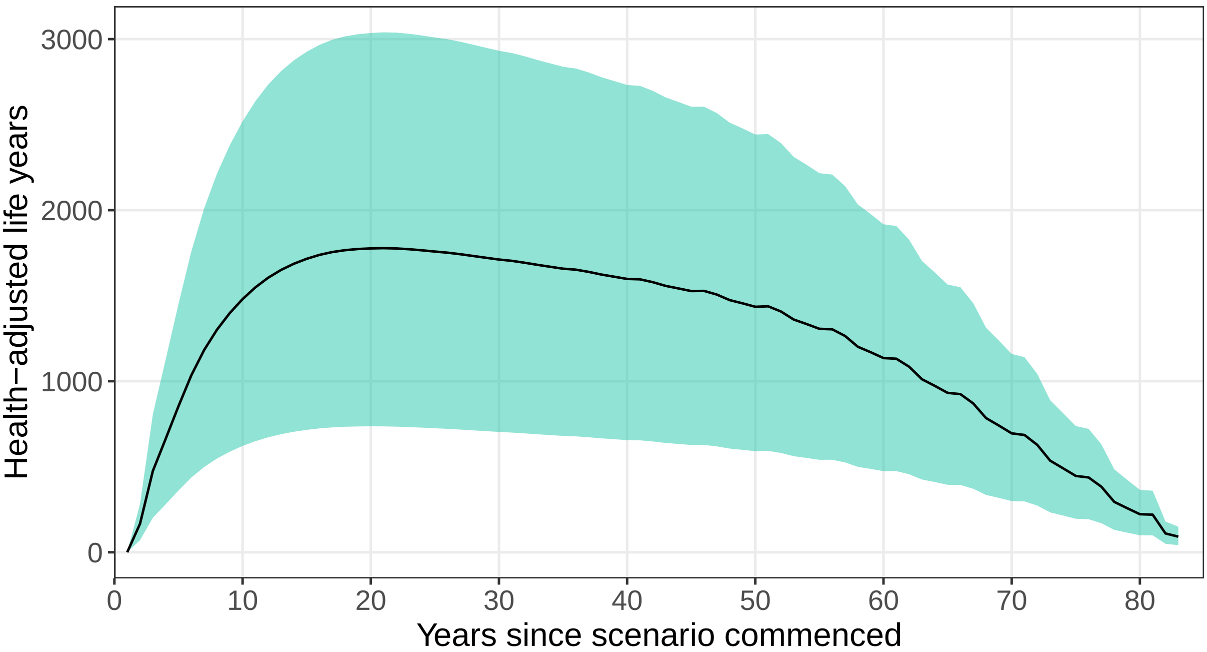

Figure 6. Total health-adjusted life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

[1] Health Adjusted Life Years are holistic measures of health that account for morbidity, mortality and quality of life.

[2] Life Years are similar to a HALYs however they exclude the quality of life component.

Life Years

The model estimates a total of **46,351** Life Years for the scenario population, which is **23** Life Years per 1,000 members of the population.

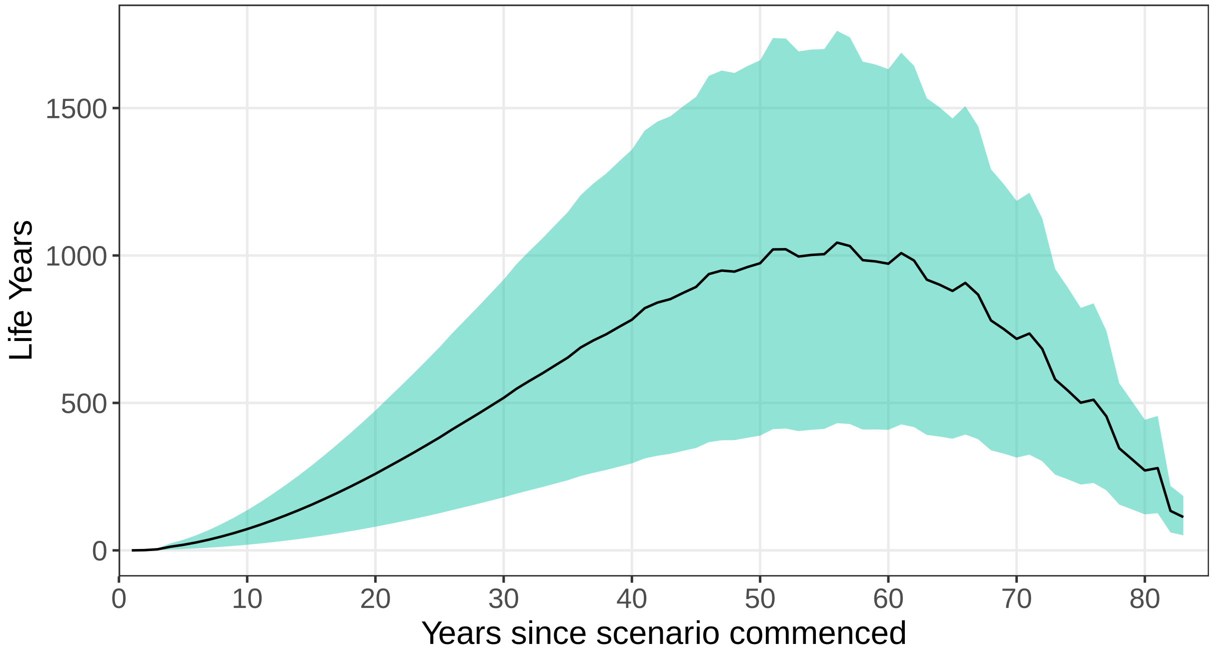

Figure 7. Total life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Value

The value of improvements to community health can be calculated**[a]** by translating the Health Adjusted Life Years (HALYs) from each scenario into dollar terms using the value of a statistical life year**[b]**. The value of a statistical life year is an estimate of the amount a society is willing to trade to reduce the risk of death for one year.

In the simulation model, HALYs are generated across time and are cumulative. Thus, to help us understand the value of HALYs across time in present day terms, it is necessary to use discounting**[c]** to reduce HALYs generated at the future point in time. Discounted HALYs from these future points can be added up to give the aggregate value of HALYs in today's terms as a measure of the value of improvements to community health arising from the chosen scenario.

The size of the discount rate can impact the aggregated value of HALYs and there is considerable debate on what discount rates should be used (with some arguing that health should not be discounted at all).[2] Hence, it is common to use a variety of discount rates to allow for differing risks, preferences and sensitivity when valuing health. The figures presented below were calculated using discount rates of 3%, 5% and 7% based on recent recommendations [3, 4] and represent the value of HALYs in present day terms resulting from an increase in physical activity from the chosen scenario.

The value of improvements to community health

The model estimates a total of **HALYs,** Health Adjusted Life Years (HALYs) gained for the scenario population, which is **51** HALYs per 1,000 members of the scenario population. The figures below represent the value of improvements to community health from the chosen scenario. These figures can be used in summary reports and for advocacy purposes**[d]**.

The HALYs gained in this scenario have a statistical value of:

- **4,318,397** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **2,718,972** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **1,866,171** per 1,000 members of the population, when calculated using a discount rate of 7%.

a. What is meant by value and how can it be measured?

Value is conceptual and measures a sense of worth or usefulness of something to individuals or to a society. Measuring the value of something, such as health, enables it to be included in assessments or analyses such as cost-benefit analyses to recognise its relative importance.

Value can be derived in many ways and a common approach is to use monetary terms, such as dollars. Valuing something using dollars is not the same as equating it with its price. Prices represent the amount at which something can be traded, prices therefore represent the amount of money for buying or selling something such as food, clothing or to pay bills. One way is to evaluate health in dollar terms is to use the Value of a Statistical Life and Value of a Statistical Life Year**[b]**.

b. What is the Value of a Statistical Life and Value of a Statistical Life Year?

The value of a **statistical life** is the estimated amount that a society is willing to trade to reduce the risk of death. The word 'Statistical' refers to the average value for life and therefore means the value of a statistical life doesn't relate to any specific individual. This value can change across risk factors and different societies who may value life differently. There are various ways of measuring the value of a statistical life with most approaches using revealed or stated preference approaches.[3] In Australia, the Office of Best Practice Regulation estimates a statistical life at $5.3M in 2022 dollar terms, and assumes that the life is of a young person with at least another 40 years to live.[5, 6]

Value of a Statistical Life Year

The value of a statistical life year is the estimated amount that a society is willing to trade to reduce the risk of death over **one year.** It can be derived from the value of a statistical life or measured directly using surveys or willingness to pay techniques.[5] The current value of a **statistical life year** is $227,000 in 2022 dollars based on current estimates from the Office of Best Practice Regulation.[6] The value of a statistical life year is useful for evaluating small increases in life years instead of evaluating full life expectancy. It is appropriate for valuing the Health Adjusted Life Years estimated from the scenarios and modelling presented in this tool. For the modelling and results presented here, the value of $227,000 was converted to 2019 dollars based on the Wage Price Index for Brisbane.

c. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

d. Application in advocacy and reporting

This section uses figures to show how the value of community health (estimated from HALYs and the value of statistical life year) can be used for reporting and advocacy purposes.

The simulation model uses **population-based estimates** for disease morbidity and mortality and is best applied to larger groups of people. It also assumes that the people of interest have similar characteristics and behaviours to the population data used in the simulation model and scenarios. The **example** below shows results from a scenario that replaces car trips with walking trips for distances of 0-2 km for All age groups.

Example:

The HALYs gained in this scenario have a statistical value of:

- **$10,859,605** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **$6,662,541** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **$4,533,392** per 1,000 members of the population, when calculated using a discount rate of 7%.

This **example** shows that the HALYs gained in this scenario have a statistical value of $10,859,605 per 1,000 members of the population using a discount of 3%.

This figure can be divided by 1,000 to give a per person figure. Once a per person figure is established, it can be multiplied by the number of people in any population size of interest for use in reports or as evidence to advocate for benefits associated with shifts to active transport modes.

$10,859,605 / 1,000 = $10,859.61 per person value

A good example of how this model can be applied links to previous research that investigated the impact of new more walkable development in Altona North on a population of 21,000 people [11]. If we assume that these people have similar characteristics to the underlying population based estimates and behaviours based on the travel survey data in the simulation model underlying this tool, then the value of community health according to the chosen scenario can be calculated as:

21,000 (people) x $10,859 (statistical value from HALYs gained) = $228 M.

Savings

An increase in physical activity due to the chosen scenario reduces chronic disease cases across a lifetime and reduces spending for each disease within the health care system resulting in overall health care cost savings**[a]**.

Table 3 provides estimated health care cost savings associated with the prevented cases of chronic diseases per 1,000 members of the population according to the selected scenario. These figures are based on applying average health care system costs per prevalent case of disease and using three alternative discount rates**[b]**:

Table 3. Total health care cost savings by disease per 1,000 members of the population.

Disease	3% discount rate	5% discount rate	7% discount rate
Alzheimer's disease and other dementias	$1,039	$750	$534
Breast cancer	$40,858	$24,875	$16,179
All cancers	$72,678	$45,965	$30,786
Colon cancer	$11,880	$8,172	$5,712
Chronic myeloid leukemia	$2,785	$1,695	$1,107
Diabetes type 2	$27,451	$15,935	$10,035
Depression	$139,915	$101,720	$76,609
Head and neck cancer	$553	$378	$272
Ischemic heart disease	$44,377	$25,905	$16,373
Liver cancer	$541	$375	$274
Multiple myeloma	$7,170	$4,640	$3,188
Stomach cancer	$2,921	$1,903	$1,316
Stroke	$5,657	$3,307	$2,090
Lung cancer	$4,005	$2,723	$1,951
Uterine cancer	$1,957	$1,205	$792

a. What do we mean by health care cost savings?

To calculate health care cost savings for each disease, the annual costs for each disease in each year is multiplied by the number of prevented cases of each disease for each scenario. This results in a total saving in spending for each disease by year. The savings in spending for future years are discounted**[b]** with annual savings aggregated to give a total amount saved for each disease. Total savings are presented as the amount saved per 1,000 members of the population to enable comparisons against populations of different sizes.

We use the term **health care cost saving** because it represents a reduction in health spending. However, the Australian Institute of Health and Welfare (AIHW) stress that the term cost is broad and not representative of the full cost experienced by individuals, families, or the health system, consequently AIHW use the term spending.[8]

These figures use AIHW estimates of the amounts spent through the health system in 2018-19 for each case of disease. This is extracted from Health system spending per case of disease and for certain risk factors, Table 1 – Estimates of health system spending per case, by burden of disease group, condition and sex, Australia 2018-2019.[9]. For head and neck cancers, supplementary figures were obtained from the Global Burden of Disease incidence data.[10]

b. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

References

1. Gold, M. R., Stevenson, D., & Fryback, D. G. (2002). *HALYS and QALYS and DALYS, Oh My: similarities and differences in summary measures of population Health.* Annual review of public health, 23(1), 115-134.
2. Attema, A.E., Brouwer, W.B. & Claxton, K. (2018). *Discounting in economic evaluations.* Pharmacoeconomics. 36: p. 745-758.
3. Ananthapavan, J., Moodie, M., Milat, A.J., & Carter, R. (2021). *Systematic review to update 'value of a statistical life' estimates for Australia.* International journal of environmental research and public health, 2021. 18(11): p. 6168.
4. Terrill, M. & Batrouney, H. (2018). *Unfreezing discount rates: Transport infrastructure for tomorrow.* Grattan Institute.
5. Abelson, P. (2008). *Establishing a monetary value for lives saved: issues and controversies.* Canberra: Office of Best Practice Regulation, Department of Finance and Deregulation.
6. Department of the Prime Minister and Cabinet. (2022). *Best practice regulation guidance note: Value of statistical life.* Australian Government.
7. Haacker, M., Hallett, T.B. & Atun, R. (2020). *On discount rates for economic evaluations in global health.* Health Policy and Planning, 2020. 35(1): p. 107-114.
8. Australian Institute of Health and Welfare (2023). Technical Notes: Estimating Spending per prevalent case of disease. Health system spending per case of disease and for certain risk factors, Estimating the spending per prevalent case of disease - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
9. Australian Institute of Health and Welfare (2023). Health system spending per case of disease and for certain risk factors. Health system spending per case of disease and for certain risk factors, Data - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
10. Global Burden of Disease (2019). Global Health Data Exchange. https://vizhub.healthdata.org/gbd-results. Accessed September 20, 2023.
11. Zapata-Diomedi, B., Boulangé, C., Giles-Corti, B., Phelan, K., Washington, S., Veerman, L.J., & Gunn, L. (2019). Physical activity-related health and economic benefits of building walkable neighbourhoods: A modelled comparison between brownfield and greenfield developments. International Journal of Behavioural Nutrition and Physical Activity.
12. Khorasani, E., Davari, M., Kebriaeezadeh, A., Fatemi, F., Akbari Sari, A., & Varahrami, V. (2022). A comprehensive review of official discount rates in guidelines of health economic evaluations over time: the trends and roots. The European Journal of Health Economics, 23(9), 1577-1590.

Scenario: replacing car trips under 10km with cycling for commuting trip purposes

This scenario shows the results of replacing car trips under 10km for work related or education purposes with cycling trips for all adults of all ages.

This implies that the selected scenario results in a mode shift in cycling from 1.3% to 13.8% and from 74.7% to 62.2% for car trips taken as either a driver or passenger.

Increases in cycling translate into a shift from 47.9% to 58.0% of the population accumulating the required minutes spent being moderately (150 – 300 mins) or vigorously physically active (75 – 150 mins) or an equivalent combination of both contributing to recommended levels as detailed in the Physical Activity Guidelines.

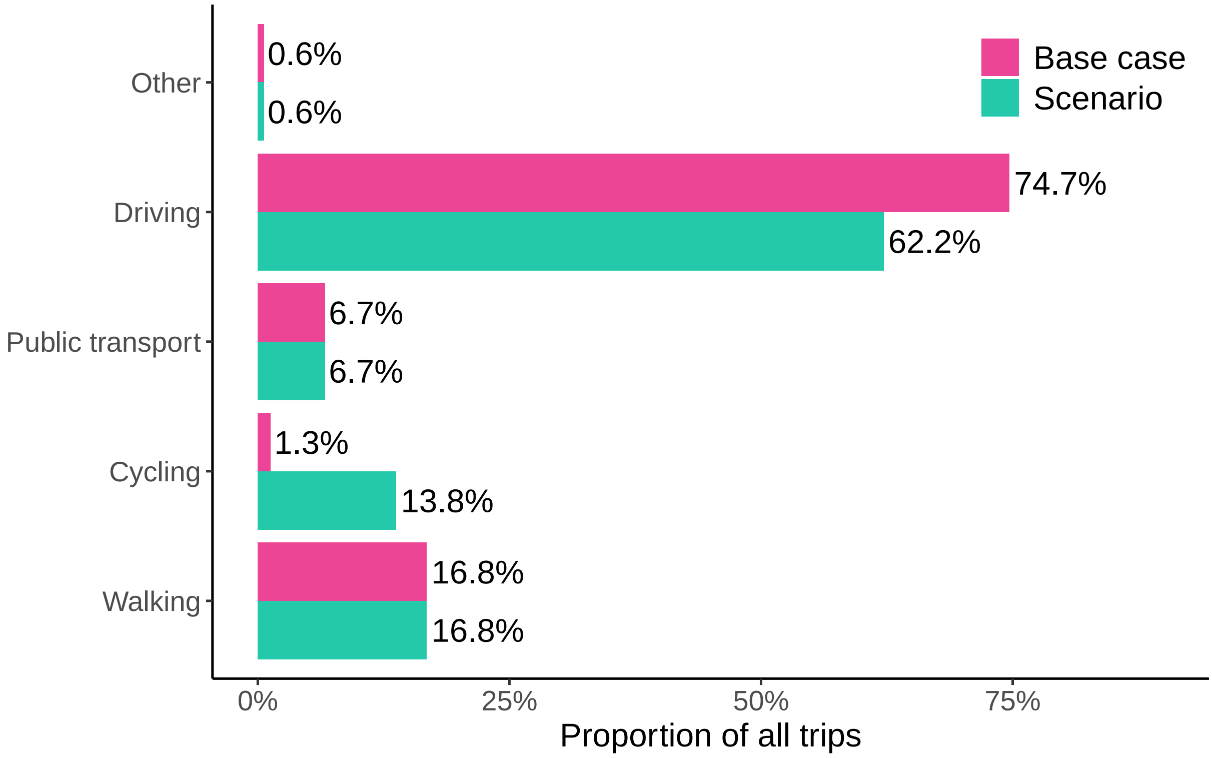

Figure 1: Distribution of base case and scenario trips.

Incidence

Incidence describes the rate of occurrence of new cases of a disease over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of disease prevented, due to increases in physical activity associated with the scenario. Figure 2 presents the change (%) in the disease incidence across the life course. Figure 3 presents how the difference in disease incidence changes over time, by year, using a snapshot of the population from 2019.

Table 1 shows how the scenario impacts the incidence of chronic diseases as both as a percentage and total number of prevented cases.

Table 1. Chronic disease incidence reduction and total number of prevented cases of disease measured across the years of the simulation

Disease*	Incidence of disease is reduced by	Total number of prevented cases of disease aggregated across the simulation
Alzheimer's disease and other dementias	-0.15%	-958
Breast cancer	0.39%	283
All cancers	0.24%	943
Colon cancer	0.03%	37
Chronic myeloid leukemia	0.14%	4
Diabetes type 2	2.06%	6,796
Depression	0.34%	5,468
Head and neck cancer	0.92%	40
Ischemic heart disease	0.53%	4,677
Liver cancer	0.56%	99
Multiple myeloma	0.37%	73
Stomach cancer	0.40%	95
Stroke	0.40%	1,040
Lung cancer	0.24%	271
Uterine cancer	0.50%	42

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

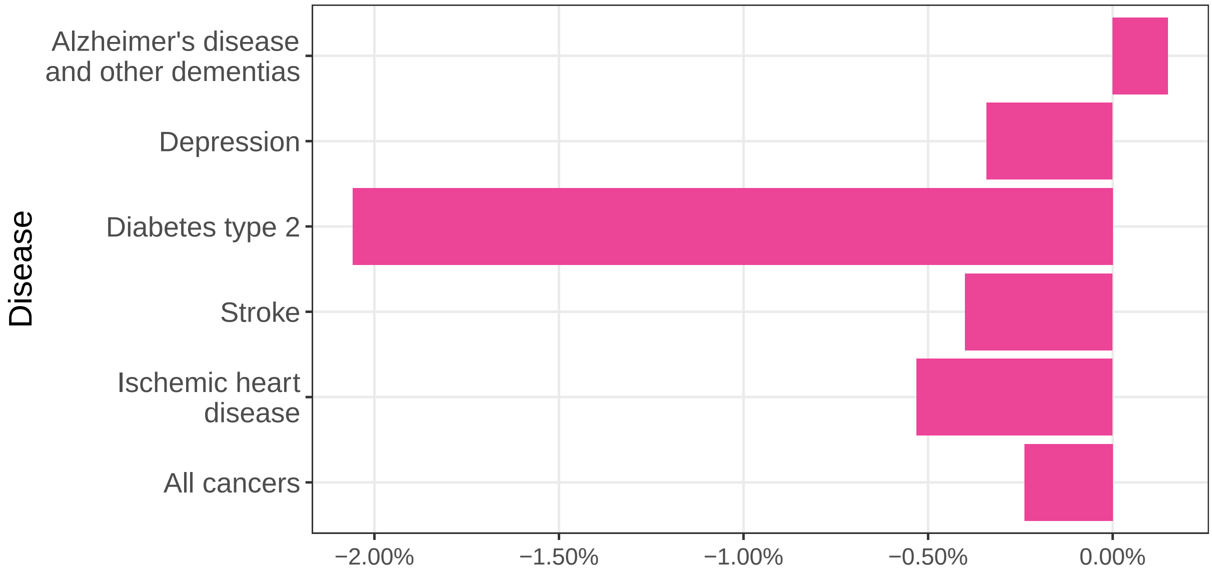

Figure 2.a: Percentage change in incidence by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

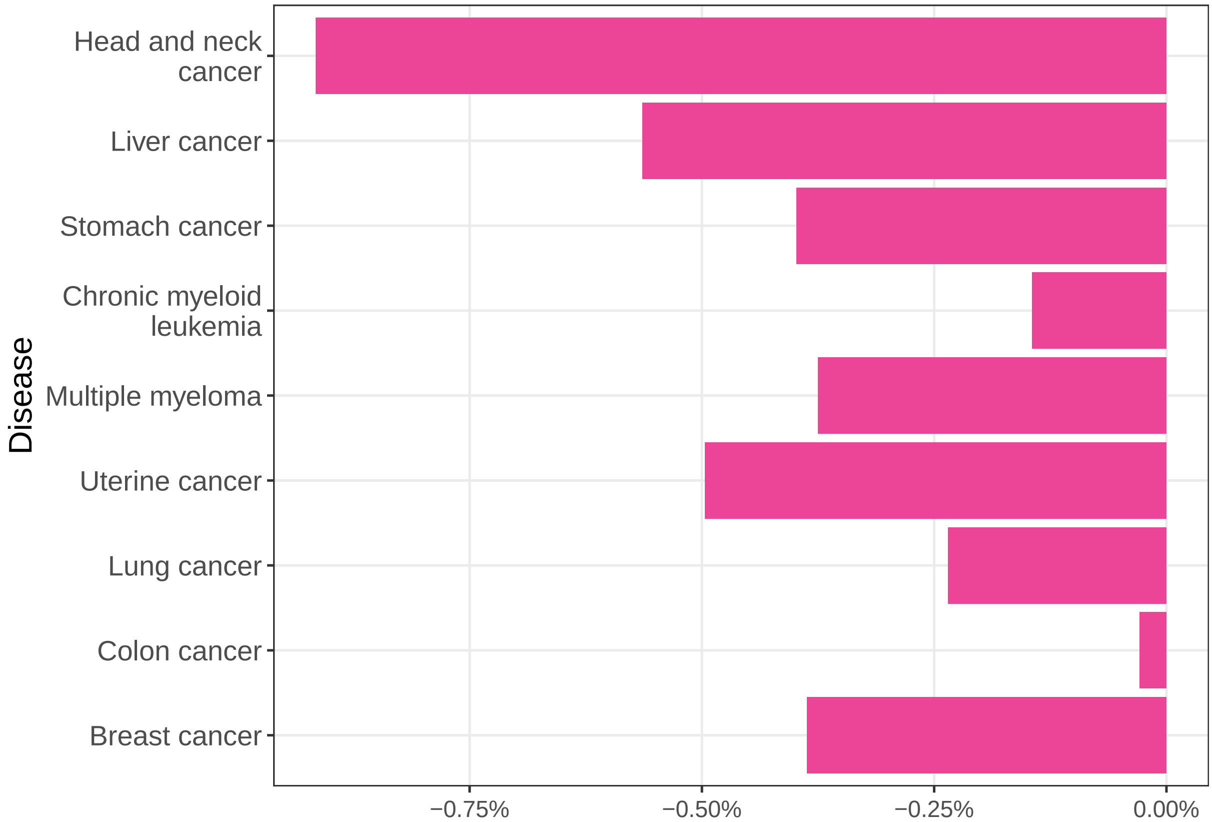

Figure 2.b: Percentage change in incidence for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

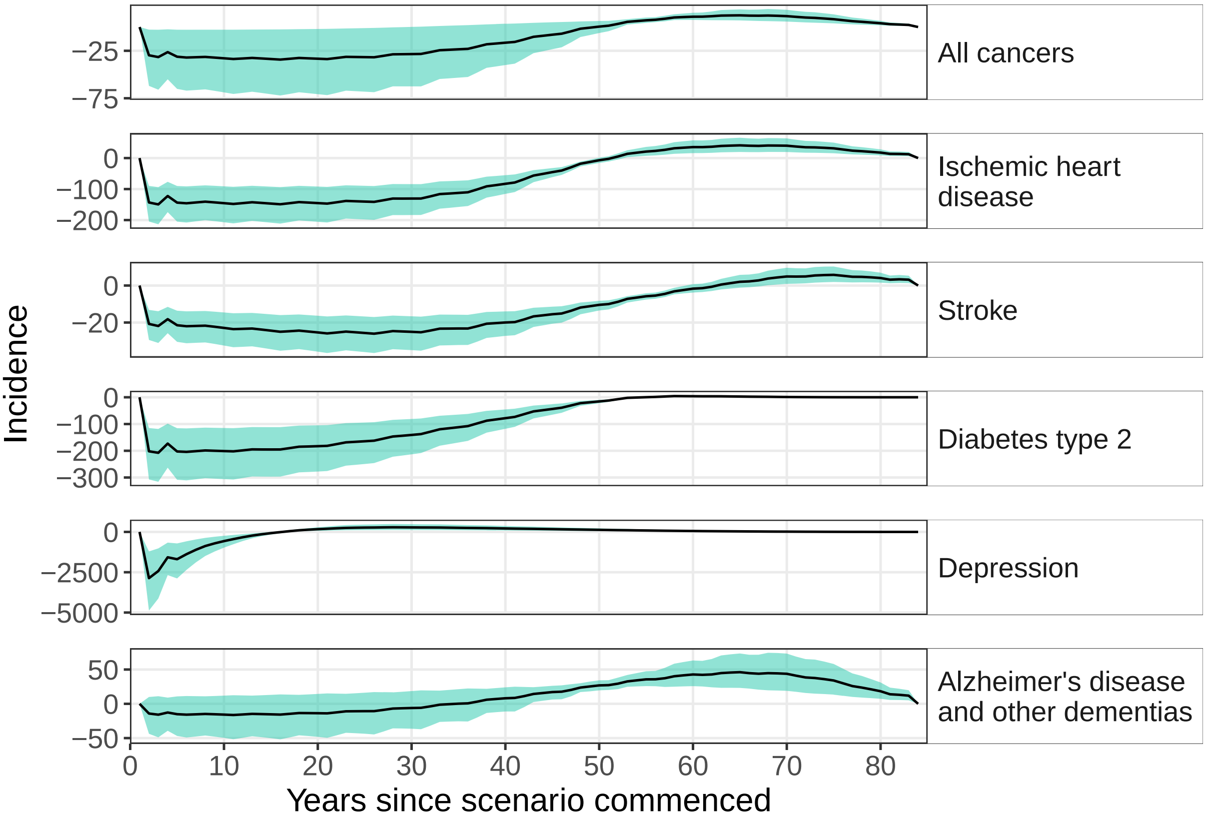

Figure 3.a: The change in incidence over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

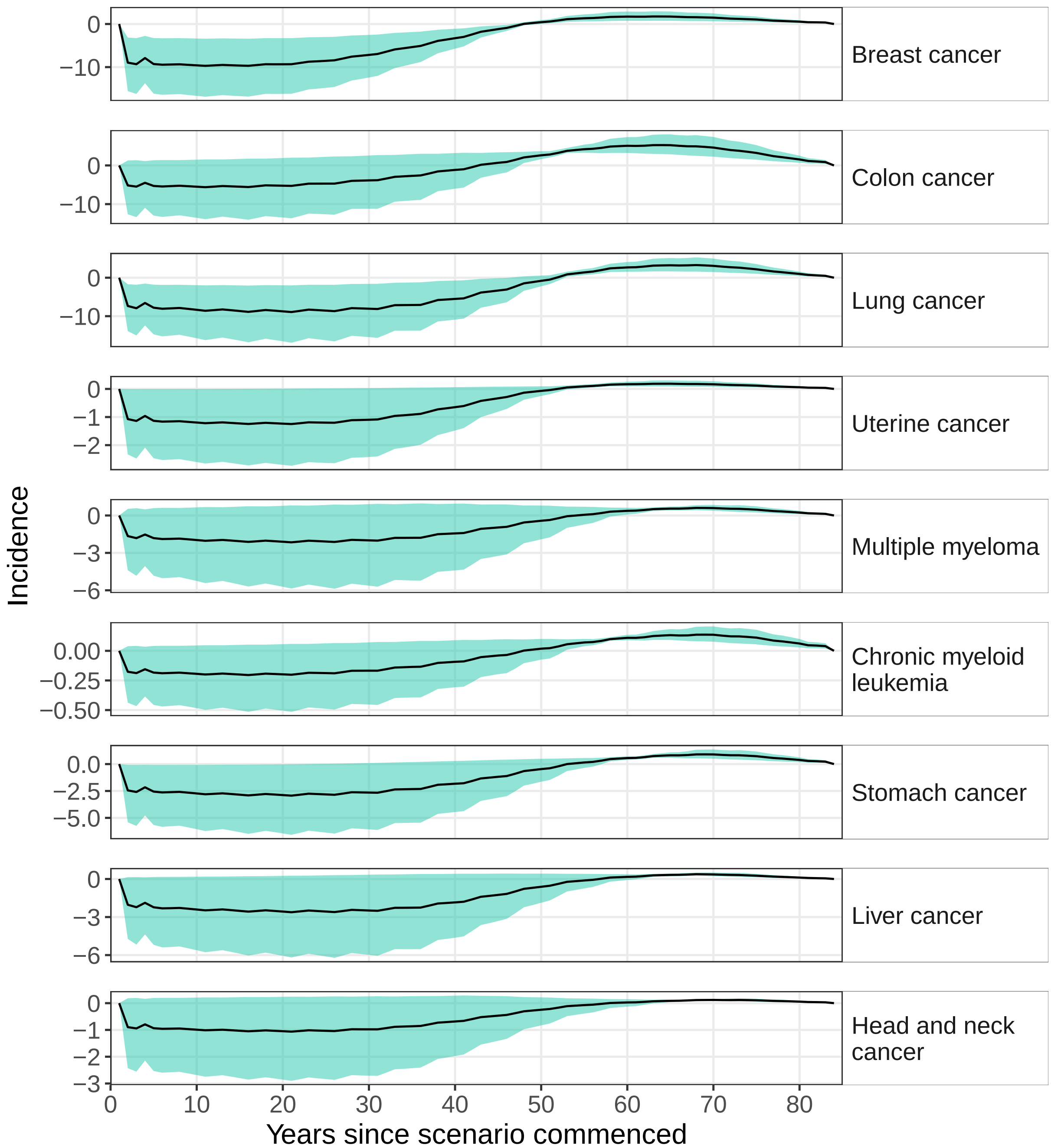

Figure 3.b: Percentage change in incidence for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Mortality

Mortality is the number of deaths due to a given disease over over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of prevented deaths due to increases in physical activity associated with the scenario. Figure 4 presents the total change in mortality over the life course. Figure 5 presents the difference in the number of deaths by year using a snapshot of the population from 2019.

Table 2 shows how the scenario impacts reductions in mortality presented as a percentage and total number of prevented deaths caused by chronic diseases.

Table 2. Percentage reduction in mortality and total number of prevented deaths by chronic disease measured across the years of the simulation.

Disease*	Mortality is reduced by	Total number of prevented deaths aggregated across the simulation
Alzheimer's disease and other dementias	-0.31%	-748
Breast cancer	0.42%	136
All cancers	0.29%	732
Colon cancer	0.06%	26
Chronic myeloid leukemia	0.09%	2
Diabetes type 2	1.89%	935
Depression	0.00%	0
Head and neck cancer	0.99%	39
Ischemic heart disease	0.54%	2,023
Liver cancer	0.57%	97
Multiple myeloma	0.36%	64
Stomach cancer	0.40%	84
Stroke	0.34%	599
Lung cancer	0.23%	253
Uterine cancer	0.44%	32

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

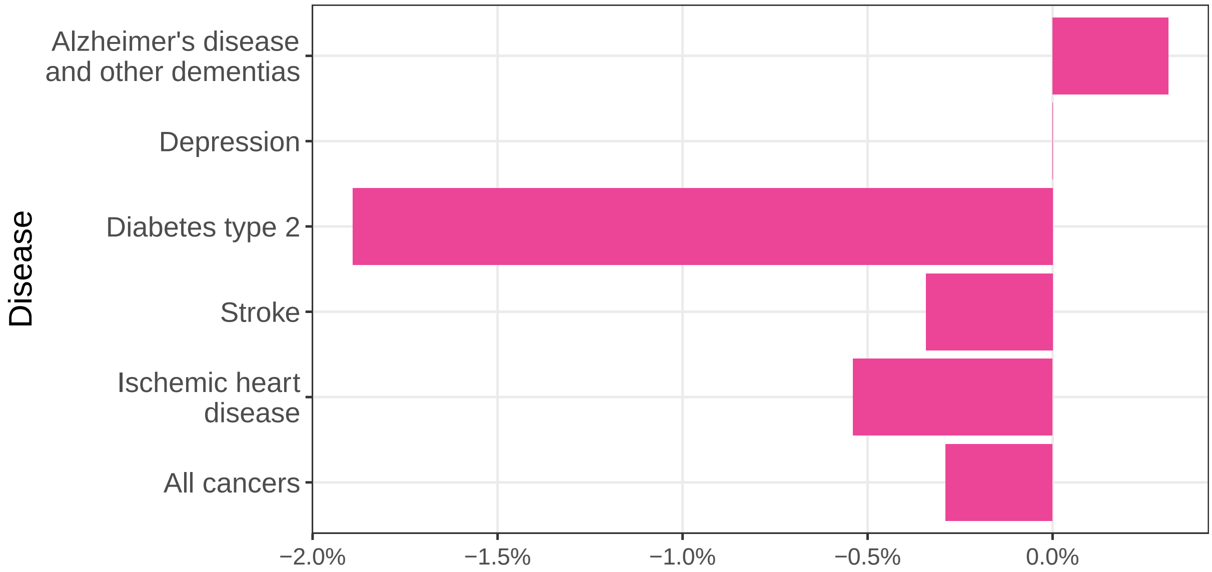

Figure 4.a: Percentage change in mortality by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

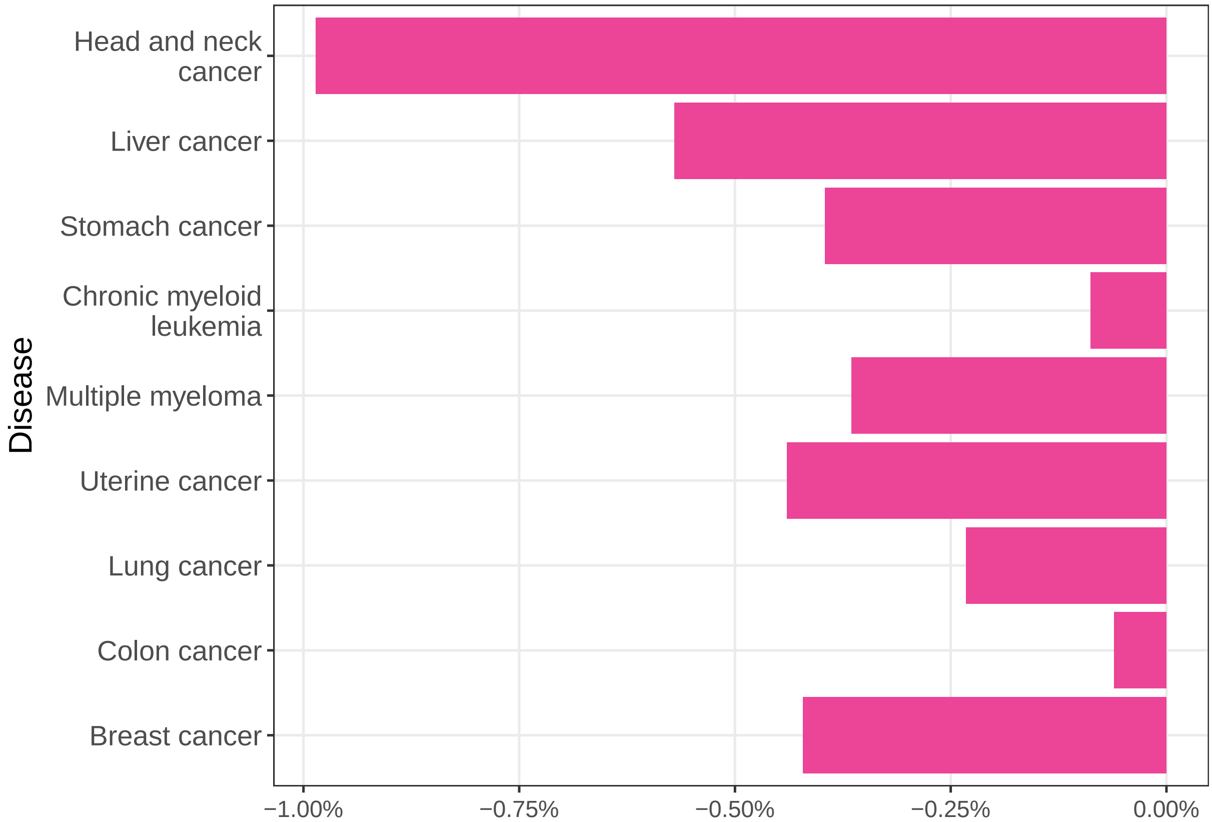

Figure 4.b: Percentage change in mortality for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

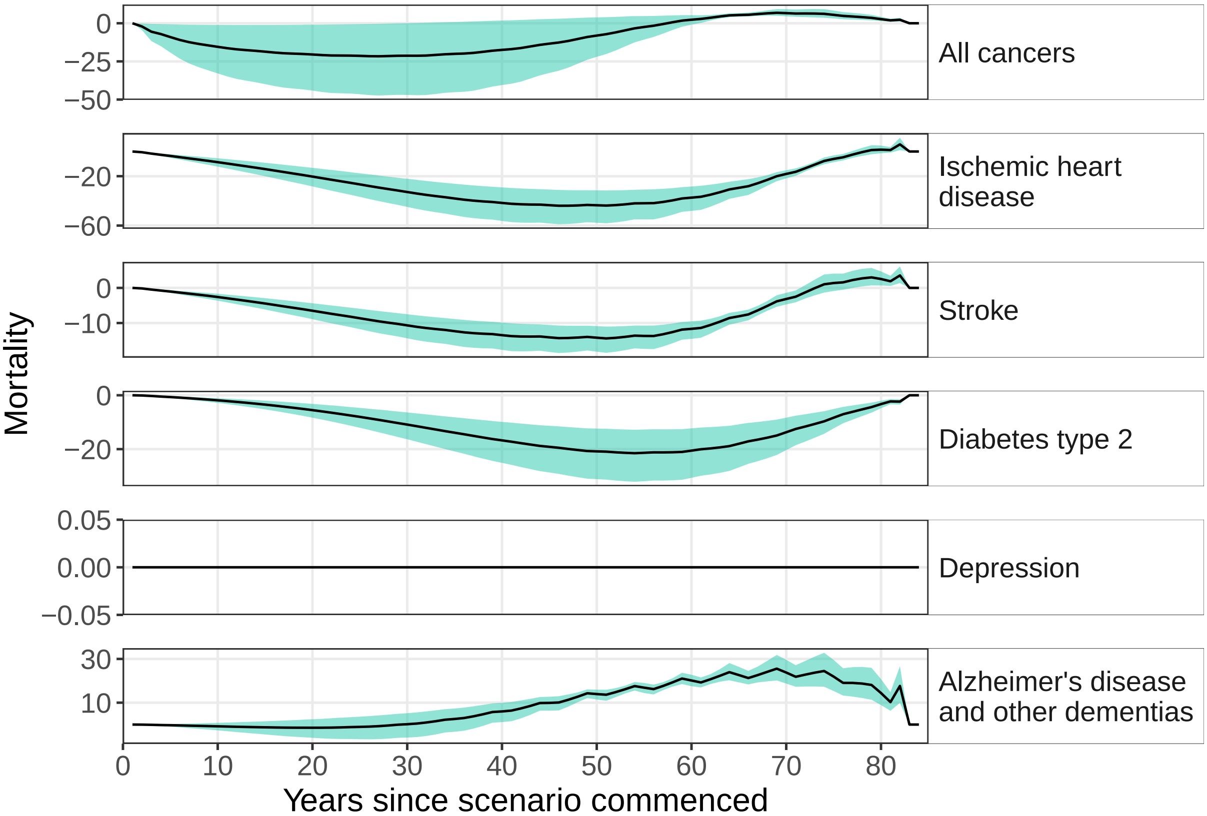

Figure 5.a: The change in mortality over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

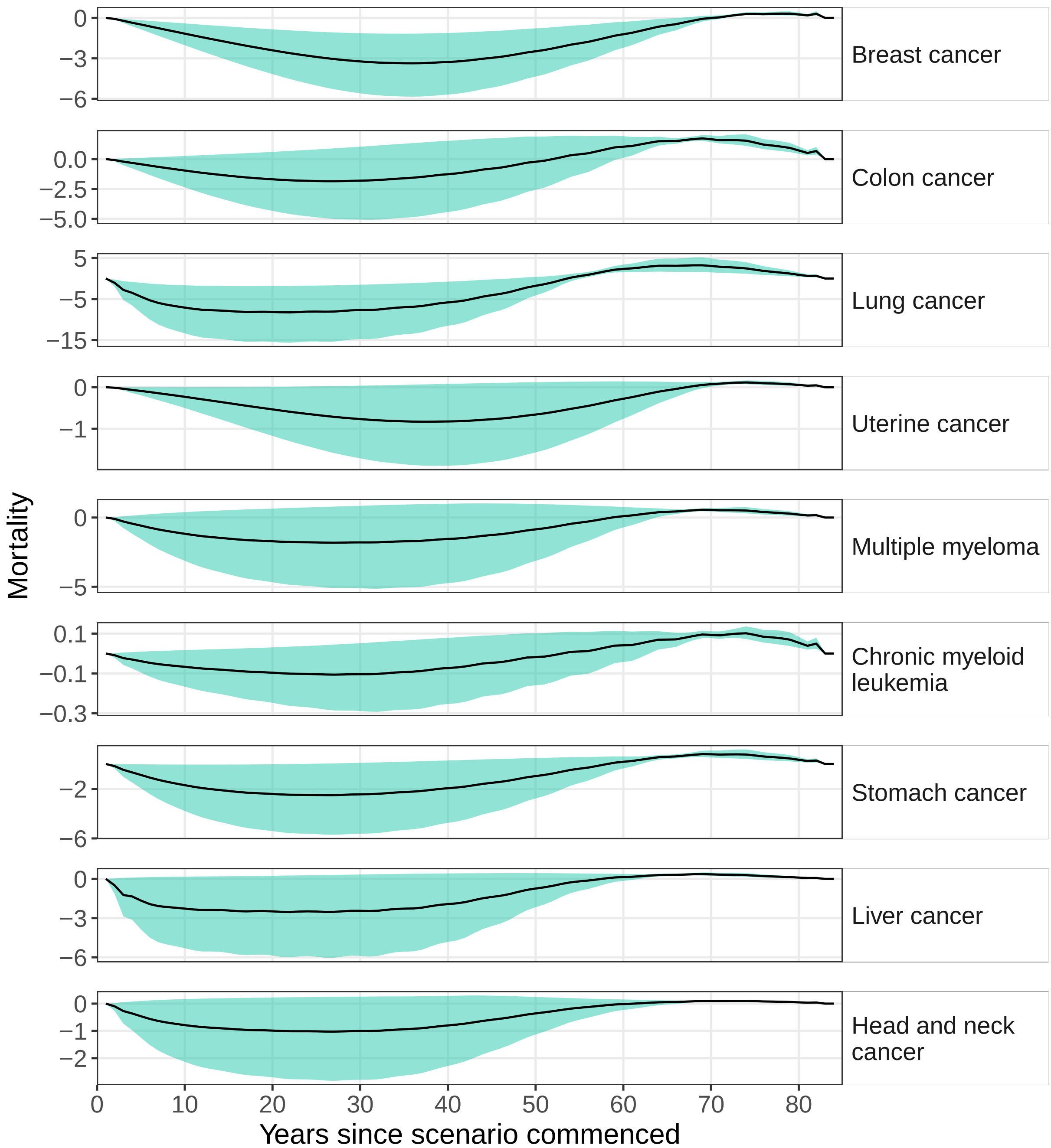

Figure 5.b: Percentage change in mortality for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Health

Figures 6 and 7 below show the change in Health Adjusted Life Years (HALYs)[1] and Life Years[2] for a snapshot of the population from 2019 for the scenario. Both figures show that the greatest gains from increasing physical activity occur midway through the life cycle with most of the gains occurring cumulatively in the long term. The decline from the mid-point onwards is due to individuals dying from natural causes within the model.

HALYS

The model estimates a total of **204,618** HALYs for the scenario population, which is **102** HALYs per 1,000 members of the population.

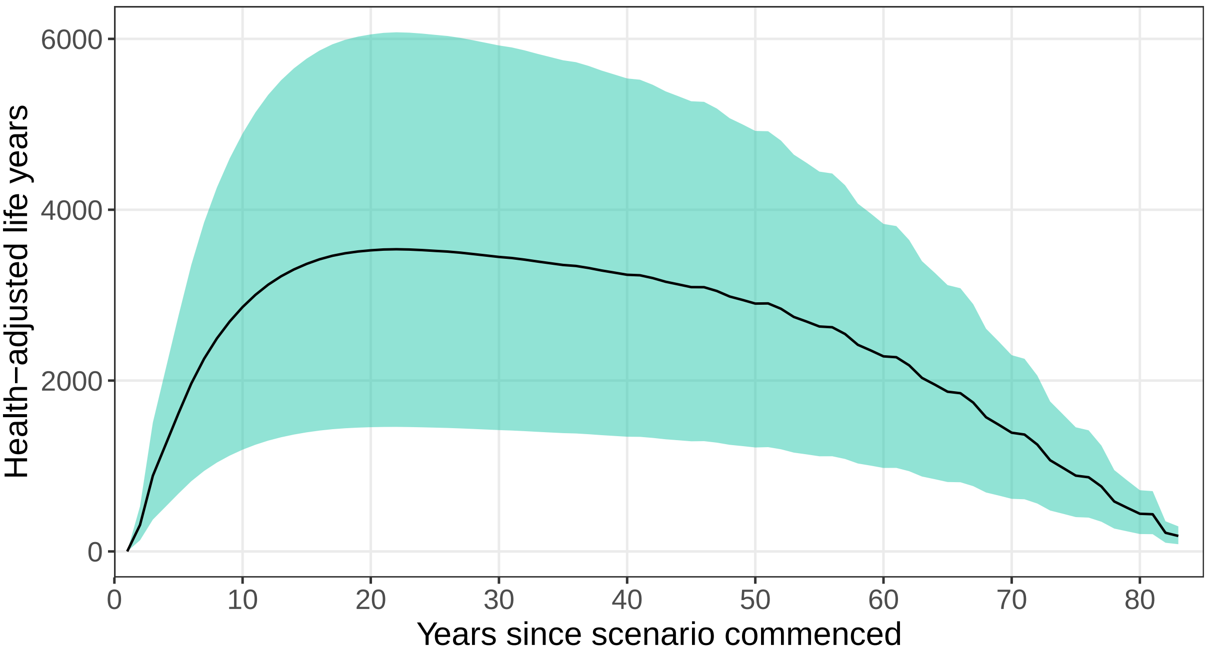

Figure 6. Total health-adjusted life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

[1] Health Adjusted Life Years are holistic measures of health that account for morbidity, mortality and quality of life.

[2] Life Years are similar to a HALYs however they exclude the quality of life component.

Life Years

The model estimates a total of **92,773** Life Years for the scenario population, which is **46** Life Years per 1,000 members of the population.

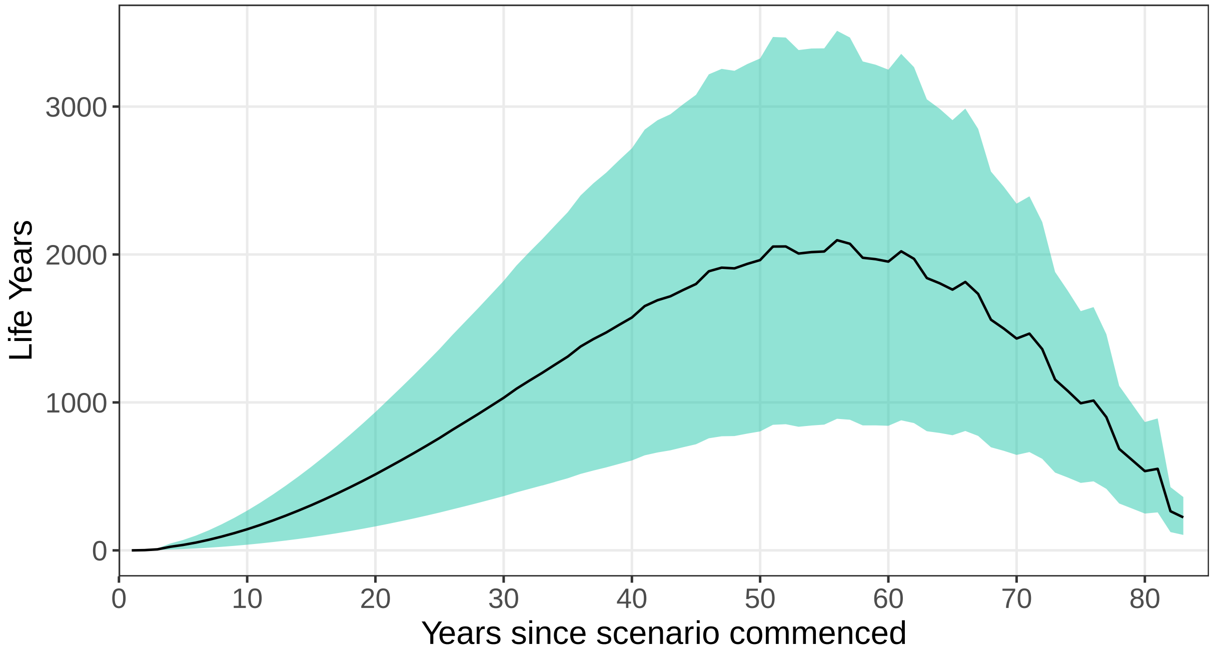

Figure 7. Total life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Value

The value of improvements to community health can be calculated**[a]** by translating the Health Adjusted Life Years (HALYs) from each scenario into dollar terms using the value of a statistical life year**[b]**. The value of a statistical life year is an estimate of the amount a society is willing to trade to reduce the risk of death for one year.

In the simulation model, HALYs are generated across time and are cumulative. Thus, to help us understand the value of HALYs across time in present day terms, it is necessary to use discounting**[c]** to reduce HALYs generated at the future point in time. Discounted HALYs from these future points can be added up to give the aggregate value of HALYs in today's terms as a measure of the value of improvements to community health arising from the chosen scenario.

The size of the discount rate can impact the aggregated value of HALYs and there is considerable debate on what discount rates should be used (with some arguing that health should not be discounted at all).[2] Hence, it is common to use a variety of discount rates to allow for differing risks, preferences and sensitivity when valuing health. The figures presented below were calculated using discount rates of 3%, 5% and 7% based on recent recommendations [3, 4] and represent the value of HALYs in present day terms resulting from an increase in physical activity from the chosen scenario.

The value of improvements to community health

The model estimates a total of **HALYs,** Health Adjusted Life Years (HALYs) gained for the scenario population, which is **102** HALYs per 1,000 members of the scenario population. The figures below represent the value of improvements to community health from the chosen scenario. These figures can be used in summary reports and for advocacy purposes**[d]**.

The HALYs gained in this scenario have a statistical value of:

- **8,550,235** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **5,353,639** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **3,655,495** per 1,000 members of the population, when calculated using a discount rate of 7%.

a. What is meant by value and how can it be measured?

Value is conceptual and measures a sense of worth or usefulness of something to individuals or to a society. Measuring the value of something, such as health, enables it to be included in assessments or analyses such as cost-benefit analyses to recognise its relative importance.

Value can be derived in many ways and a common approach is to use monetary terms, such as dollars. Valuing something using dollars is not the same as equating it with its price. Prices represent the amount at which something can be traded, prices therefore represent the amount of money for buying or selling something such as food, clothing or to pay bills. One way is to evaluate health in dollar terms is to use the Value of a Statistical Life and Value of a Statistical Life Year**[b]**.

b. What is the Value of a Statistical Life and Value of a Statistical Life Year?

The value of a **statistical life** is the estimated amount that a society is willing to trade to reduce the risk of death. The word 'Statistical' refers to the average value for life and therefore means the value of a statistical life doesn't relate to any specific individual. This value can change across risk factors and different societies who may value life differently. There are various ways of measuring the value of a statistical life with most approaches using revealed or stated preference approaches.[3] In Australia, the Office of Best Practice Regulation estimates a statistical life at $5.3M in 2022 dollar terms, and assumes that the life is of a young person with at least another 40 years to live.[5, 6]

Value of a Statistical Life Year

The value of a statistical life year is the estimated amount that a society is willing to trade to reduce the risk of death over **one year.** It can be derived from the value of a statistical life or measured directly using surveys or willingness to pay techniques.[5] The current value of a **statistical life year** is $227,000 in 2022 dollars based on current estimates from the Office of Best Practice Regulation.[6] The value of a statistical life year is useful for evaluating small increases in life years instead of evaluating full life expectancy. It is appropriate for valuing the Health Adjusted Life Years estimated from the scenarios and modelling presented in this tool. For the modelling and results presented here, the value of $227,000 was converted to 2019 dollars based on the Wage Price Index for Brisbane.

c. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

d. Application in advocacy and reporting

This section uses figures to show how the value of community health (estimated from HALYs and the value of statistical life year) can be used for reporting and advocacy purposes.

The simulation model uses **population-based estimates** for disease morbidity and mortality and is best applied to larger groups of people. It also assumes that the people of interest have similar characteristics and behaviours to the population data used in the simulation model and scenarios. The **example** below shows results from a scenario that replaces car trips with walking trips for distances of 0-2 km for All age groups.

Example:

The HALYs gained in this scenario have a statistical value of:

- **$10,859,605** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **$6,662,541** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **$4,533,392** per 1,000 members of the population, when calculated using a discount rate of 7%.

This **example** shows that the HALYs gained in this scenario have a statistical value of $10,859,605 per 1,000 members of the population using a discount of 3%.

This figure can be divided by 1,000 to give a per person figure. Once a per person figure is established, it can be multiplied by the number of people in any population size of interest for use in reports or as evidence to advocate for benefits associated with shifts to active transport modes.

$10,859,605 / 1,000 = $10,859.61 per person value

A good example of how this model can be applied links to previous research that investigated the impact of new more walkable development in Altona North on a population of 21,000 people [11]. If we assume that these people have similar characteristics to the underlying population based estimates and behaviours based on the travel survey data in the simulation model underlying this tool, then the value of community health according to the chosen scenario can be calculated as:

21,000 (people) x $10,859 (statistical value from HALYs gained) = $228 M.

Savings

An increase in physical activity due to the chosen scenario reduces chronic disease cases across a lifetime and reduces spending for each disease within the health care system resulting in overall health care cost savings**[a]**.

Table 3 provides estimated health care cost savings associated with the prevented cases of chronic diseases per 1,000 members of the population according to the selected scenario. These figures are based on applying average health care system costs per prevalent case of disease and using three alternative discount rates**[b]**:

Table 3. Total health care cost savings by disease per 1,000 members of the population.

Disease	3% discount rate	5% discount rate	7% discount rate
Alzheimer's disease and other dementias	$1,914	$1,413	$1,015
Breast cancer	$88,805	$53,767	$34,825
All cancers	$151,320	$95,349	$63,676
Colon cancer	$24,089	$16,588	$11,597
Chronic myeloid leukemia	$5,010	$3,068	$2,010
Diabetes type 2	$57,097	$33,138	$20,859
Depression	$271,164	$196,247	$147,215
Head and neck cancer	$1,100	$755	$543
Ischemic heart disease	$92,041	$53,770	$33,985
Liver cancer	$1,146	$797	$583
Multiple myeloma	$13,572	$8,816	$6,072
Stomach cancer	$5,851	$3,822	$2,648
Stroke	$11,047	$6,459	$4,078
Lung cancer	$7,791	$5,321	$3,821
Uterine cancer	$3,932	$2,420	$1,588

a. What do we mean by health care cost savings?

To calculate health care cost savings for each disease, the annual costs for each disease in each year is multiplied by the number of prevented cases of each disease for each scenario. This results in a total saving in spending for each disease by year. The savings in spending for future years are discounted**[b]** with annual savings aggregated to give a total amount saved for each disease. Total savings are presented as the amount saved per 1,000 members of the population to enable comparisons against populations of different sizes.

We use the term **health care cost saving** because it represents a reduction in health spending. However, the Australian Institute of Health and Welfare (AIHW) stress that the term cost is broad and not representative of the full cost experienced by individuals, families, or the health system, consequently AIHW use the term spending.[8]

These figures use AIHW estimates of the amounts spent through the health system in 2018-19 for each case of disease. This is extracted from Health system spending per case of disease and for certain risk factors, Table 1 – Estimates of health system spending per case, by burden of disease group, condition and sex, Australia 2018-2019.[9]. For head and neck cancers, supplementary figures were obtained from the Global Burden of Disease incidence data.[10]

b. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

References

1. Gold, M. R., Stevenson, D., & Fryback, D. G. (2002). *HALYS and QALYS and DALYS, Oh My: similarities and differences in summary measures of population Health.* Annual review of public health, 23(1), 115-134.
2. Attema, A.E., Brouwer, W.B. & Claxton, K. (2018). *Discounting in economic evaluations.* Pharmacoeconomics. 36: p. 745-758.
3. Ananthapavan, J., Moodie, M., Milat, A.J., & Carter, R. (2021). *Systematic review to update 'value of a statistical life' estimates for Australia.* International journal of environmental research and public health, 2021. 18(11): p. 6168.
4. Terrill, M. & Batrouney, H. (2018). *Unfreezing discount rates: Transport infrastructure for tomorrow.* Grattan Institute.
5. Abelson, P. (2008). *Establishing a monetary value for lives saved: issues and controversies.* Canberra: Office of Best Practice Regulation, Department of Finance and Deregulation.
6. Department of the Prime Minister and Cabinet. (2022). *Best practice regulation guidance note: Value of statistical life.* Australian Government.
7. Haacker, M., Hallett, T.B. & Atun, R. (2020). *On discount rates for economic evaluations in global health.* Health Policy and Planning, 2020. 35(1): p. 107-114.
8. Australian Institute of Health and Welfare (2023). Technical Notes: Estimating Spending per prevalent case of disease. Health system spending per case of disease and for certain risk factors, Estimating the spending per prevalent case of disease - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
9. Australian Institute of Health and Welfare (2023). Health system spending per case of disease and for certain risk factors. Health system spending per case of disease and for certain risk factors, Data - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
10. Global Burden of Disease (2019). Global Health Data Exchange. https://vizhub.healthdata.org/gbd-results. Accessed September 20, 2023.
11. Zapata-Diomedi, B., Boulangé, C., Giles-Corti, B., Phelan, K., Washington, S., Veerman, L.J., & Gunn, L. (2019). Physical activity-related health and economic benefits of building walkable neighbourhoods: A modelled comparison between brownfield and greenfield developments. International Journal of Behavioural Nutrition and Physical Activity.
12. Khorasani, E., Davari, M., Kebriaeezadeh, A., Fatemi, F., Akbari Sari, A., & Varahrami, V. (2022). A comprehensive review of official discount rates in guidelines of health economic evaluations over time: the trends and roots. The European Journal of Health Economics, 23(9), 1577-1590.

Scenario: replacing car trips under 1km with walking, and car trips between 1 and 2km with cycling for all trip purposes

This scenario shows the results of replacing car trips under 1km with walking and replacing car trips between 1km and 2km with cycling for leisure, shopping, work, education or other purposes for all adults of all ages.

This implies that the selected scenario results in a mode shift in walking from 16.8% to 20.2%; cycling from 1.3% to 10.0%; and, from 74.7% to 62.6% for car trips taken as either a driver or passenger.

Increases in walking and cycling translate into a shift from 47.9% to 55.3% of the population accumulating the required minutes spent being moderately (150 – 300 mins) or vigorously physically active (75 – 150 mins) or an equivalent combination of both contributing to recommended levels as detailed in the Physical Activity Guidelines.

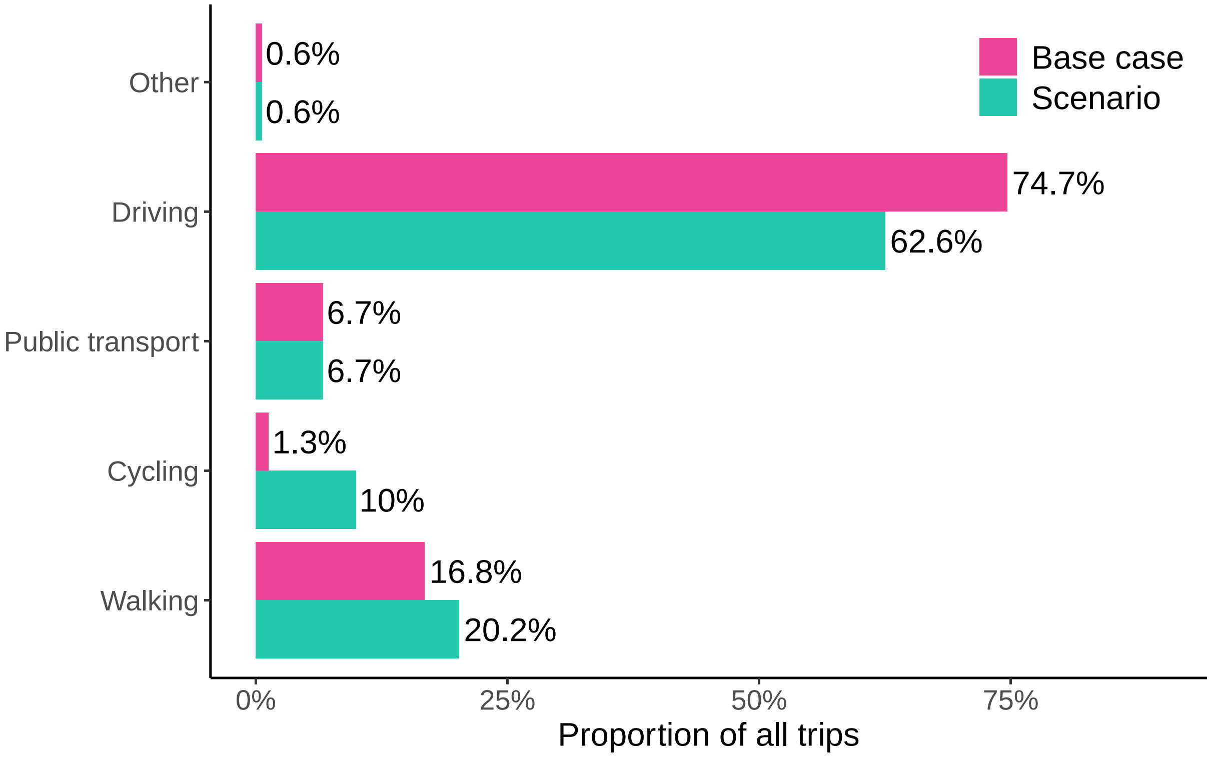

Figure 1: Distribution of base case and scenario trips.

Incidence

Incidence describes the rate of occurrence of new cases of a disease over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of disease prevented, due to increases in physical activity associated with the scenario. Figure 2 presents the change (%) in the disease incidence across the life course. Figure 3 presents how the difference in disease incidence changes over time, by year, using a snapshot of the population from 2019.

Table 1 shows how the scenario impacts the incidence of chronic diseases as both as a percentage and total number of prevented cases.

Table 1. Chronic disease incidence reduction and total number of prevented cases of disease measured across the years of the simulation

Disease*	Incidence of disease is reduced by	Total number of prevented cases of disease aggregated across the simulation
Alzheimer's disease and other dementias	0.54%	3,437
Breast cancer	0.40%	290
All cancers	0.95%	3,740
Colon cancer	0.42%	539
Chronic myeloid leukemia	1.88%	51
Diabetes type 2	2.49%	8,224
Depression	0.62%	9,964
Head and neck cancer	3.15%	139
Ischemic heart disease	1.36%	12,012
Liver cancer	1.57%	277
Multiple myeloma	2.21%	427
Stomach cancer	2.02%	482
Stroke	1.69%	4,400
Lung cancer	1.28%	1,467
Uterine cancer	0.79%	67

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

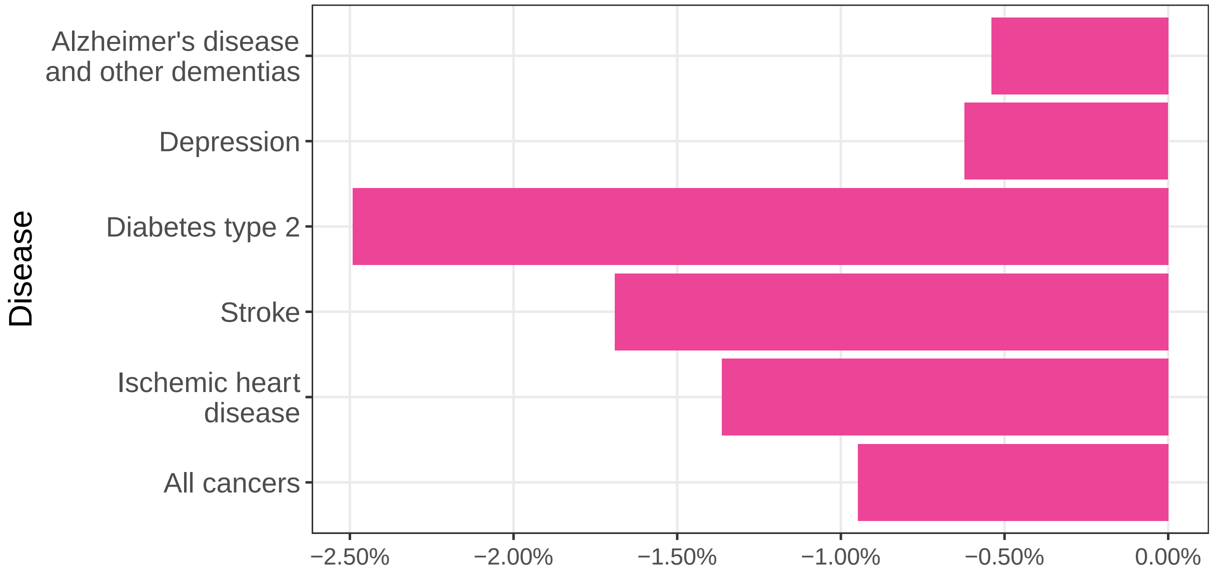

Figure 2.a: Percentage change in incidence by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

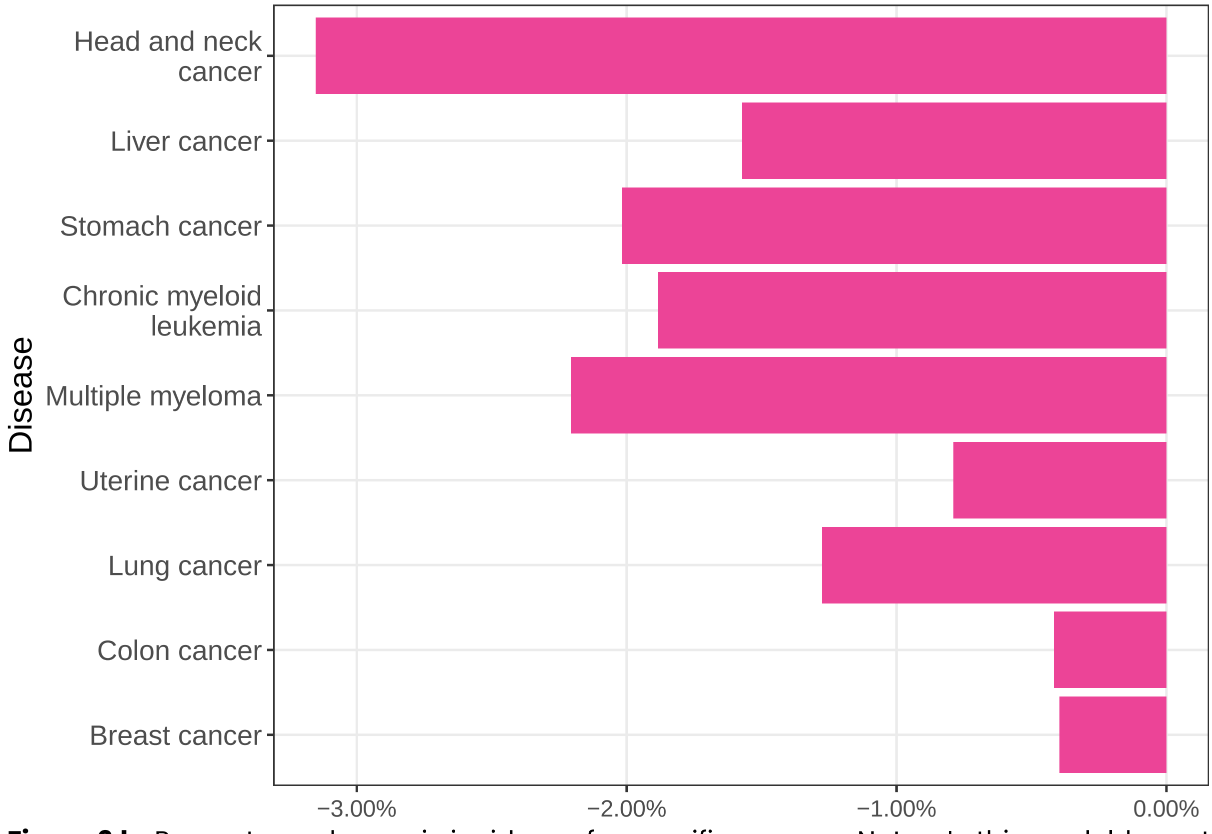

Figure 2.b: Percentage change in incidence for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

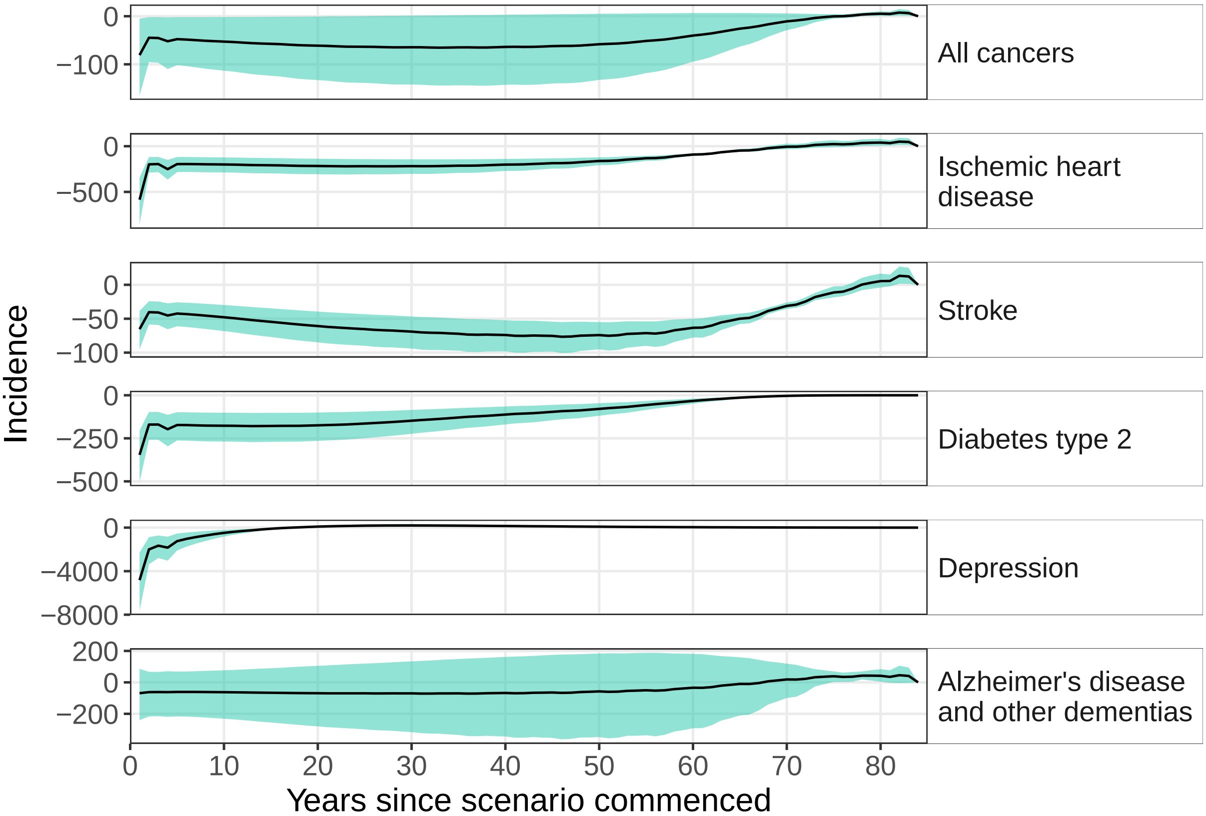

Figure 3.a: The change in incidence over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

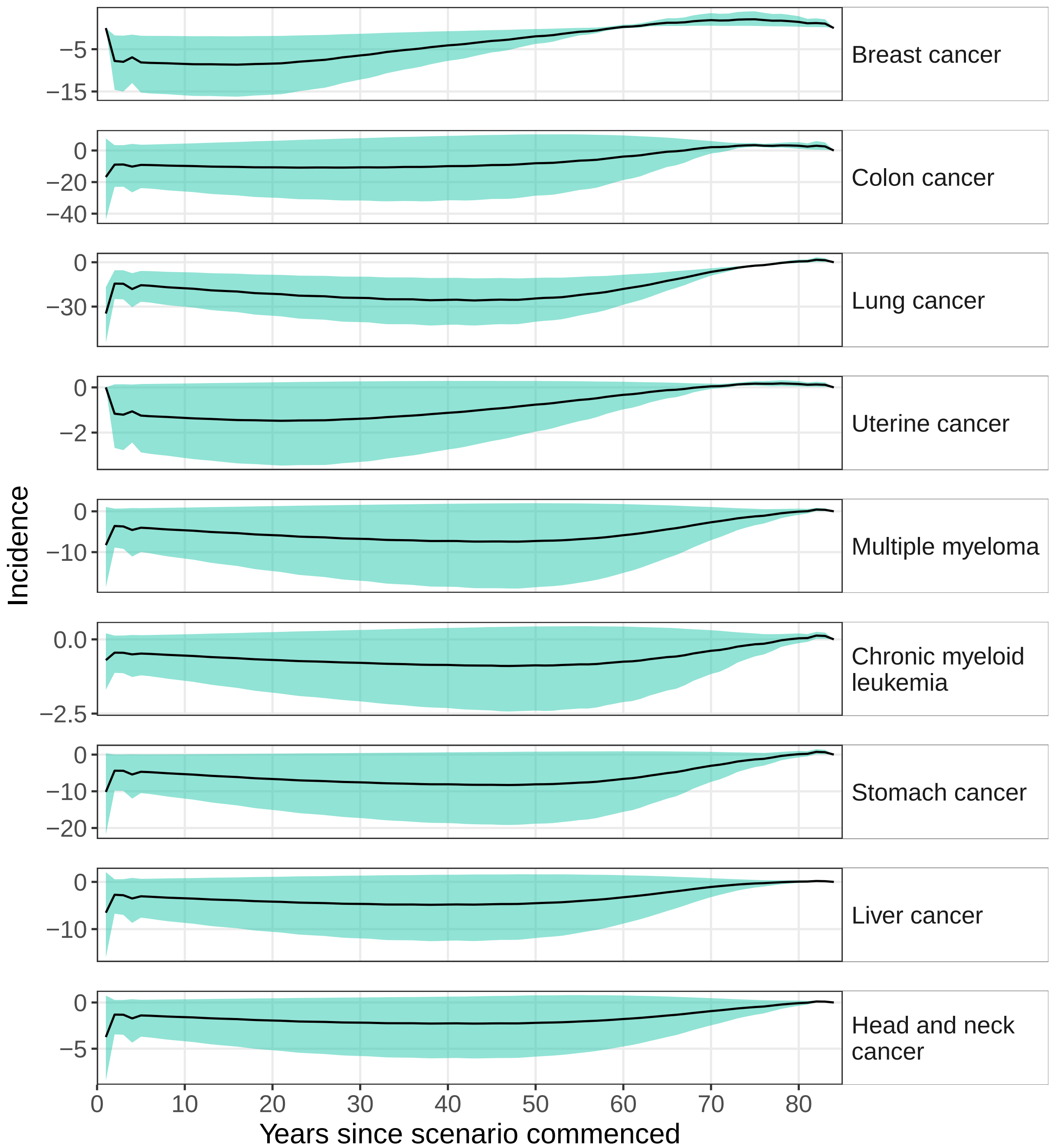

Figure 3.b: Percentage change in incidence for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Mortality

Mortality is the number of deaths due to a given disease over over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of prevented deaths due to increases in physical activity associated with the scenario. Figure 4 presents the total change in mortality over the life course. Figure 5 presents the difference in the number of deaths by year using a snapshot of the population from 2019.

Table 2 shows how the scenario impacts reductions in mortality presented as a percentage and total number of prevented deaths caused by chronic diseases.

Table 2. Percentage reduction in mortality and total number of prevented deaths by chronic disease measured across the years of the simulation.

Disease*	Mortality is reduced by	Total number of prevented deaths aggregated across the simulation
Alzheimer's disease and other dementias	0.19%	444
Breast cancer	0.14%	47
All cancers	1.09%	2,759
Colon cancer	0.19%	81
Chronic myeloid leukemia	1.76%	36
Diabetes type 2	1.77%	875
Depression	0.00%	0
Head and neck cancer	3.12%	124
Ischemic heart disease	1.20%	4,519
Liver cancer	1.57%	267
Multiple myeloma	2.15%	374
Stomach cancer	1.97%	416
Stroke	1.58%	2,759
Lung cancer	1.25%	1,367
Uterine cancer	0.64%	46

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

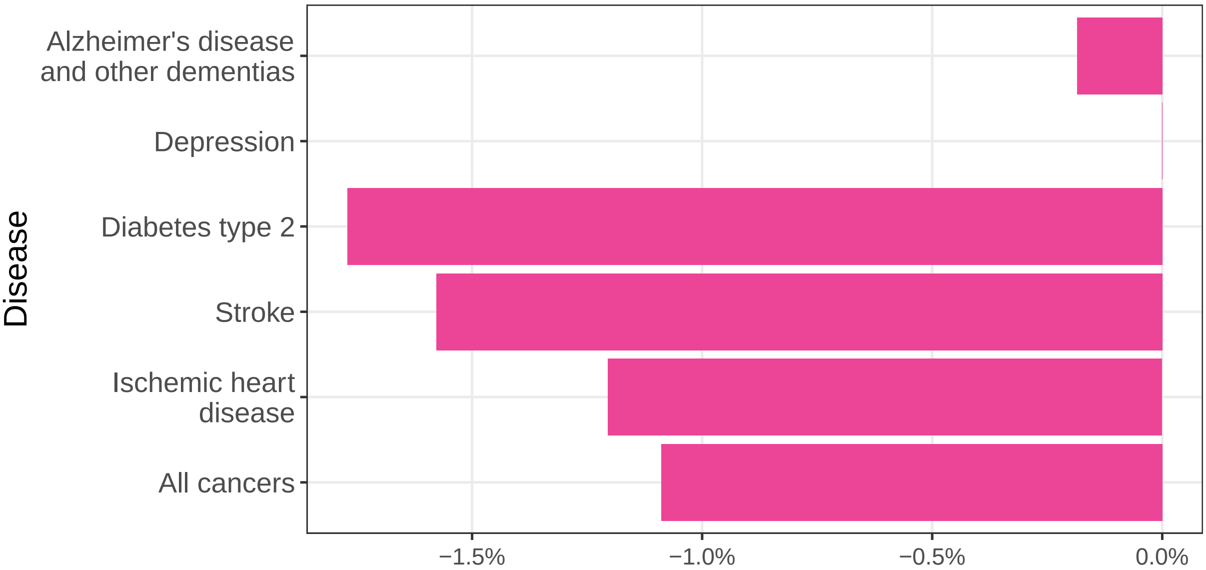

Figure 4.a: Percentage change in mortality by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

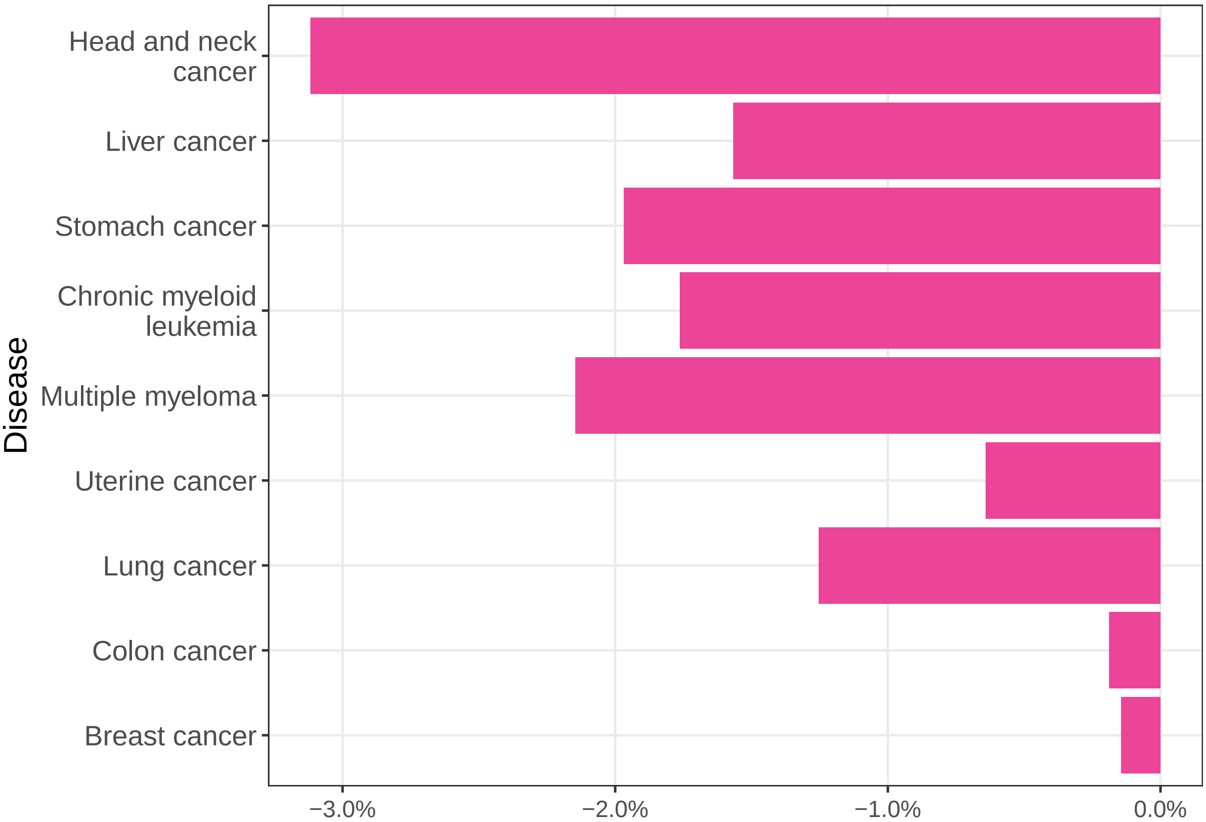

Figure 4.b: Percentage change in mortality for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

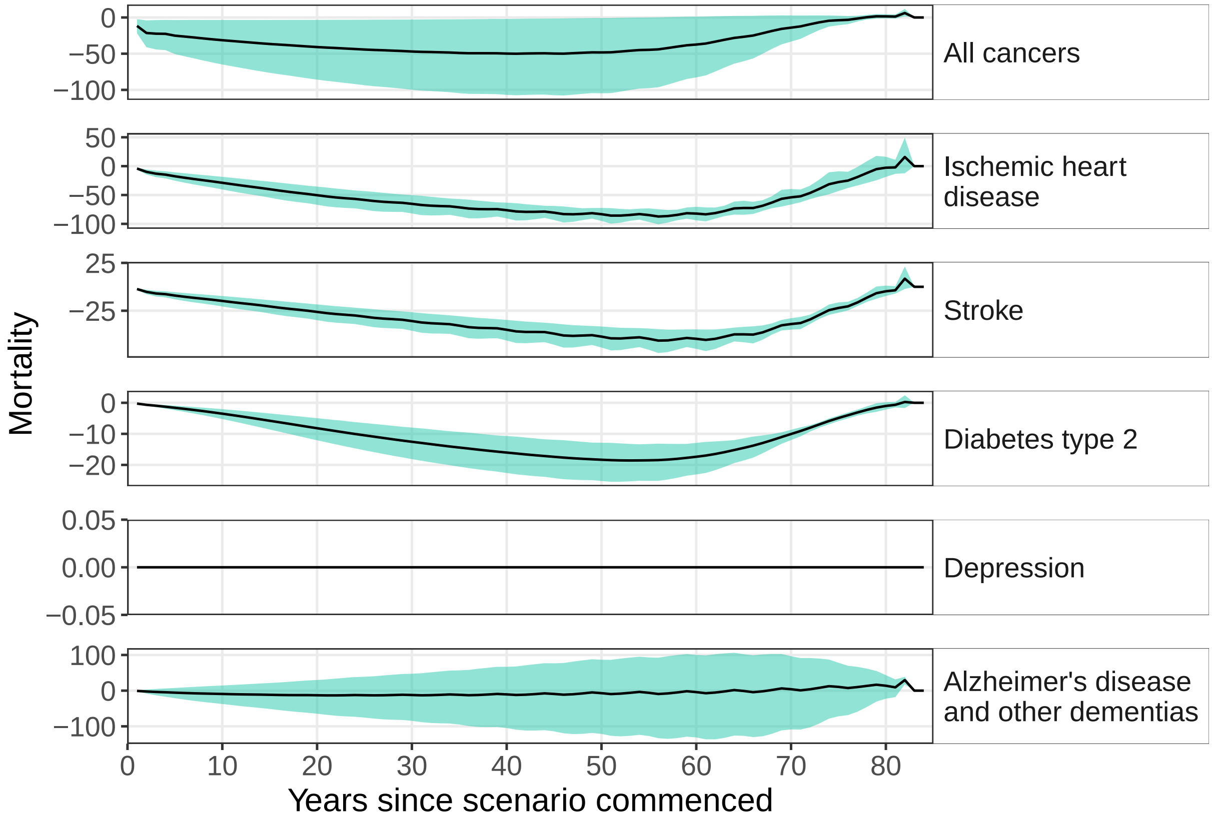

Figure 5.a: The change in mortality over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

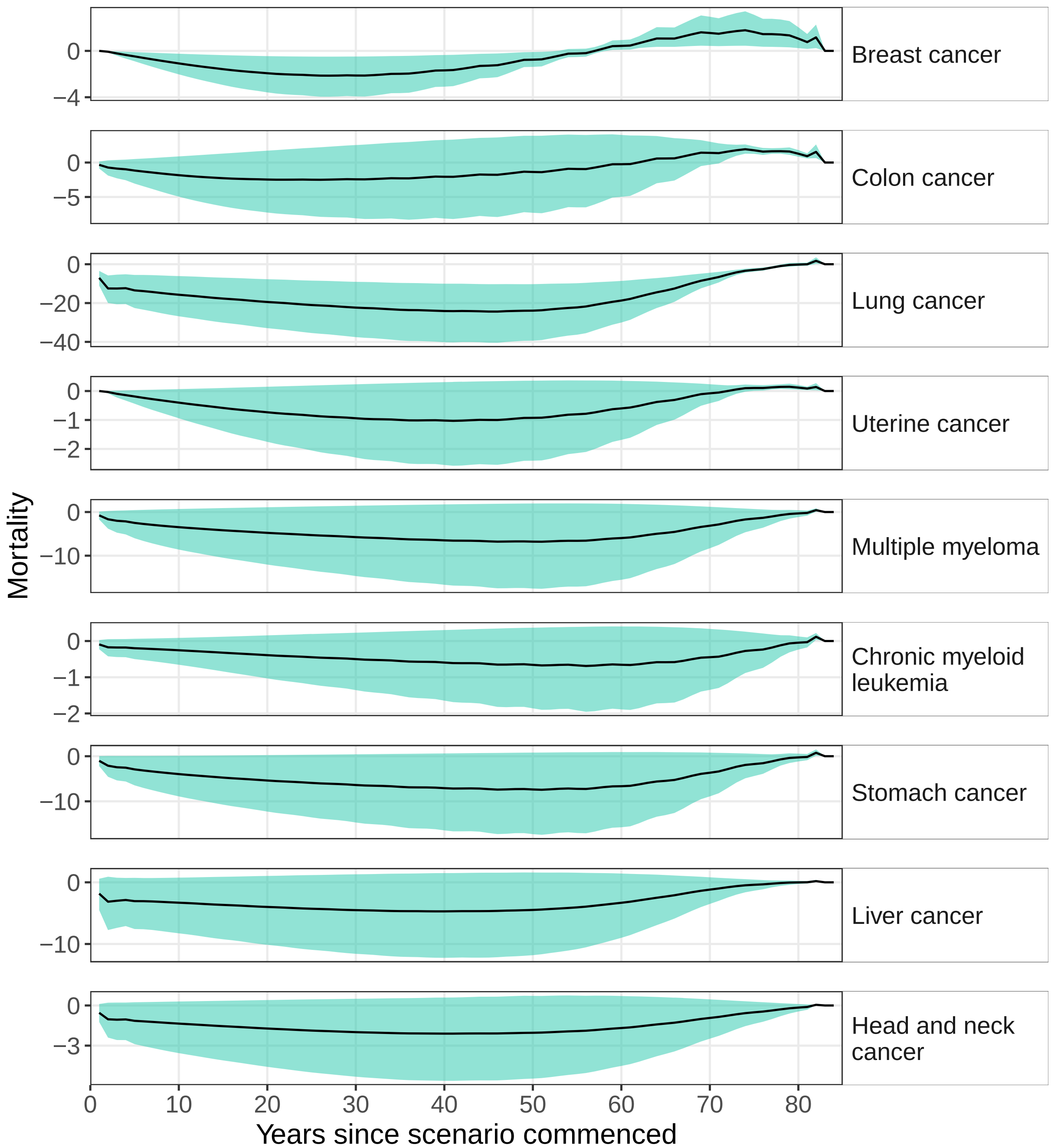

Figure 5.b: Percentage change in mortality for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Health

Figures 6 and 7 below show the change in Health Adjusted Life Years (HALYs)[1] and Life Years[2] for a snapshot of the population from 2019 for the scenario. Both figures show that the greatest gains from increasing physical activity occur midway through the life cycle with most of the gains occurring cumulatively in the long term. The decline from the mid-point onwards is due to individuals dying from natural causes within the model.

HALYS

The model estimates a total of **294,976** HALYs for the scenario population, which is **146** HALYs per 1,000 members of the population.

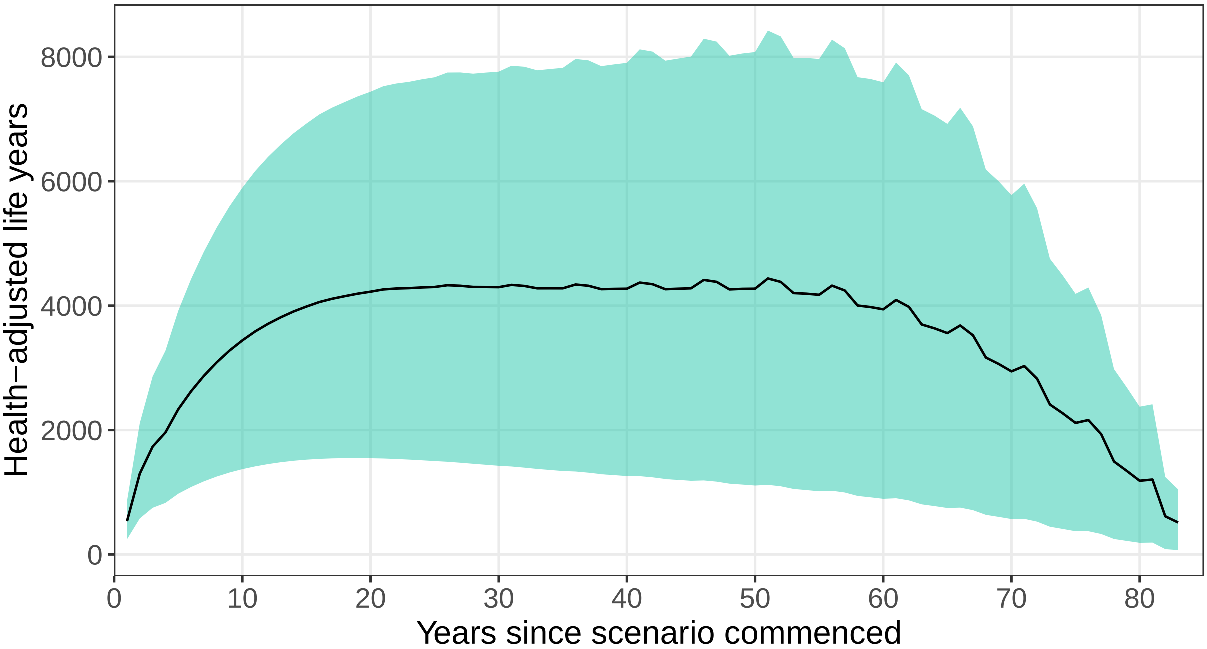

Figure 6. Total health-adjusted life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

[1]Health Adjusted Life Years are holistic measures of health that account for morbidity, mortality and quality of life.

[2]Life Years are similar to a HALYs however they exclude the quality of life component.

Life Years

The model estimates a total of **181,924** Life Years for the scenario population, which is **90** Life Years per 1,000 members of the population.

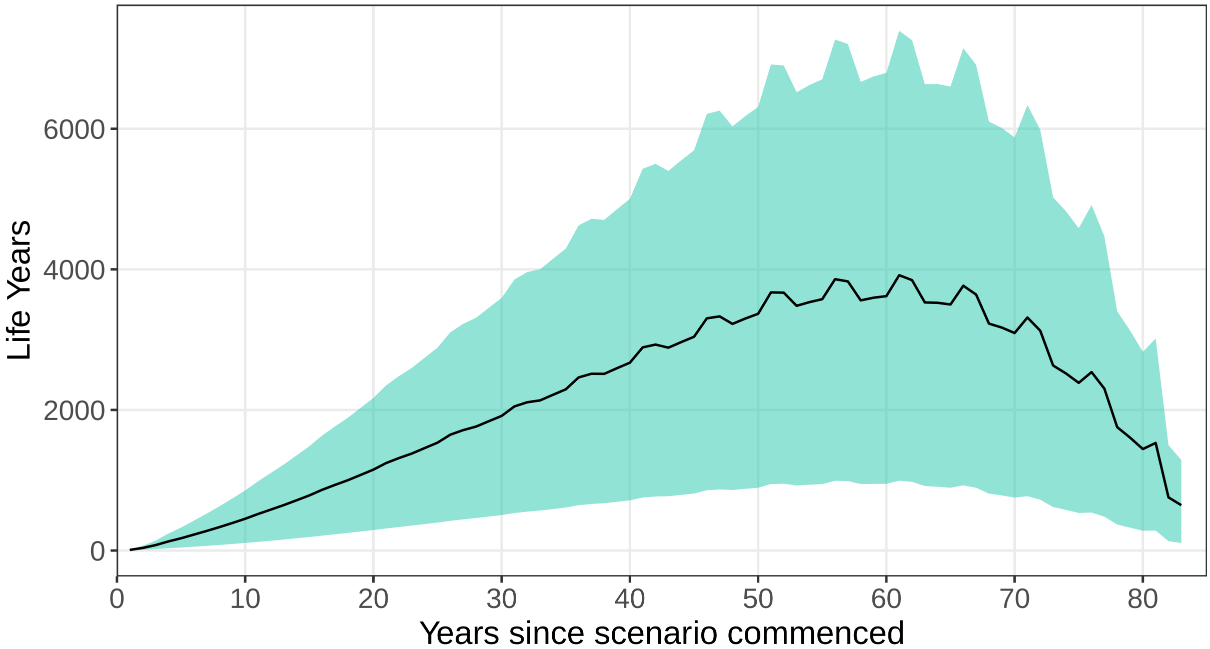

Figure 7. Total life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Value

The value of improvements to community health can be calculated**[a]** by translating the Health Adjusted Life Years (HALYs) from each scenario into dollar terms using the value of a statistical life year**[b]**. The value of a statistical life year is an estimate of the amount a society is willing to trade to reduce the risk of death for one year.

In the simulation model, HALYs are generated across time and are cumulative. Thus, to help us understand the value of HALYs across time in present day terms, it is necessary to use discounting**[c]** to reduce HALYs generated at the future point in time. Discounted HALYs from these future points can be added up to give the aggregate value of HALYs in today's terms as a measure of the value of improvements to community health arising from the chosen scenario.

The size of the discount rate can impact the aggregated value of HALYs and there is considerable debate on what discount rates should be used (with some arguing that health should not be discounted at all).[2] Hence, it is common to use a variety of discount rates to allow for differing risks, preferences and sensitivity when valuing health. The figures presented below were calculated using discount rates of 3%, 5% and 7% based on recent recommendations [3, 4] and represent the value of HALYs in present day terms resulting from an increase in physical activity from the chosen scenario.

The value of improvements to community health

The model estimates a total of **HALYs,** Health Adjusted Life Years (HALYs) gained for the scenario population, which is **146** HALYs per 1,000 members of the scenario population. The figures below represent the value of improvements to community health from the chosen scenario. These figures can be used in summary reports and for advocacy purposes**[d]**.

The HALYs gained in this scenario have a statistical value of:

- **11,429,791** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **7,016,152** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **4,776,488** per 1,000 members of the population, when calculated using a discount rate of 7%.

a. What is meant by value and how can it be measured?

Value is conceptual and measures a sense of worth or usefulness of something to individuals or to a society. Measuring the value of something, such as health, enables it to be included in assessments or analyses such as cost-benefit analyses to recognise its relative importance.

Value can be derived in many ways and a common approach is to use monetary terms, such as dollars. Valuing something using dollars is not the same as equating it with its price. Prices represent the amount at which something can be traded, prices therefore represent the amount of money for buying or selling something such as food, clothing or to pay bills. One way is to evaluate health in dollar terms is to use the Value of a Statistical Life and Value of a Statistical Life Year**[b]**.

b. What is the Value of a Statistical Life and Value of a Statistical Life Year?

The value of a **statistical life** is the estimated amount that a society is willing to trade to reduce the risk of death. The word 'Statistical' refers to the average value for life and therefore means the value of a statistical life doesn't relate to any specific individual. This value can change across risk factors and different societies who may value life differently. There are various ways of measuring the value of a statistical life with most approaches using revealed or stated preference approaches.[3] In Australia, the Office of Best Practice Regulation estimates a statistical life at $5.3M in 2022 dollar terms, and assumes that the life is of a young person with at least another 40 years to live.[5, 6]

Value of a Statistical Life Year

The value of a statistical life year is the estimated amount that a society is willing to trade to reduce the risk of death over **one year.** It can be derived from the value of a statistical life or measured directly using surveys or willingness to pay techniques.[5] The current value of a **statistical life year** is $227,000 in 2022 dollars based on current estimates from the Office of Best Practice Regulation.[6] The value of a statistical life year is useful for evaluating small increases in life years instead of evaluating full life expectancy. It is appropriate for valuing the Health Adjusted Life Years estimated from the scenarios and modelling presented in this tool. For the modelling and results presented here, the value of $227,000 was converted to 2019 dollars based on the Wage Price Index for Brisbane.

c. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

d. Application in advocacy and reporting

This section uses figures to show how the value of community health (estimated from HALYs and the value of statistical life year) can be used for reporting and advocacy purposes.

The simulation model uses **population-based estimates** for disease morbidity and mortality and is best applied to larger groups of people. It also assumes that the people of interest have similar characteristics and behaviours to the population data used in the simulation model and scenarios. The **example** below shows results from a scenario that replaces car trips with walking trips for distances of 0-2 km for All age groups.

Example:

The HALYs gained in this scenario have a statistical value of:

- **$10,859,605** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **$6,662,541** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **$4,533,392** per 1,000 members of the population, when calculated using a discount rate of 7%.

This **example** shows that the HALYs gained in this scenario have a statistical value of $10,859,605 per 1,000 members of the population using a discount of 3%.

This figure can be divided by 1,000 to give a per person figure. Once a per person figure is established, it can be multiplied by the number of people in any population size of interest for use in reports or as evidence to advocate for benefits associated with shifts to active transport modes.

$10,859,605 / 1,000 = $10,859.61 per person value

A good example of how this model can be applied links to previous research that investigated the impact of new more walkable development in Altona North on a population of 21,000 people [11]. If we assume that these people have similar characteristics to the underlying population based estimates and behaviours based on the travel survey data in the simulation model underlying this tool, then the value of community health according to the chosen scenario can be calculated as:

21,000 (people) x $10,859 (statistical value from HALYs gained) = $228 M.

Savings

An increase in physical activity due to the chosen scenario reduces chronic disease cases across a lifetime and reduces spending for each disease within the health care system resulting in overall health care cost savings**[a]**.

Table 3 provides estimated health care cost savings associated with the prevented cases of chronic diseases per 1,000 members of the population according to the selected scenario. These figures are based on applying average health care system costs per prevalent case of disease and using three alternative discount rates**[b]**:

Table 3. Total health care cost savings by disease per 1,000 members of the population.

Disease	3% discount rate	5% discount rate	7% discount rate
Alzheimer's disease and other dementias	$8,806	$5,324	$3,524
Breast cancer	$61,672	$38,995	$26,015
All cancers	$174,737	$111,551	$76,225
Colon cancer	$38,760	$26,131	$18,457
Chronic myeloid leukemia	$11,659	$6,840	$4,411
Diabetes type 2	$50,861	$30,347	$19,709
Depression	$281,088	$212,107	$164,192
Head and neck cancer	$1,905	$1,232	$869
Ischemic heart disease	$114,573	$69,204	$45,858
Liver cancer	$1,593	$1,061	$769
Multiple myeloma	$28,371	$17,765	$12,166
Stomach cancer	$10,805	$6,766	$4,641
Stroke	$17,486	$10,185	$6,527
Lung cancer	$16,253	$10,501	$7,404
Uterine cancer	$3,738	$2,285	$1,498

a. What do we mean by health care cost savings?

To calculate health care cost savings for each disease, the annual costs for each disease in each year is multiplied by the number of prevented cases of each disease for each scenario. This results in a total saving in spending for each disease by year. The savings in spending for future years are discounted**[b]** with annual savings aggregated to give a total amount saved for each disease. Total savings are presented as the amount saved per 1,000 members of the population to enable comparisons against populations of different sizes.

We use the term **health care cost saving** because it represents a reduction in health spending. However, the Australian Institute of Health and Welfare (AIHW) stress that the term cost is broad and not representative of the full cost experienced by individuals, families, or the health system, consequently AIHW use the term spending.[8]

These figures use AIHW estimates of the amounts spent through the health system in 2018-19 for each case of disease. This is extracted from Health system spending per case of disease and for certain risk factors, Table 1 – Estimates of health system spending per case, by burden of disease group, condition and sex, Australia 2018-2019.[9]. For head and neck cancers, supplementary figures were obtained from the Global Burden of Disease incidence data.[10]

b. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

References

1. Gold, M. R., Stevenson, D., & Fryback, D. G. (2002). *HALYS and QALYS and DALYS, Oh My: similarities and differences in summary measures of population Health.* Annual review of public health, 23(1), 115-134.
2. Attema, A.E., Brouwer, W.B. & Claxton, K. (2018). *Discounting in economic evaluations.* Pharmacoeconomics. 36: p. 745-758.
3. Ananthapavan, J., Moodie, M., Milat, A.J., & Carter, R. (2021). *Systematic review to update 'value of a statistical life' estimates for Australia.* International journal of environmental research and public health, 2021. 18(11): p. 6168.
4. Terrill, M. & Batrouney, H. (2018). *Unfreezing discount rates: Transport infrastructure for tomorrow.* Grattan Institute.
5. Abelson, P. (2008). *Establishing a monetary value for lives saved: issues and controversies.* Canberra: Office of Best Practice Regulation, Department of Finance and Deregulation.
6. Department of the Prime Minister and Cabinet. (2022). *Best practice regulation guidance note: Value of statistical life.* Australian Government.
7. Haacker, M., Hallett, T.B. & Atun, R. (2020). *On discount rates for economic evaluations in global health.* Health Policy and Planning, 2020. 35(1): p. 107-114.
8. Australian Institute of Health and Welfare (2023). Technical Notes: Estimating Spending per prevalent case of disease. Health system spending per case of disease and for certain risk factors, Estimating the spending per prevalent case of disease - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
9. Australian Institute of Health and Welfare (2023). Health system spending per case of disease and for certain risk factors. Health system spending per case of disease and for certain risk factors, Data - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
10. Global Burden of Disease (2019). Global Health Data Exchange. https://vizhub.healthdata.org/gbd-results. Accessed September 20, 2023.
11. Zapata-Diomedi, B., Boulangé, C., Giles-Corti, B., Phelan, K., Washington, S., Veerman, L.J., & Gunn, L. (2019). Physical activity-related health and economic benefits of building walkable neighbourhoods: A modelled comparison between brownfield and greenfield developments. International Journal of Behavioural Nutrition and Physical Activity.
12. Khorasani, E., Davari, M., Kebriaeezadeh, A., Fatemi, F., Akbari Sari, A., & Varahrami, V. (2022). A comprehensive review of official discount rates in guidelines of health economic evaluations over time: the trends and roots. The European Journal of Health Economics, 23(9), 1577-1590.

Scenario: replacing car trips under 1km with walking, and car trips between 1 and 5km with cycling for all trip purposes

This scenario shows the results of replacing car trips under 1km with walking and replacing car trips between 1km and 5km with cycling for leisure, shopping, work, education or other purposes for all adults of all ages.

This implies that the selected scenario results in a mode shift in walking from 16.8% to 20.2%; cycling from 1.3% to 30.2%; and, from 74.7% to 42.3% for car trips taken as either a driver or passenger.

Increases in walking and cycling translate into a shift from 47.9% to 67.7% of the population accumulating the required minutes spent being moderately (150 – 300 mins) or vigorously physically active (75 – 150 mins) or an equivalent combination of both contributing to recommended levels as detailed in the Physical Activity Guidelines.

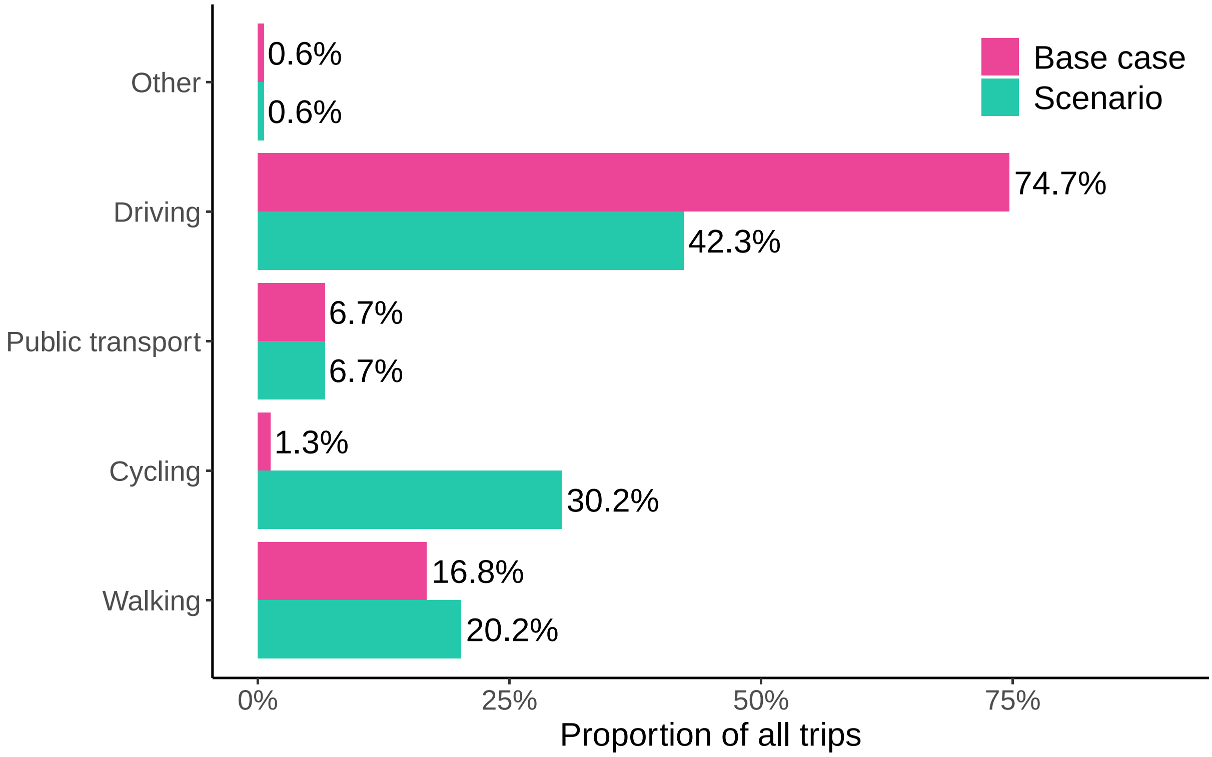

Figure 1: Distribution of base case and scenario trips.

Incidence

Incidence describes the rate of occurrence of new cases of a disease over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of disease prevented, due to increases in physical activity associated with the scenario. Figure 2 presents the change (%) in the disease incidence across the life course. Figure 3 presents how the difference in disease incidence changes over time, by year, using a snapshot of the population from 2019.

Table 1 shows how the scenario impacts the incidence of chronic diseases as both as a percentage and total number of prevented cases.

Table 1. Chronic disease incidence reduction and total number of prevented cases of disease measured across the years of the simulation

Disease*	Incidence of disease is reduced by	Total number of prevented cases of disease aggregated across the simulation
Alzheimer's disease and other dementias	1.18%	7,506
Breast cancer	1.47%	1,077
All cancers	2.26%	8,895
Colon cancer	1.07%	1,388
Chronic myeloid leukemia	3.54%	97
Diabetes type 2	6.94%	22,907
Depression	1.51%	24,129
Head and neck cancer	6.62%	292
Ischemic heart disease	3.28%	28,904
Liver cancer	4.16%	732
Multiple myeloma	4.50%	872
Stomach cancer	4.59%	1,096
Stroke	3.73%	9,708
Lung cancer	2.73%	3,143
Uterine cancer	2.31%	196

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

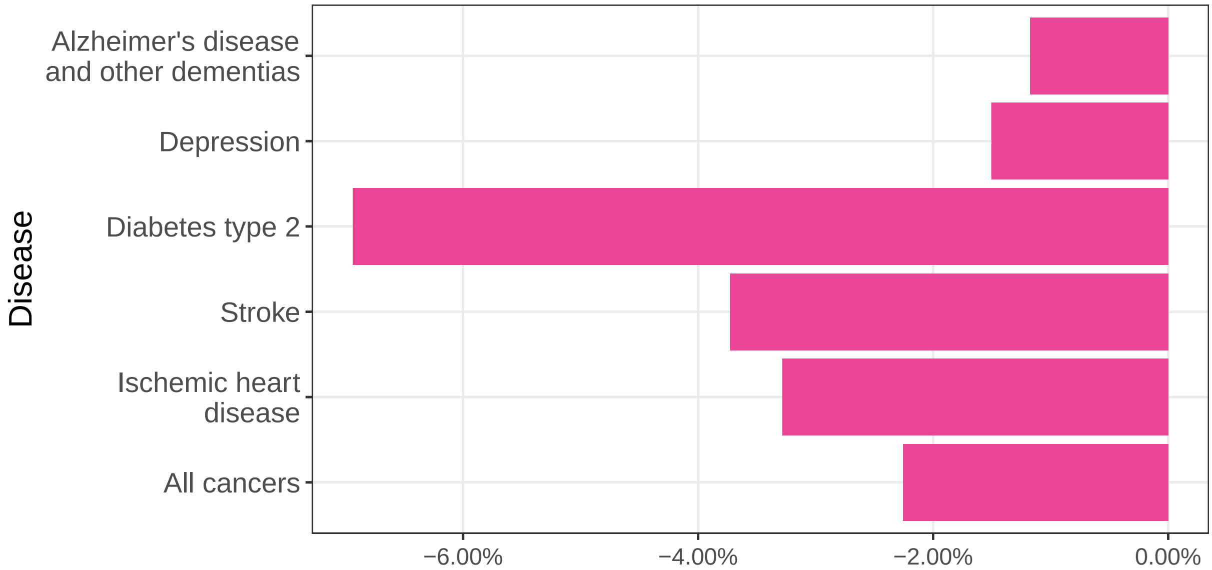

Figure 2.a: Percentage change in incidence by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

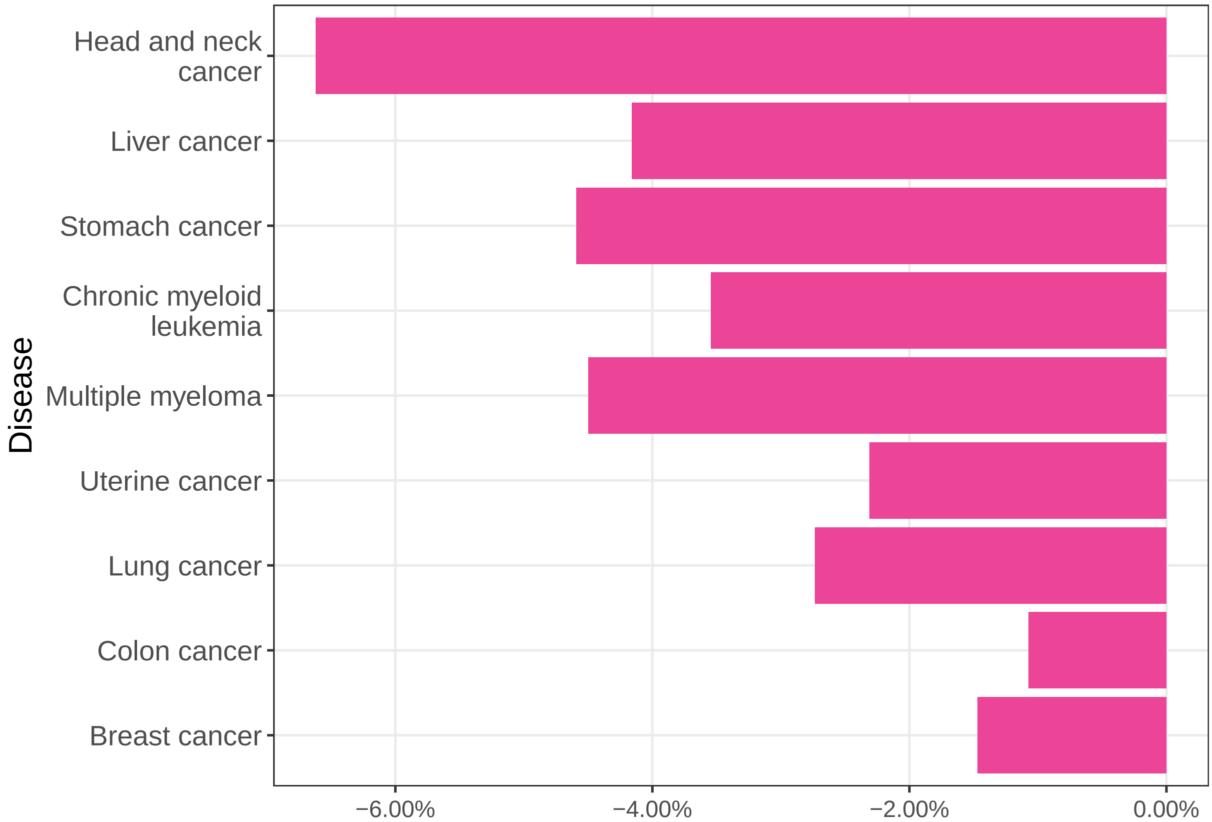

Figure 2.b: Percentage change in incidence for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

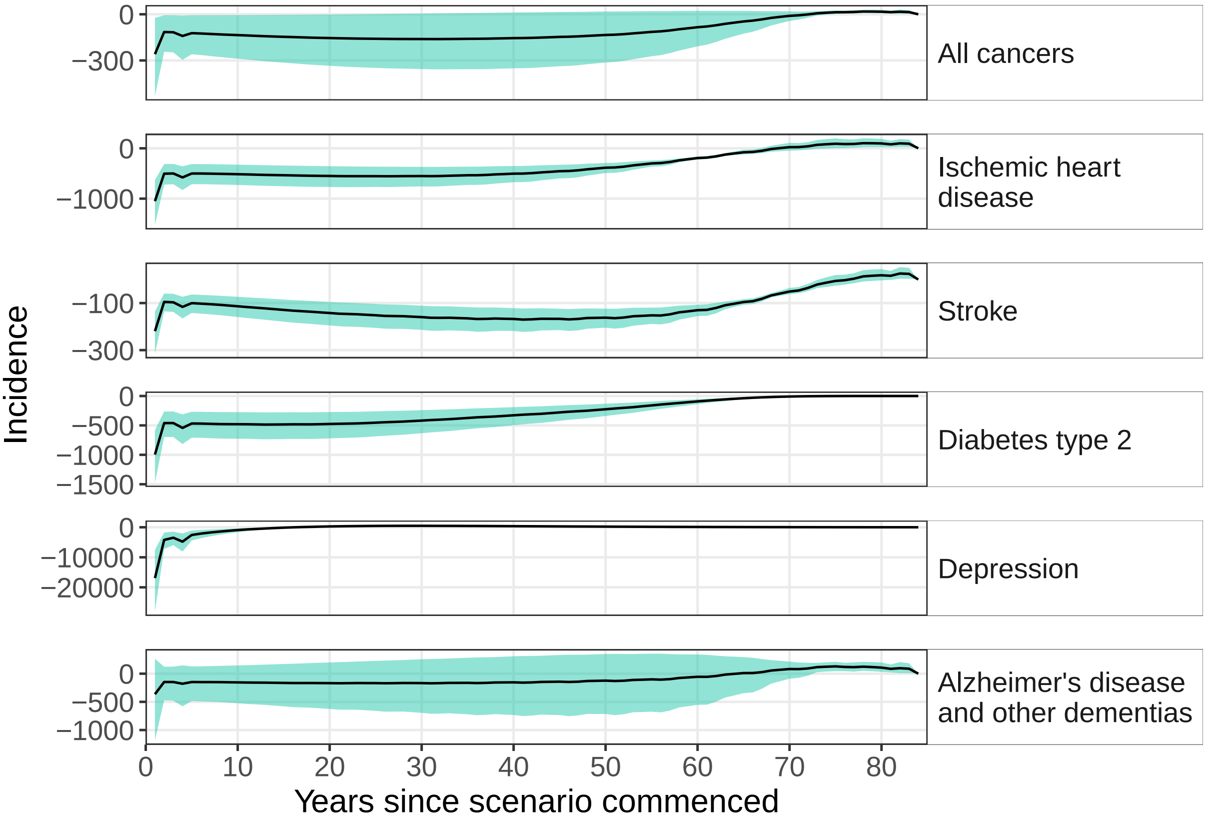

Figure 3.a: The change in incidence over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

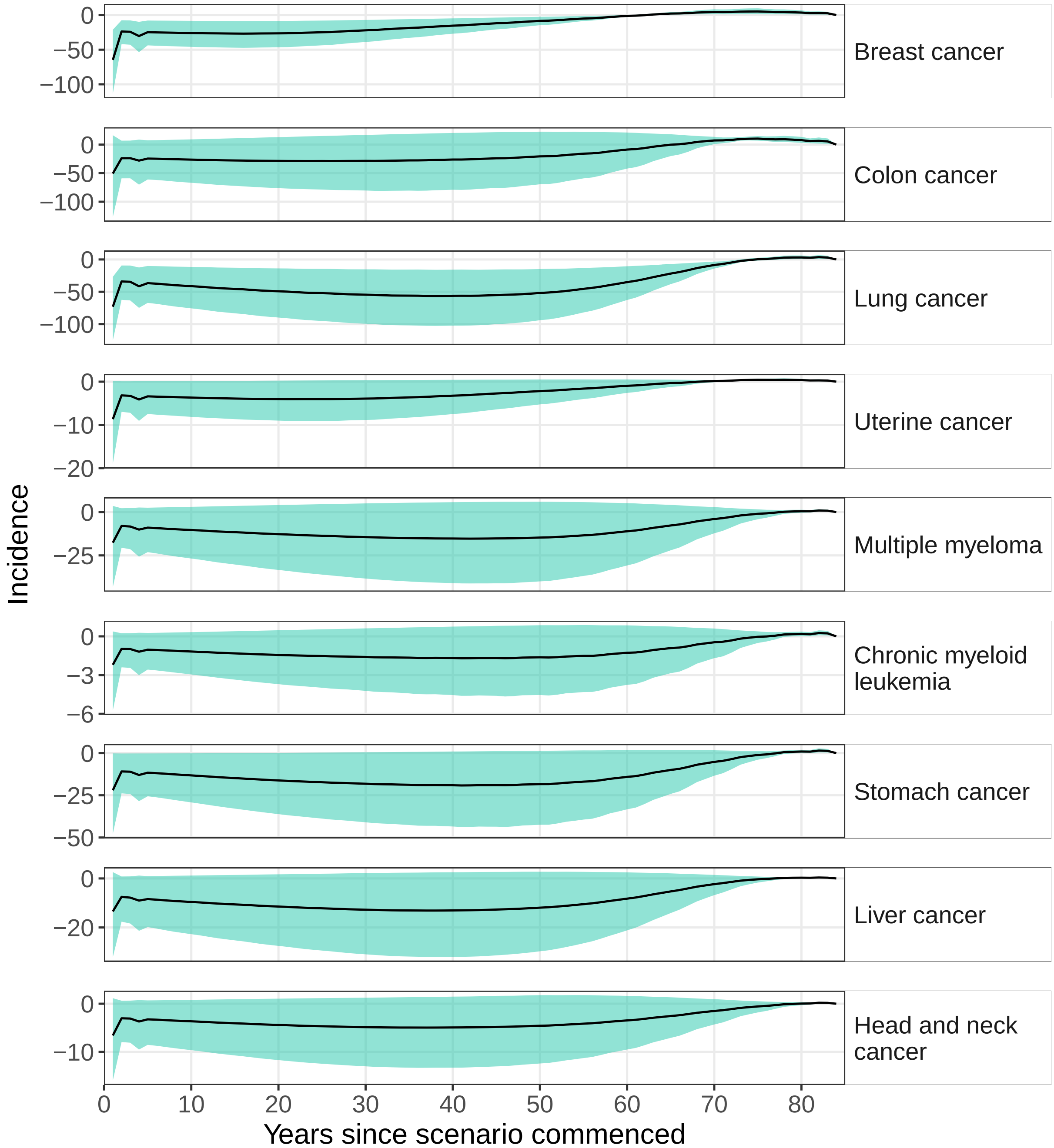

Figure 3.b: Percentage change in incidence for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Mortality

Mortality is the number of deaths due to a given disease over over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of prevented deaths due to increases in physical activity associated with the scenario. Figure 4 presents the total change in mortality over the life course. Figure 5 presents the difference in the number of deaths by year using a snapshot of the population from 2019.

Table 2 shows how the scenario impacts reductions in mortality presented as a percentage and total number of prevented deaths caused by chronic diseases.

Table 2. Percentage reduction in mortality and total number of prevented deaths by chronic disease measured across the years of the simulation.

Disease*	Mortality is reduced by	Total number of prevented deaths aggregated across the simulation
Alzheimer's disease and other dementias	0.31%	736
Breast cancer	0.87%	281
All cancers	2.51%	6,357
Colon cancer	0.61%	265
Chronic myeloid leukemia	3.13%	64
Diabetes type 2	5.25%	2,597
Depression	0.00%	0
Head and neck cancer	6.64%	264
Ischemic heart disease	3.00%	11,260
Liver cancer	4.15%	709
Multiple myeloma	4.36%	759
Stomach cancer	4.47%	946
Stroke	3.38%	5,912
Lung cancer	2.69%	2,929
Uterine cancer	1.92%	139

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

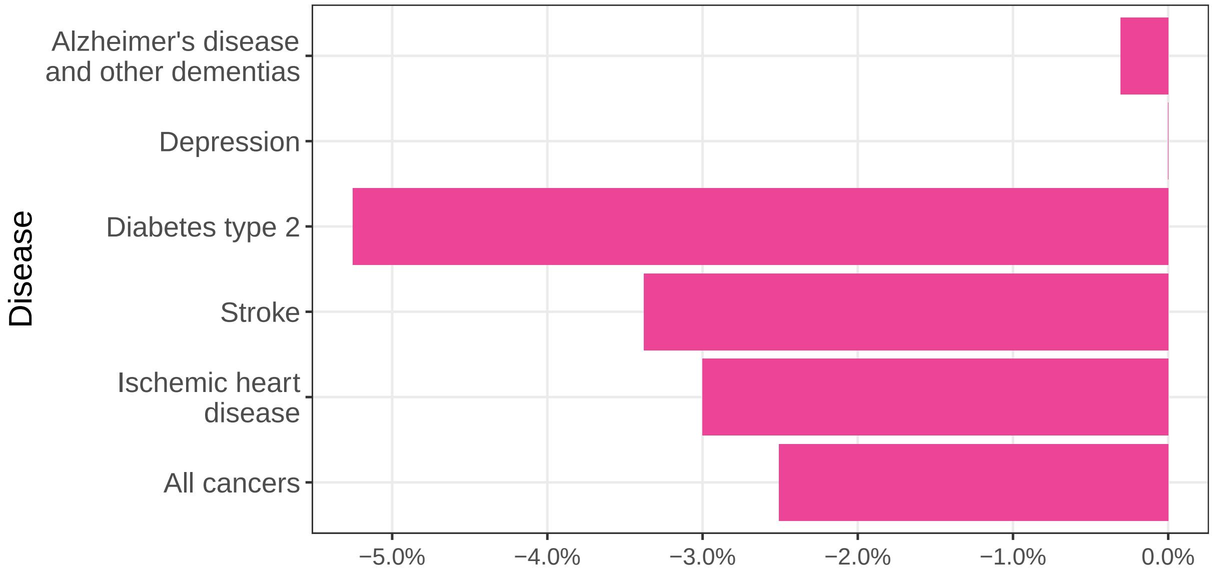

Figure 4.a: Percentage change in mortality by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

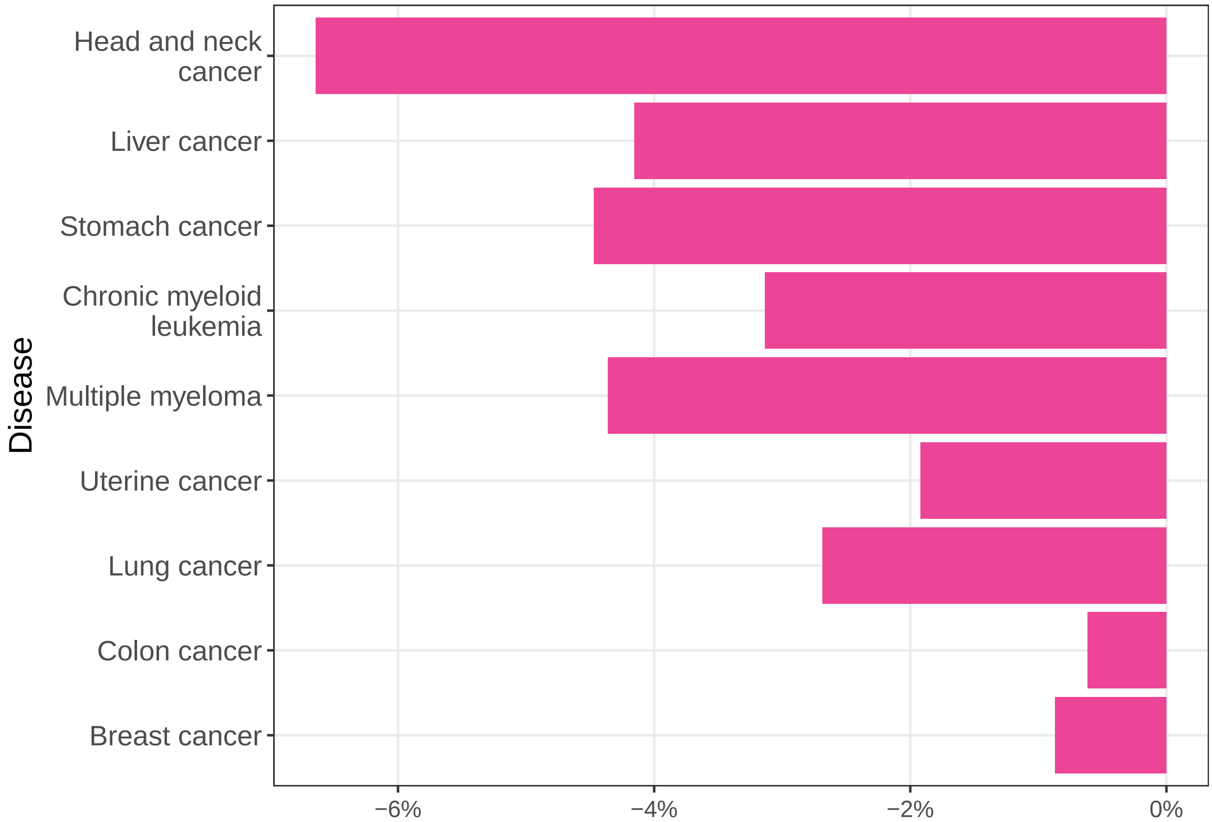

Figure 4.b: Percentage change in mortality for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

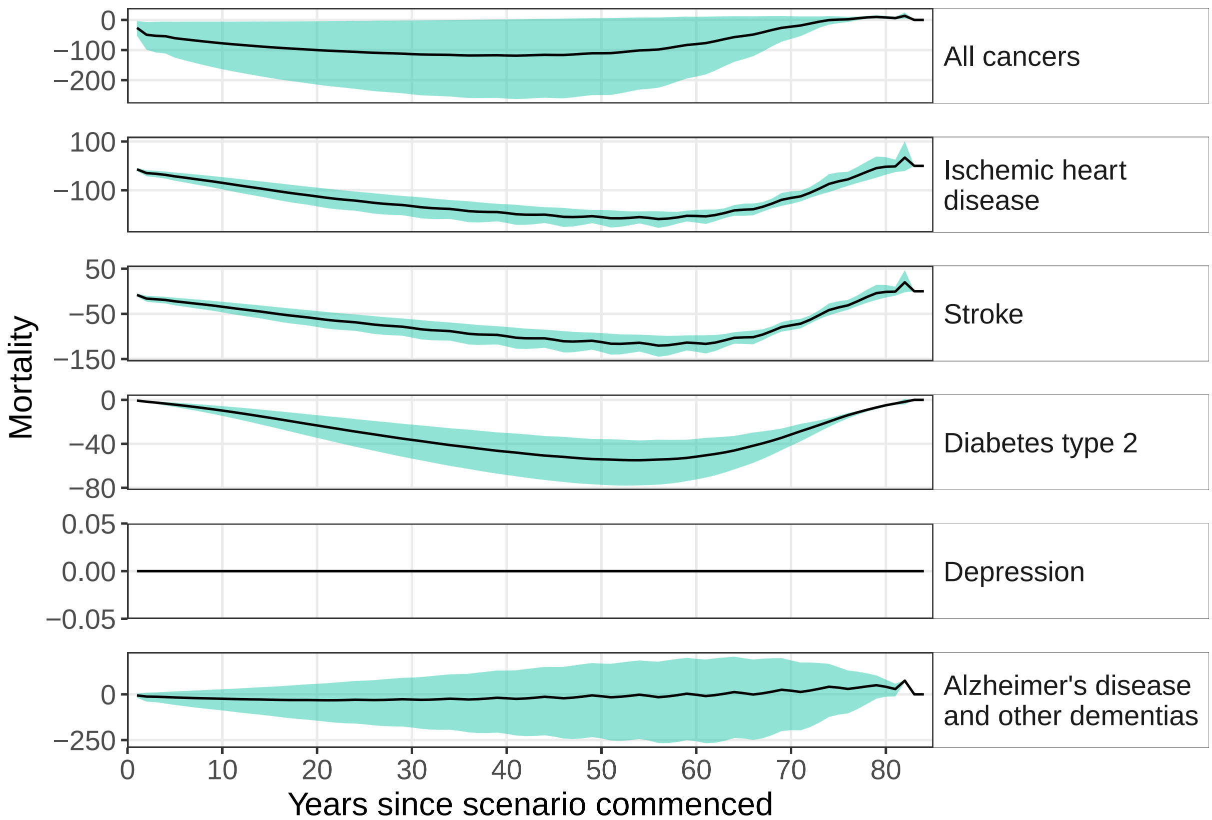

Figure 5.a: The change in mortality over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

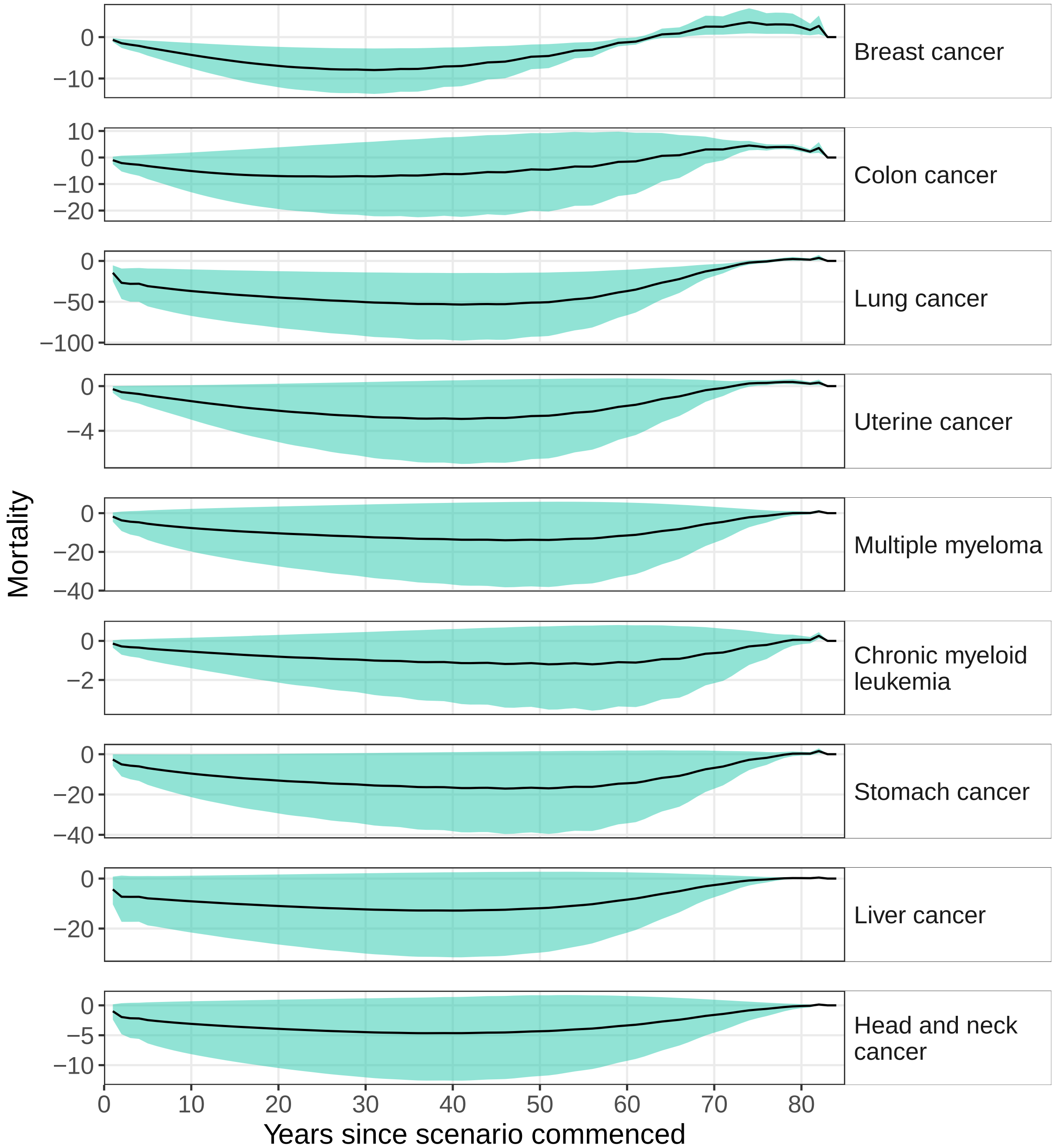

Figure 5.b: Percentage change in mortality for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Health

Figures 6 and 7 below show the change in Health Adjusted Life Years (HALYs)[1] and Life Years[2] for a snapshot of the population from 2019 for the scenario. Both figures show that the greatest gains from increasing physical activity occur midway through the life cycle with most of the gains occurring cumulatively in the long term. The decline from the mid-point onwards is due to individuals dying from natural causes within the model.

HALYS

The model estimates a total of **744,756** HALYs for the scenario population, which is **370** HALYs per 1,000 members of the population.

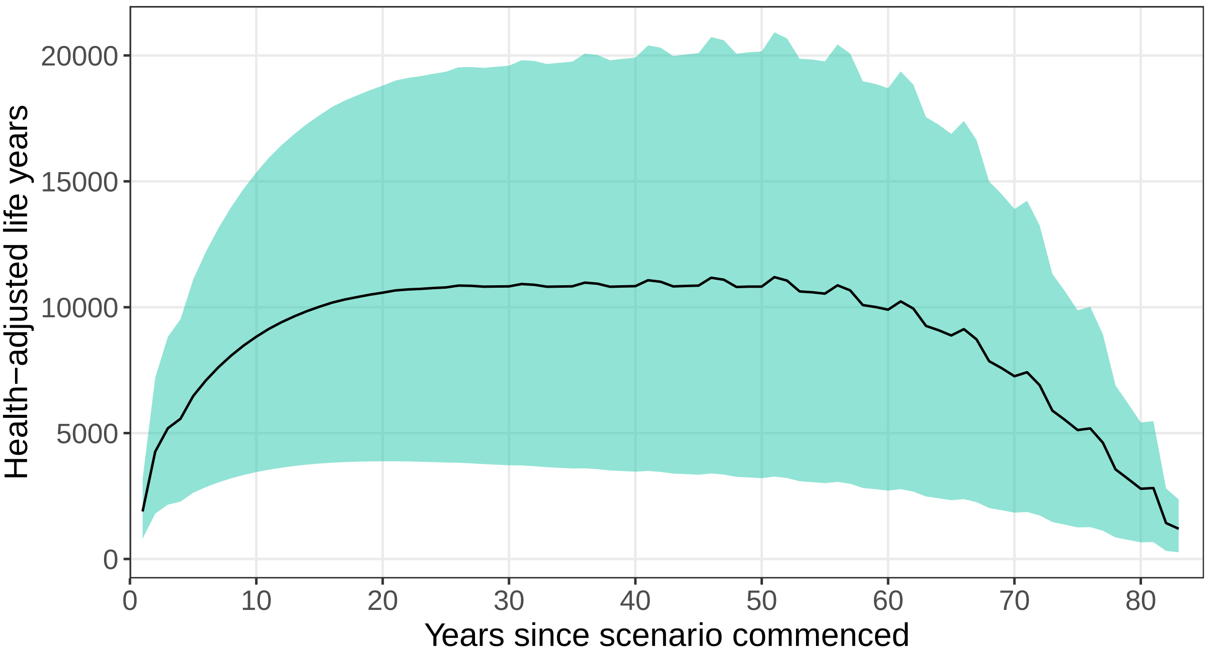

Figure 6. Total health-adjusted life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

[1]Health Adjusted Life Years are holistic measures of health that account for morbidity, mortality and quality of life.

[2]Life Years are similar to a HALYs however they exclude the quality of life component.

Life Years

The model estimates a total of **451,638** Life Years for the scenario population, which is **224** Life Years per 1,000 members of the population.

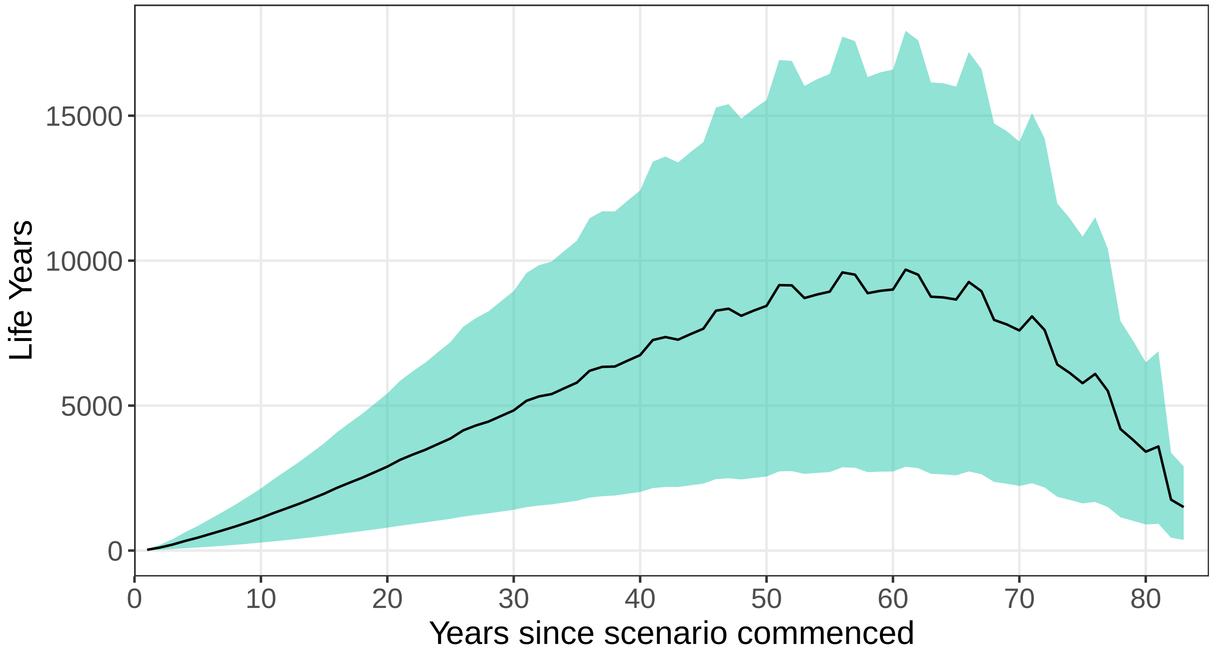

Figure 7. Total life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Value

The value of improvements to community health can be calculated**[a]** by translating the Health Adjusted Life Years (HALYs) from each scenario into dollar terms using the value of a statistical life year**[b]**. The value of a statistical life year is an estimate of the amount a society is willing to trade to reduce the risk of death for one year.

In the simulation model, HALYs are generated across time and are cumulative. Thus, to help us understand the value of HALYs across time in present day terms, it is necessary to use discounting**[c]** to reduce HALYs generated at the future point in time. Discounted HALYs from these future points can be added up to give the aggregate value of HALYs in today's terms as a measure of the value of improvements to community health arising from the chosen scenario.

The size of the discount rate can impact the aggregated value of HALYs and there is considerable debate on what discount rates should be used (with some arguing that health should not be discounted at all).[2] Hence, it is common to use a variety of discount rates to allow for differing risks, preferences and sensitivity when valuing health. The figures presented below were calculated using discount rates of 3%, 5% and 7% based on recent recommendations [3, 4] and represent the value of HALYs in present day terms resulting from an increase in physical activity from the chosen scenario.

The value of improvements to community health

The model estimates a total of **HALYs,** Health Adjusted Life Years (HALYs) gained for the scenario population, which is **370** HALYs per 1,000 members of the scenario population. The figures below represent the value of improvements to community health from the chosen scenario. These figures can be used in summary reports and for advocacy purposes**[d]**.

The HALYs gained in this scenario have a statistical value of:

- **29,225,040** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **18,098,410** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **12,431,757** per 1,000 members of the population, when calculated using a discount rate of 7%.

a. What is meant by value and how can it be measured?

Value is conceptual and measures a sense of worth or usefulness of something to individuals or to a society. Measuring the value of something, such as health, enables it to be included in assessments or analyses such as cost-benefit analyses to recognise its relative importance.

Value can be derived in many ways and a common approach is to use monetary terms, such as dollars. Valuing something using dollars is not the same as equating it with its price. Prices represent the amount at which something can be traded, prices therefore represent the amount of money for buying or selling something such as food, clothing or to pay bills. One way is to evaluate health in dollar terms is to use the Value of a Statistical Life and Value of a Statistical Life Year**[b]**.

b. What is the Value of a Statistical Life and Value of a Statistical Life Year?

The value of a **statistical life** is the estimated amount that a society is willing to trade to reduce the risk of death. The word 'Statistical' refers to the average value for life and therefore means the value of a statistical life doesn't relate to any specific individual. This value can change across risk factors and different societies who may value life differently. There are various ways of measuring the value of a statistical life with most approaches using revealed or stated preference approaches.[3] In Australia, the Office of Best Practice Regulation estimates a statistical life at $5.3M in 2022 dollar terms, and assumes that the life is of a young person with at least another 40 years to live.[5, 6]

Value of a Statistical Life Year

The value of a statistical life year is the estimated amount that a society is willing to trade to reduce the risk of death over **one year.** It can be derived from the value of a statistical life or measured directly using surveys or willingness to pay techniques.[5] The current value of a **statistical life year** is $227,000 in 2022 dollars based on current estimates from the Office of Best Practice Regulation.[6] The value of a statistical life year is useful for evaluating small increases in life years instead of evaluating full life expectancy. It is appropriate for valuing the Health Adjusted Life Years estimated from the scenarios and modelling presented in this tool. For the modelling and results presented here, the value of $227,000 was converted to 2019 dollars based on the Wage Price Index for Brisbane.

c. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

d. Application in advocacy and reporting

This section uses figures to show how the value of community health (estimated from HALYs and the value of statistical life year) can be used for reporting and advocacy purposes.

The simulation model uses **population-based estimates** for disease morbidity and mortality and is best applied to larger groups of people. It also assumes that the people of interest have similar characteristics and behaviours to the population data used in the simulation model and scenarios. The **example** below shows results from a scenario that replaces car trips with walking trips for distances of 0-2 km for All age groups.

Example:

The HALYs gained in this scenario have a statistical value of:

- **$10,859,605** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **$6,662,541** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **$4,533,392** per 1,000 members of the population, when calculated using a discount rate of 7%.

This **example** shows that the HALYs gained in this scenario have a statistical value of $10,859,605 per 1,000 members of the population using a discount of 3%.

This figure can be divided by 1,000 to give a per person figure. Once a per person figure is established, it can be multiplied by the number of people in any population size of interest for use in reports or as evidence to advocate for benefits associated with shifts to active transport modes.

$10,859,605 / 1,000 = $10,859.61 per person value

A good example of how this model can be applied links to previous research that investigated the impact of new more walkable development in Altona North on a population of 21,000 people [11]. If we assume that these people have similar characteristics to the underlying population based estimates and behaviours based on the travel survey data in the simulation model underlying this tool, then the value of community health according to the chosen scenario can be calculated as:

21,000 (people) x $10,859 (statistical value from HALYs gained) = $228 M.

Savings

An increase in physical activity due to the chosen scenario reduces chronic disease cases across a lifetime and reduces spending for each disease within the health care system resulting in overall health care cost savings**[a]**.

Table 3 provides estimated health care cost savings associated with the prevented cases of chronic diseases per 1,000 members of the population according to the selected scenario. These figures are based on applying average health care system costs per prevalent case of disease and using three alternative discount rates**[b]**:

Table 3. Total health care cost savings by disease per 1,000 members of the population.

Disease	3% discount rate	5% discount rate	7% discount rate
Alzheimer's disease and other dementias	$23,299	$14,261	$9,544
Breast cancer	$230,508	$146,734	$99,765
All cancers	$518,134	$331,358	$227,485
Colon cancer	$113,191	$74,875	$52,337
Chronic myeloid leukemia	$26,565	$15,985	$10,555
Diabetes type 2	$139,694	$82,951	$53,688
Depression	$744,918	$569,478	$446,745
Head and neck cancer	$4,296	$2,793	$1,975
Ischemic heart disease	$283,628	$168,495	$109,662
Liver cancer	$4,254	$2,801	$2,001
Multiple myeloma	$63,233	$39,690	$27,187
Stomach cancer	$26,868	$16,794	$11,475
Stroke	$43,552	$25,667	$16,639
Lung cancer	$37,917	$24,596	$17,358
Uterine cancer	$11,339	$7,144	$4,844

a. What do we mean by health care cost savings?

To calculate health care cost savings for each disease, the annual costs for each disease in each year is multiplied by the number of prevented cases of each disease for each scenario. This results in a total saving in spending for each disease by year. The savings in spending for future years are discounted**[b]** with annual savings aggregated to give a total amount saved for each disease. Total savings are presented as the amount saved per 1,000 members of the population to enable comparisons against populations of different sizes.

We use the term **health care cost saving** because it represents a reduction in health spending. However, the Australian Institute of Health and Welfare (AIHW) stress that the term cost is broad and not representative of the full cost experienced by individuals, families, or the health system, consequently AIHW use the term spending.[8]

These figures use AIHW estimates of the amounts spent through the health system in 2018-19 for each case of disease. This is extracted from Health system spending per case of disease and for certain risk factors, Table 1 – Estimates of health system spending per case, by burden of disease group, condition and sex, Australia 2018-2019.[9]. For head and neck cancers, supplementary figures were obtained from the Global Burden of Disease incidence data.[10]

b. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

References

1. Gold, M. R., Stevenson, D., & Fryback, D. G. (2002). *HALYS and QALYS and DALYS, Oh My: similarities and differences in summary measures of population Health.* Annual review of public health, 23(1), 115-134.
2. Attema, A.E., Brouwer, W.B. & Claxton, K. (2018). *Discounting in economic evaluations.* Pharmacoeconomics. 36: p. 745-758.
3. Ananthapavan, J., Moodie, M., Milat, A.J., & Carter, R. (2021). *Systematic review to update 'value of a statistical life' estimates for Australia.* International journal of environmental research and public health, 2021. 18(11): p. 6168.
4. Terrill, M. & Batrouney, H. (2018). *Unfreezing discount rates: Transport infrastructure for tomorrow.* Grattan Institute.
5. Abelson, P. (2008). *Establishing a monetary value for lives saved: issues and controversies.* Canberra: Office of Best Practice Regulation, Department of Finance and Deregulation.
6. Department of the Prime Minister and Cabinet. (2022). *Best practice regulation guidance note: Value of statistical life.* Australian Government.
7. Haacker, M., Hallett, T.B. & Atun, R. (2020). *On discount rates for economic evaluations in global health.* Health Policy and Planning, 2020. 35(1): p. 107-114.
8. Australian Institute of Health and Welfare (2023). Technical Notes: Estimating Spending per prevalent case of disease. Health system spending per case of disease and for certain risk factors, Estimating the spending per prevalent case of disease - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
9. Australian Institute of Health and Welfare (2023). Health system spending per case of disease and for certain risk factors. Health system spending per case of disease and for certain risk factors, Data - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
10. Global Burden of Disease (2019). Global Health Data Exchange. https://vizhub.healthdata.org/gbd-results. Accessed September 20, 2023.
11. Zapata-Diomedi, B., Boulangé, C., Giles-Corti, B., Phelan, K., Washington, S., Veerman, L.J., & Gunn, L. (2019). Physical activity-related health and economic benefits of building walkable neighbourhoods: A modelled comparison between brownfield and greenfield developments. International Journal of Behavioural Nutrition and Physical Activity.
12. Khorasani, E., Davari, M., Kebriaeezadeh, A., Fatemi, F., Akbari Sari, A., & Varahrami, V. (2022). A comprehensive review of official discount rates in guidelines of health economic evaluations over time: the trends and roots. The European Journal of Health Economics, 23(9), 1577-1590.

Scenario: replacing car trips under 1km with walking, and car trips between 1 and 10km with cycling for all trip purposes

This scenario shows the results of replacing car trips under 1km with walking and replacing car trips between 1km and 10km with cycling for leisure, shopping, work, education or other purposes for all adults of all ages.

This implies that the selected scenario results in a mode shift in walking from 16.8% to 20.2%; cycling from 1.3% to 47.5%; and, from 74.7% to 25.0% for car trips taken as either a driver or passenger.

Increases in walking and cycling translate into a shift from 47.9% to 75.2% of the population accumulating the required minutes spent being moderately (150 – 300 mins) or vigorously physically active (75 – 150 mins) or an equivalent combination of both contributing to recommended levels as detailed in the Physical Activity Guidelines.

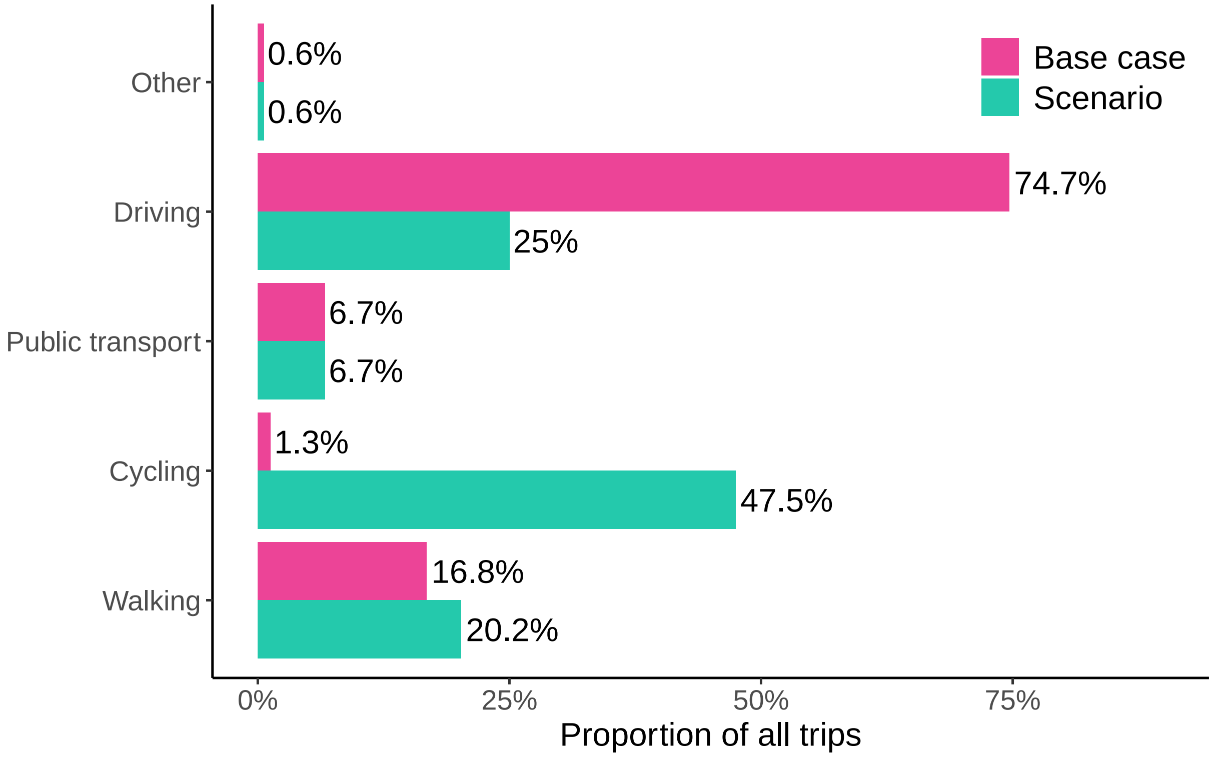

Figure 1: Distribution of base case and scenario trips.

Incidence

Incidence describes the rate of occurrence of new cases of a disease over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of disease prevented, due to increases in physical activity associated with the scenario. Figure 2 presents the change (%) in the disease incidence across the life course. Figure 3 presents how the difference in disease incidence changes over time, by year, using a snapshot of the population from 2019.

Table 1 shows how the scenario impacts the incidence of chronic diseases as both as a percentage and total number of prevented cases.

Table 1. Chronic disease incidence reduction and total number of prevented cases of disease measured across the years of the simulation

Disease*	Incidence of disease is reduced by	Total number of prevented cases of disease aggregated across the simulation
Alzheimer's disease and other dementias	1.68%	10,685
Breast cancer	2.15%	1,578
All cancers	3.03%	11,956
Colon cancer	1.47%	1,906
Chronic myeloid leukemia	4.65%	127
Diabetes type 2	9.49%	31,342
Depression	1.99%	31,936
Head and neck cancer	8.78%	387
Ischemic heart disease	4.61%	40,600
Liver cancer	5.73%	1,008
Multiple myeloma	5.70%	1,106
Stomach cancer	6.16%	1,472
Stroke	5.09%	13,255
Lung cancer	3.57%	4,101
Uterine cancer	3.17%	269

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

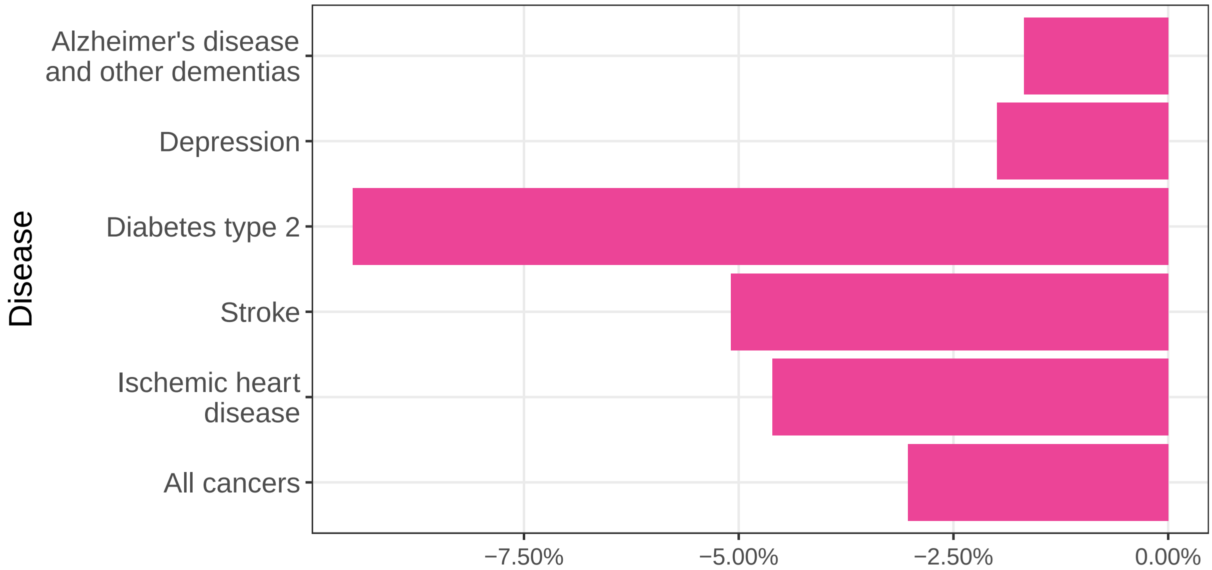

Figure 2.a: Percentage change in incidence by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

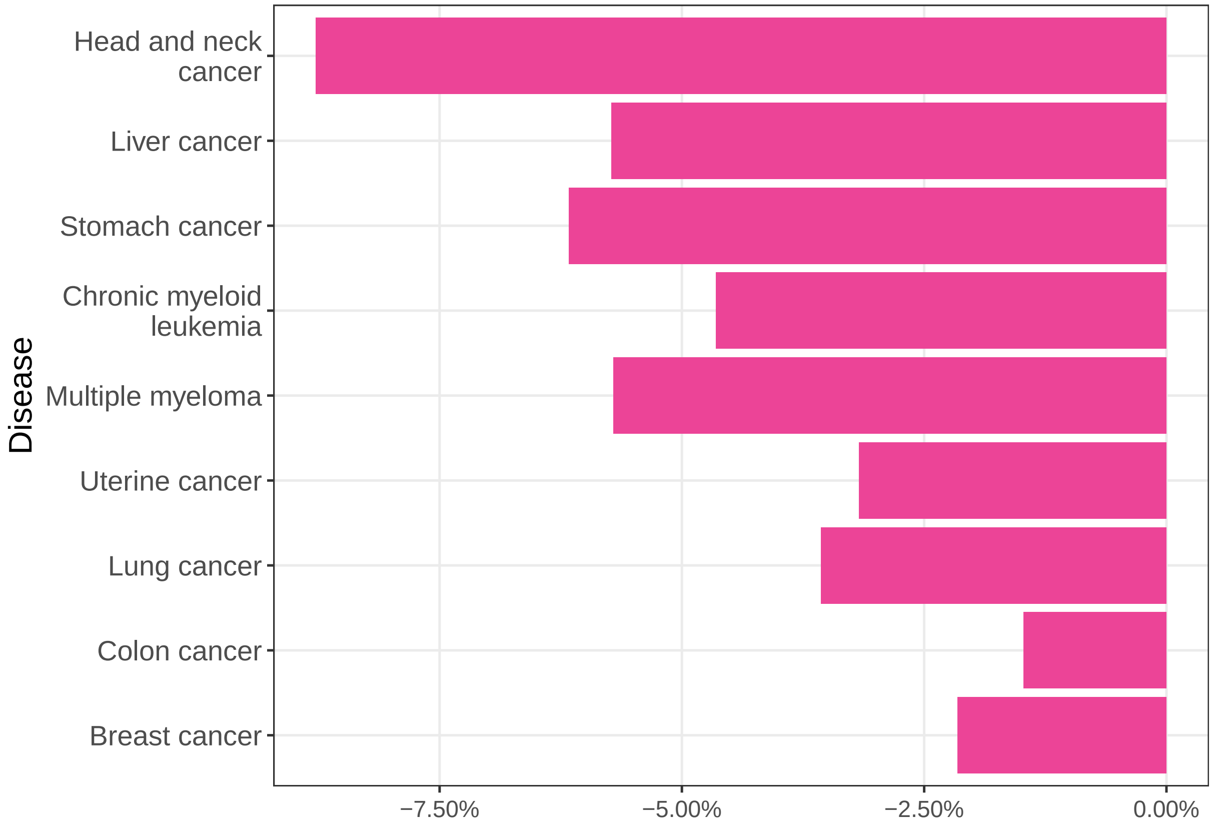

Figure 2.b: Percentage change in incidence for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

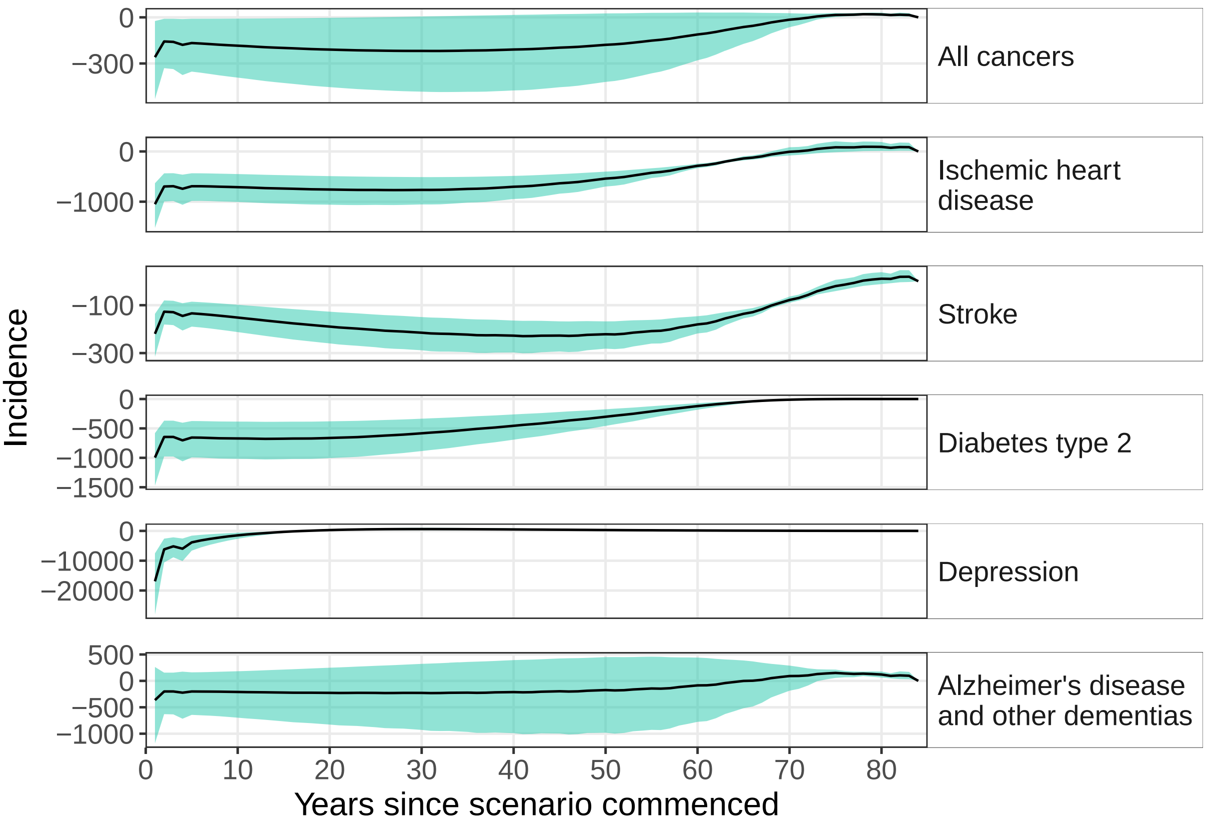

Figure 3.a: The change in incidence over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

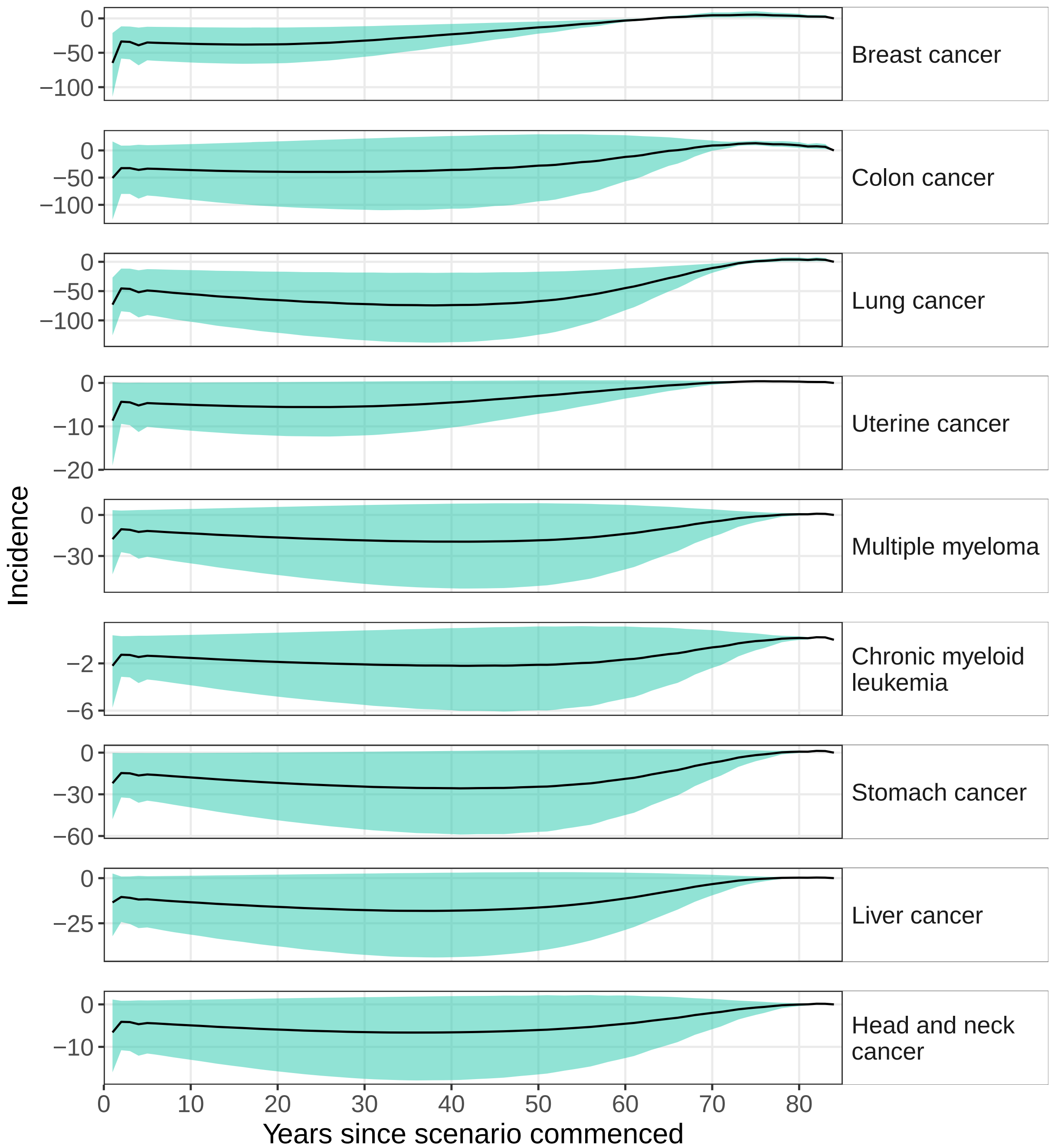

Figure 3.b: Percentage change in incidence for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Mortality

Mortality is the number of deaths due to a given disease over over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of prevented deaths due to increases in physical activity associated with the scenario. Figure 4 presents the total change in mortality over the life course. Figure 5 presents the difference in the number of deaths by year using a snapshot of the population from 2019.

Table 2 shows how the scenario impacts reductions in mortality presented as a percentage and total number of prevented deaths caused by chronic diseases.

Table 2. Percentage reduction in mortality and total number of prevented deaths by chronic disease measured across the years of the simulation.

Disease*	Mortality is reduced by	Total number of prevented deaths aggregated across the simulation
Alzheimer's disease and other dementias	0.39%	925
Breast cancer	1.35%	436
All cancers	3.33%	8,434
Colon cancer	0.85%	366
Chronic myeloid leukemia	4.03%	83
Diabetes type 2	7.34%	3,625
Depression	0.00%	0
Head and neck cancer	8.78%	350
Ischemic heart disease	4.13%	15,496
Liver cancer	5.71%	974
Multiple myeloma	5.51%	960
Stomach cancer	5.97%	1,262
Stroke	4.50%	7,872
Lung cancer	3.50%	3,812
Uterine cancer	2.65%	191

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

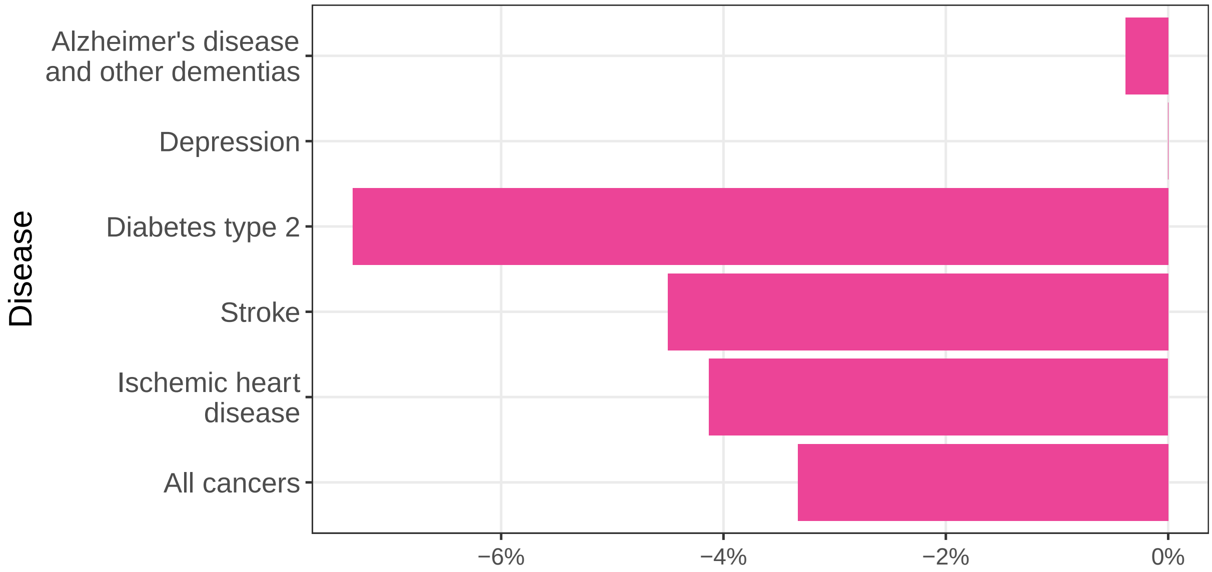

Figure 4.a: Percentage change in mortality by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

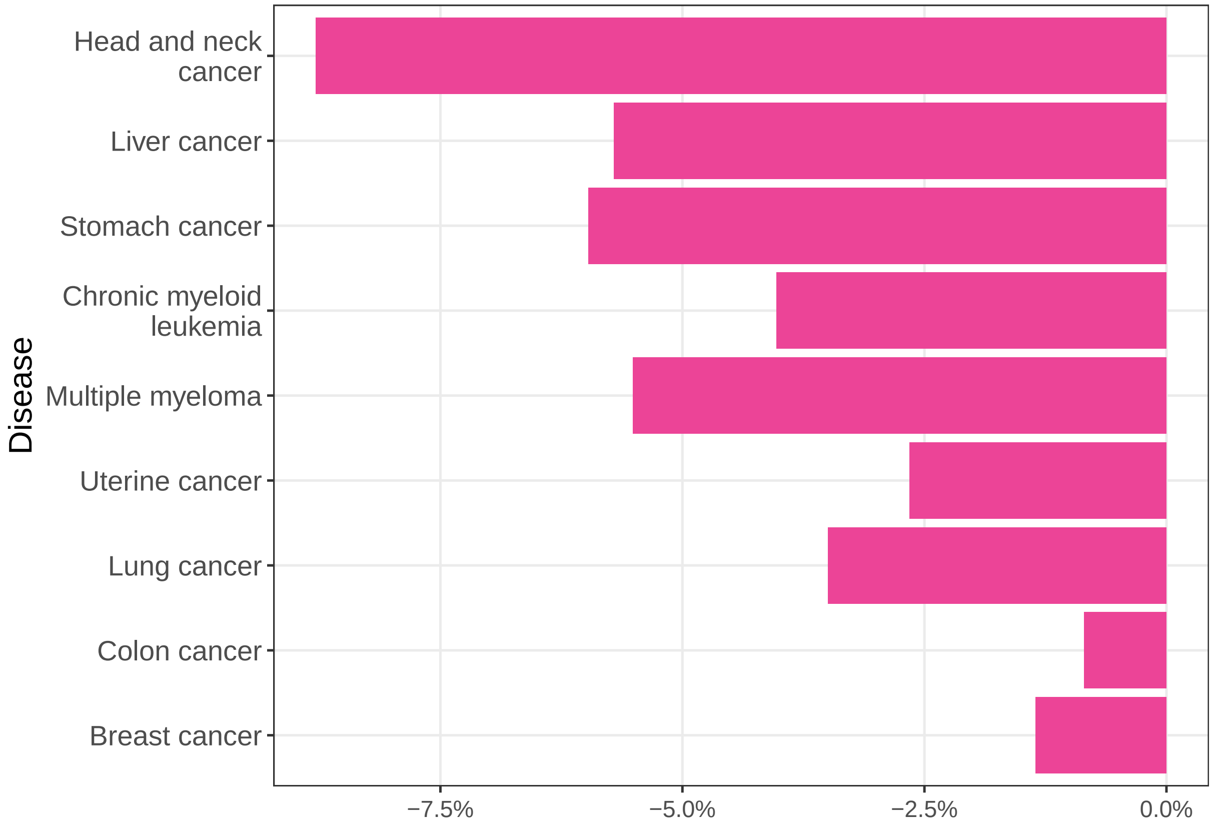

Figure 4.b: Percentage change in mortality for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

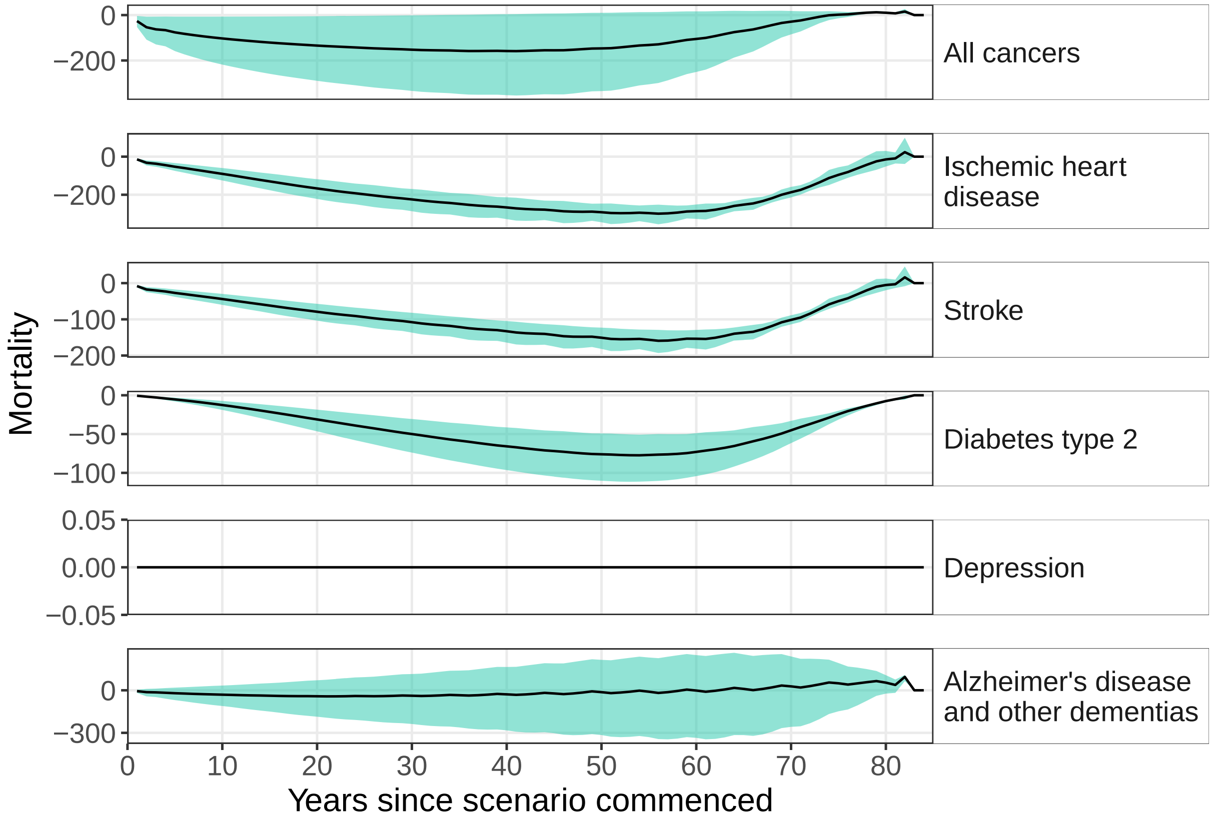

Figure 5.a: The change in mortality over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

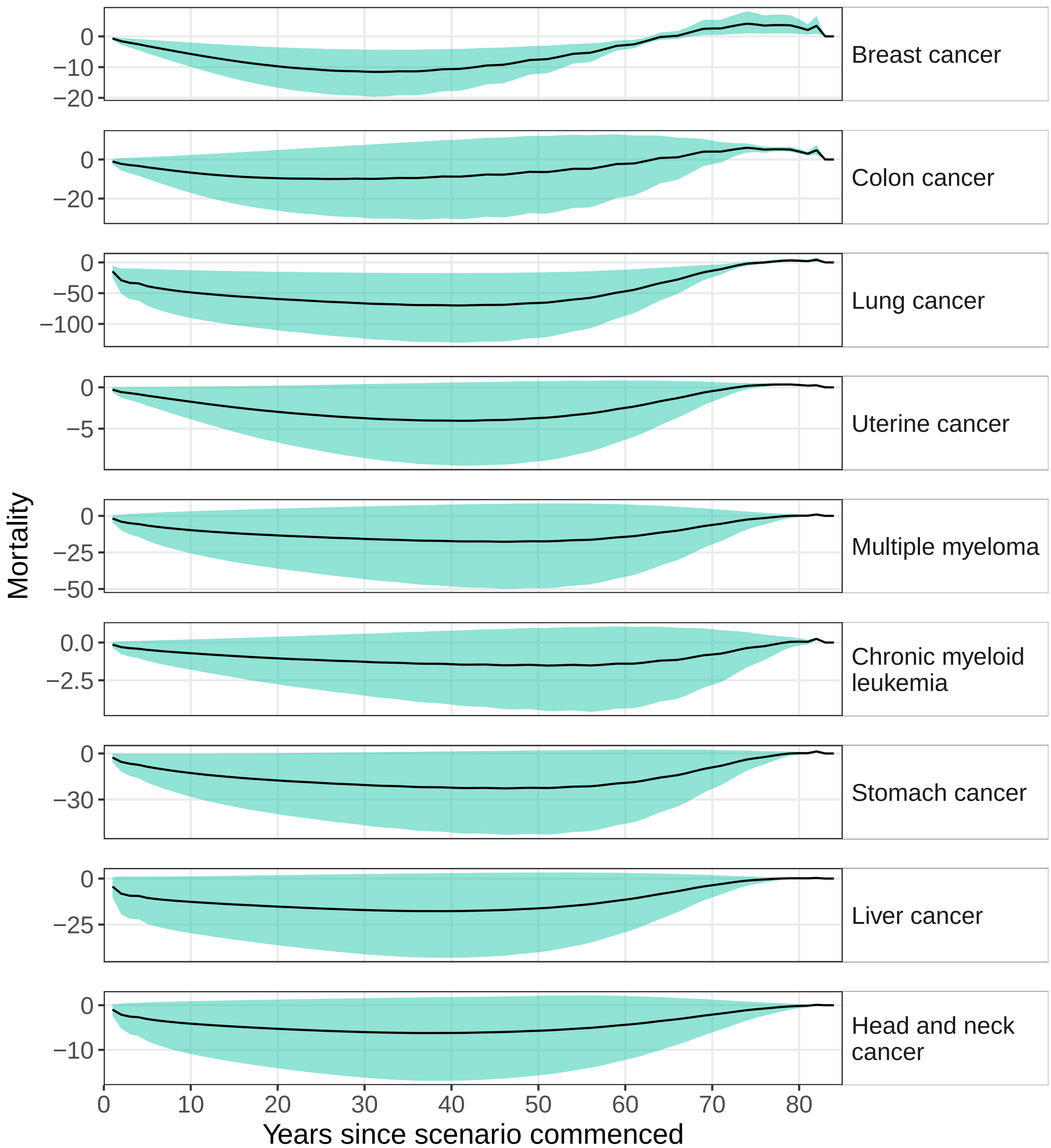

Figure 5.b: Percentage change in mortality for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Health

Figures 6 and 7 below show the change in Health Adjusted Life Years (HALYs)[1] and Life Years[2] for a snapshot of the population from 2019 for the scenario. Both figures show that the greatest gains from increasing physical activity occur midway through the life cycle with most of the gains occurring cumulatively in the long term. The decline from the mid-point onwards is due to individuals dying from natural causes within the model.

HALYS

The model estimates a total of **994,246** HALYs for the scenario population, which is **494** HALYs per 1,000 members of the population.

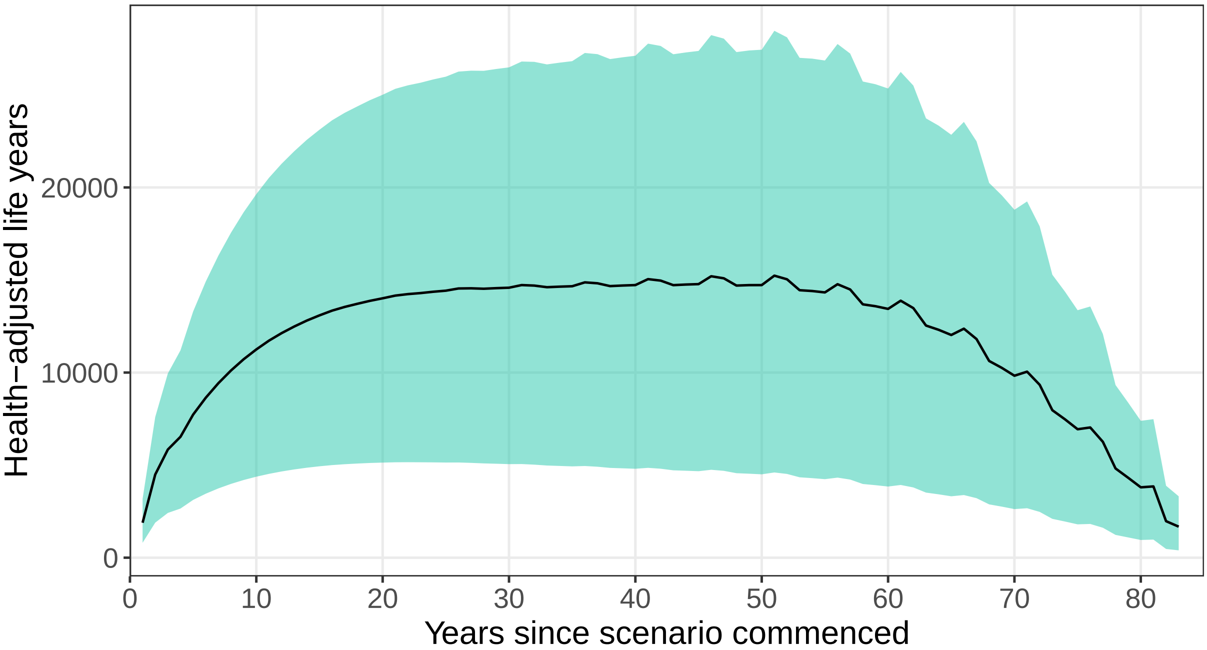

Figure 6. Total health-adjusted life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

[1] Health Adjusted Life Years are holistic measures of health that account for morbidity, mortality and quality of life.

[2] Life Years are similar to a HALYs however they exclude the quality of life component.

Life Years

The model estimates a total of **607,251** Life Years for the scenario population, which is **302** Life Years per 1,000 members of the population.

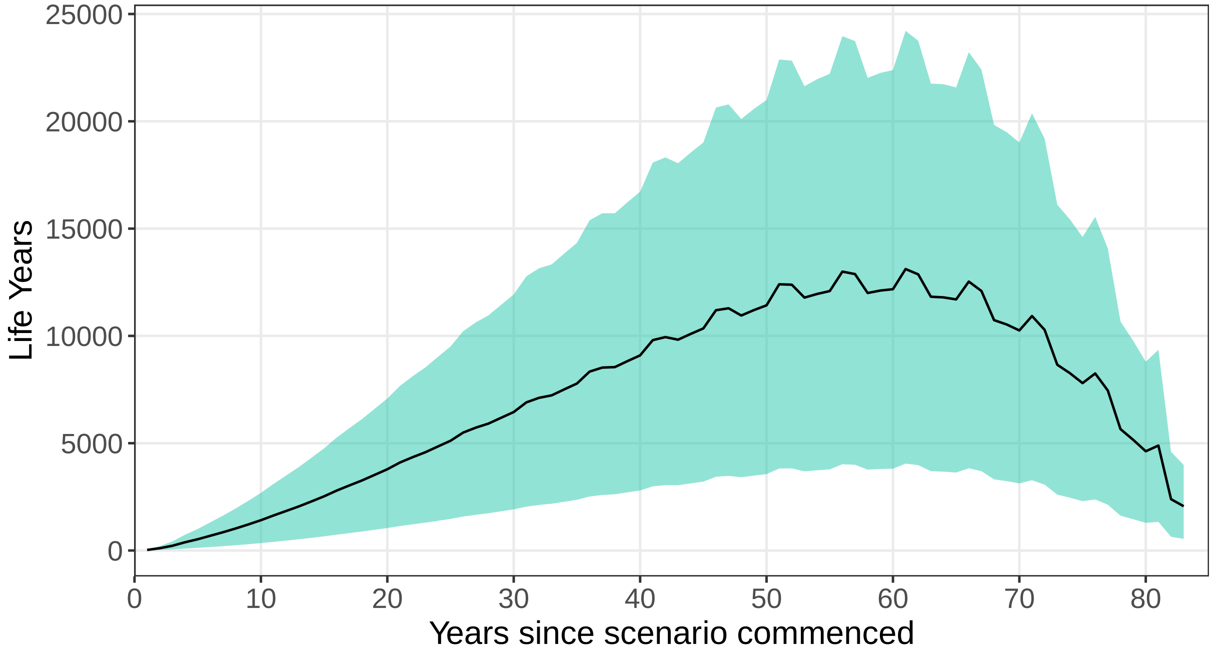

Figure 7. Total life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Value

The value of improvements to community health can be calculated**[a]** by translating the Health Adjusted Life Years (HALYs) from each scenario into dollar terms using the value of a statistical life year**[b]**. The value of a statistical life year is an estimate of the amount a society is willing to trade to reduce the risk of death for one year.

In the simulation model, HALYs are generated across time and are cumulative. Thus, to help us understand the value of HALYs across time in present day terms, it is necessary to use discounting**[c]** to reduce HALYs generated at the future point in time. Discounted HALYs from these future points can be added up to give the aggregate value of HALYs in today's terms as a measure of the value of improvements to community health arising from the chosen scenario.

The size of the discount rate can impact the aggregated value of HALYs and there is considerable debate on what discount rates should be used (with some arguing that health should not be discounted at all).[2] Hence, it is common to use a variety of discount rates to allow for differing risks, preferences and sensitivity when valuing health. The figures presented below were calculated using discount rates of 3%, 5% and 7% based on recent recommendations [3, 4] and represent the value of HALYs in present day terms resulting from an increase in physical activity from the chosen scenario.

The value of improvements to community health

The model estimates a total of **HALYs,** Health Adjusted Life Years (HALYs) gained for the scenario population, which is **494** HALYs per 1,000 members of the scenario population. The figures below represent the value of improvements to community health from the chosen scenario. These figures can be used in summary reports and for advocacy purposes**[d]**.

The HALYs gained in this scenario have a statistical value of:

- **38,342,345** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **23,442,857** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **15,906,876** per 1,000 members of the population, when calculated using a discount rate of 7%.

a. What is meant by value and how can it be measured?

Value is conceptual and measures a sense of worth or usefulness of something to individuals or to a society. Measuring the value of something, such as health, enables it to be included in assessments or analyses such as cost-benefit analyses to recognise its relative importance.

Value can be derived in many ways and a common approach is to use monetary terms, such as dollars. Valuing something using dollars is not the same as equating it with its price. Prices represent the amount at which something can be traded, prices therefore represent the amount of money for buying or selling something such as food, clothing or to pay bills. One way is to evaluate health in dollar terms is to use the Value of a Statistical Life and Value of a Statistical Life Year**[b]**.

b. What is the Value of a Statistical Life and Value of a Statistical Life Year?

The value of a **statistical life** is the estimated amount that a society is willing to trade to reduce the risk of death. The word 'Statistical' refers to the average value for life and therefore means the value of a statistical life doesn't relate to any specific individual. This value can change across risk factors and different societies who may value life differently. There are various ways of measuring the value of a statistical life with most approaches using revealed or stated preference approaches.[3] In Australia, the Office of Best Practice Regulation estimates a statistical life at $5.3M in 2022 dollar terms, and assumes that the life is of a young person with at least another 40 years to live.[5, 6]

Value of a Statistical Life Year

The value of a statistical life year is the estimated amount that a society is willing to trade to reduce the risk of death over **one year.** It can be derived from the value of a statistical life or measured directly using surveys or willingness to pay techniques.[5] The current value of a **statistical life year** is $227,000 in 2022 dollars based on current estimates from the Office of Best Practice Regulation.[6] The value of a statistical life year is useful for evaluating small increases in life years instead of evaluating full life expectancy. It is appropriate for valuing the Health Adjusted Life Years estimated from the scenarios and modelling presented in this tool. For the modelling and results presented here, the value of $227,000 was converted to 2019 dollars based on the Wage Price Index for Brisbane.

c. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

d. Application in advocacy and reporting

This section uses figures to show how the value of community health (estimated from HALYs and the value of statistical life year) can be used for reporting and advocacy purposes.

The simulation model uses **population-based estimates** for disease morbidity and mortality and is best applied to larger groups of people. It also assumes that the people of interest have similar characteristics and behaviours to the population data used in the simulation model and scenarios. The **example** below shows results from a scenario that replaces car trips with walking trips for distances of 0-2 km for All age groups.

Example:

The HALYs gained in this scenario have a statistical value of:

- **$10,859,605** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **$6,662,541** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **$4,533,392** per 1,000 members of the population, when calculated using a discount rate of 7%.

This **example** shows that the HALYs gained in this scenario have a statistical value of $10,859,605 per 1,000 members of the population using a discount of 3%.

This figure can be divided by 1,000 to give a per person figure. Once a per person figure is established, it can be multiplied by the number of people in any population size of interest for use in reports or as evidence to advocate for benefits associated with shifts to active transport modes.

$10,859,605 / 1,000 = $10,859.61 per person value

A good example of how this model can be applied links to previous research that investigated the impact of new more walkable development in Altona North on a population of 21,000 people [11]. If we assume that these people have similar characteristics to the underlying population based estimates and behaviours based on the travel survey data in the simulation model underlying this tool, then the value of community health according to the chosen scenario can be calculated as:

21,000 (people) x $10,859 (statistical value from HALYs gained) = $228 M.

Savings

An increase in physical activity due to the chosen scenario reduces chronic disease cases across a lifetime and reduces spending for each disease within the health care system resulting in overall health care cost savings**[a]**.

Table 3 provides estimated health care cost savings associated with the prevented cases of chronic diseases per 1,000 members of the population according to the selected scenario. These figures are based on applying average health care system costs per prevalent case of disease and using three alternative discount rates**[b]**:

Table 3. Total health care cost savings by disease per 1,000 members of the population.

Disease	3% discount rate	5% discount rate	7% discount rate
Alzheimer's disease and other dementias	$30,726	$18,694	$12,420
Breast cancer	$322,704	$202,287	$135,691
All cancers	$703,846	$445,529	$302,802
Colon cancer	$153,698	$100,767	$69,801
Chronic myeloid leukemia	$33,845	$20,263	$13,299
Diabetes type 2	$191,878	$113,017	$72,533
Depression	$948,278	$718,246	$558,443
Head and neck cancer	$5,660	$3,663	$2,574
Ischemic heart disease	$387,398	$228,427	$147,428
Liver cancer	$5,899	$3,868	$2,748
Multiple myeloma	$81,171	$50,759	$34,585
Stomach cancer	$35,845	$22,297	$15,141
Stroke	$57,185	$33,458	$21,519
Lung cancer	$49,909	$32,238	$22,619
Uterine cancer	$15,163	$9,470	$6,363

a. What do we mean by health care cost savings?

To calculate health care cost savings for each disease, the annual costs for each disease in each year is multiplied by the number of prevented cases of each disease for each scenario. This results in a total saving in spending for each disease by year. The savings in spending for future years are discounted**[b]** with annual savings aggregated to give a total amount saved for each disease. Total savings are presented as the amount saved per 1,000 members of the population to enable comparisons against populations of different sizes.

We use the term **health care cost saving** because it represents a reduction in health spending. However, the Australian Institute of Health and Welfare (AIHW) stress that the term cost is broad and not representative of the full cost experienced by individuals, families, or the health system, consequently AIHW use the term spending.[8]

These figures use AIHW estimates of the amounts spent through the health system in 2018-19 for each case of disease. This is extracted from Health system spending per case of disease and for certain risk factors, Table 1 – Estimates of health system spending per case, by burden of disease group, condition and sex, Australia 2018-2019.[9]. For head and neck cancers, supplementary figures were obtained from the Global Burden of Disease incidence data.[10]

b. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

References

1. Gold, M. R., Stevenson, D., & Fryback, D. G. (2002). *HALYS and QALYS and DALYS, Oh My: similarities and differences in summary measures of population Health.* Annual review of public health, 23(1), 115-134.
2. Attema, A.E., Brouwer, W.B. & Claxton, K. (2018). *Discounting in economic evaluations.* Pharmacoeconomics. 36: p. 745-758.
3. Ananthapavan, J., Moodie, M., Milat, A.J., & Carter, R. (2021). *Systematic review to update 'value of a statistical life' estimates for Australia.* International journal of environmental research and public health, 2021. 18(11): p. 6168.
4. Terrill, M. & Batrouney, H. (2018). *Unfreezing discount rates: Transport infrastructure for tomorrow.* Grattan Institute.
5. Abelson, P. (2008). *Establishing a monetary value for lives saved: issues and controversies.* Canberra: Office of Best Practice Regulation, Department of Finance and Deregulation.
6. Department of the Prime Minister and Cabinet. (2022). *Best practice regulation guidance note: Value of statistical life.* Australian Government.
7. Haacker, M., Hallett, T.B. & Atun, R. (2020). *On discount rates for economic evaluations in global health.* Health Policy and Planning, 2020. 35(1): p. 107-114.
8. Australian Institute of Health and Welfare (2023). Technical Notes: Estimating Spending per prevalent case of disease. Health system spending per case of disease and for certain risk factors, Estimating the spending per prevalent case of disease - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
9. Australian Institute of Health and Welfare (2023). Health system spending per case of disease and for certain risk factors. Health system spending per case of disease and for certain risk factors, Data - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
10. Global Burden of Disease (2019). Global Health Data Exchange. https://vizhub.healthdata.org/gbd-results. Accessed September 20, 2023.
11. Zapata-Diomedi, B., Boulangé, C., Giles-Corti, B., Phelan, K., Washington, S., Veerman, L.J., & Gunn, L. (2019). Physical activity-related health and economic benefits of building walkable neighbourhoods: A modelled comparison between brownfield and greenfield developments. International Journal of Behavioural Nutrition and Physical Activity.
12. Khorasani, E., Davari, M., Kebriaeezadeh, A., Fatemi, F., Akbari Sari, A., & Varahrami, V. (2022). A comprehensive review of official discount rates in guidelines of health economic evaluations over time: the trends and roots. The European Journal of Health Economics, 23(9), 1577-1590.

Scenario: replacing car trips under 2km with walking, and car trips between 2 and 5km with cycling for all trip purposes

This scenario shows the results of replacing car trips under 2km with walking and replacing car trips between 2km and 5km with cycling for leisure, shopping, work, education or other purposes for all adults of all ages.

This implies that the selected scenario results in a mode shift in walking from 16.8% to 28.9%; cycling from 1.3% to 21.5%; and, from 74.7% to 42.3% for car trips taken as either a driver or passenger.

Increases in walking and cycling translate into a shift from 47.9% to 67.9% of the population accumulating the required minutes spent being moderately (150 – 300 mins) or vigorously physically active (75 – 150 mins) or an equivalent combination of both contributing to recommended levels as detailed in the Physical Activity Guidelines.

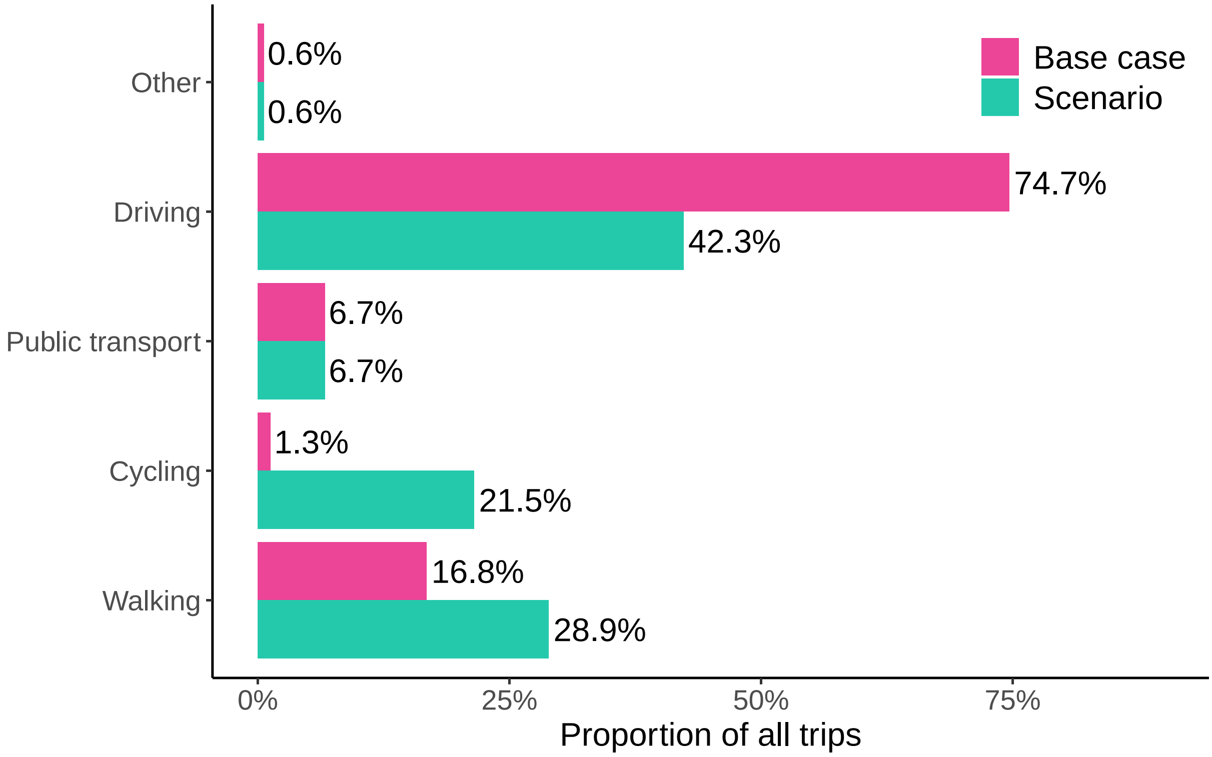

Figure 1: Distribution of base case and scenario trips.

Incidence

Incidence describes the rate of occurrence of new cases of a disease over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of disease prevented, due to increases in physical activity associated with the scenario. Figure 2 presents the change (%) in the disease incidence across the life course. Figure 3 presents how the difference in disease incidence changes over time, by year, using a snapshot of the population from 2019.

Table 1 shows how the scenario impacts the incidence of chronic diseases as both as a percentage and total number of prevented cases.

Table 1. Chronic disease incidence reduction and total number of prevented cases of disease measured across the years of the simulation

Disease*	Incidence of disease is reduced by	Total number of prevented cases of disease aggregated across the simulation
Alzheimer's disease and other dementias	1.21%	7,702
Breast cancer	1.50%	1,095
All cancers	2.28%	8,981
Colon cancer	1.09%	1,413
Chronic myeloid leukemia	3.54%	97
Diabetes type 2	7.01%	23,154
Depression	1.51%	24,246
Head and neck cancer	6.65%	293
Ischemic heart disease	3.32%	29,208
Liver cancer	4.22%	742
Multiple myeloma	4.52%	876
Stomach cancer	4.65%	1,109
Stroke	3.76%	9,791
Lung cancer	2.74%	3,156
Uterine cancer	2.34%	198

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

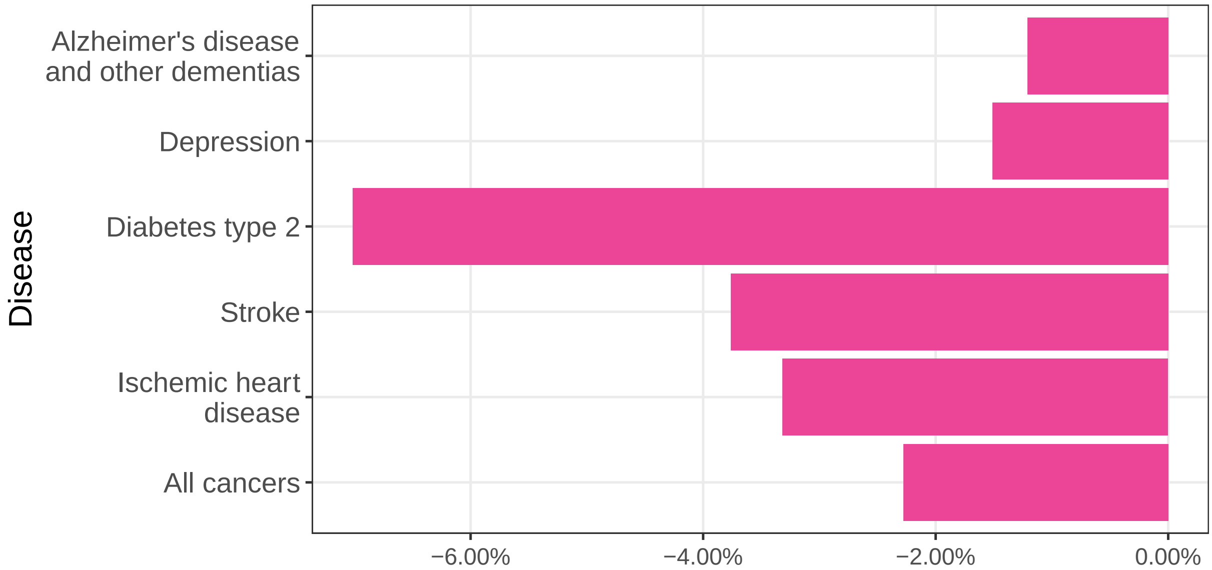

Figure 2.a: Percentage change in incidence by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

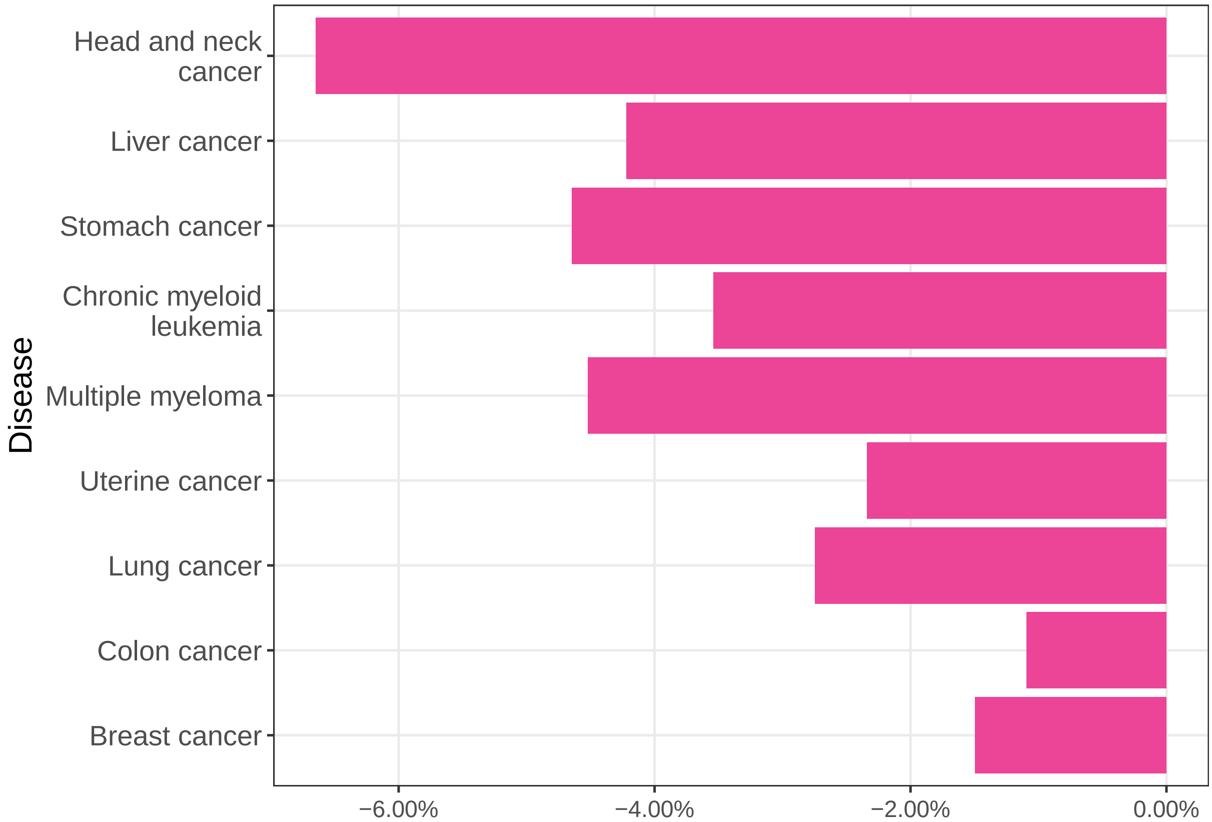

Figure 2.b: Percentage change in incidence for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

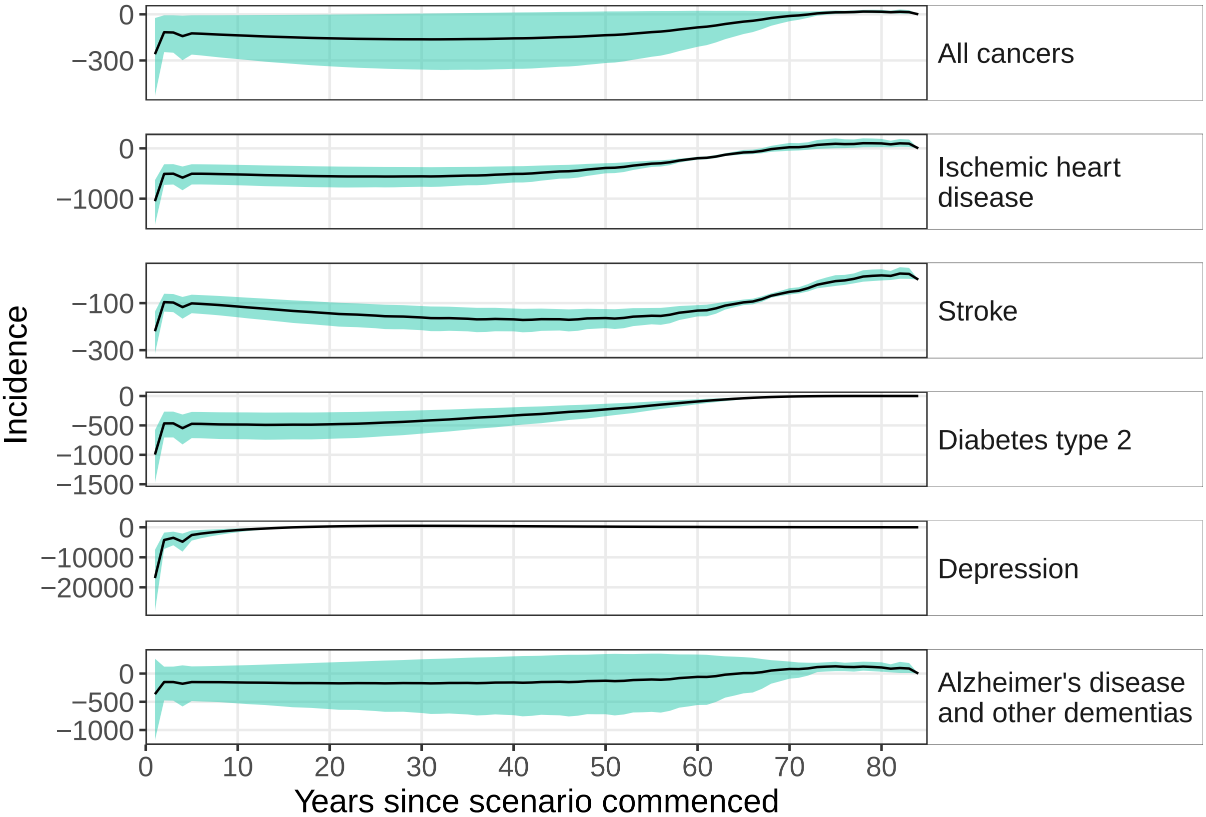

Figure 3.a: The change in incidence over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

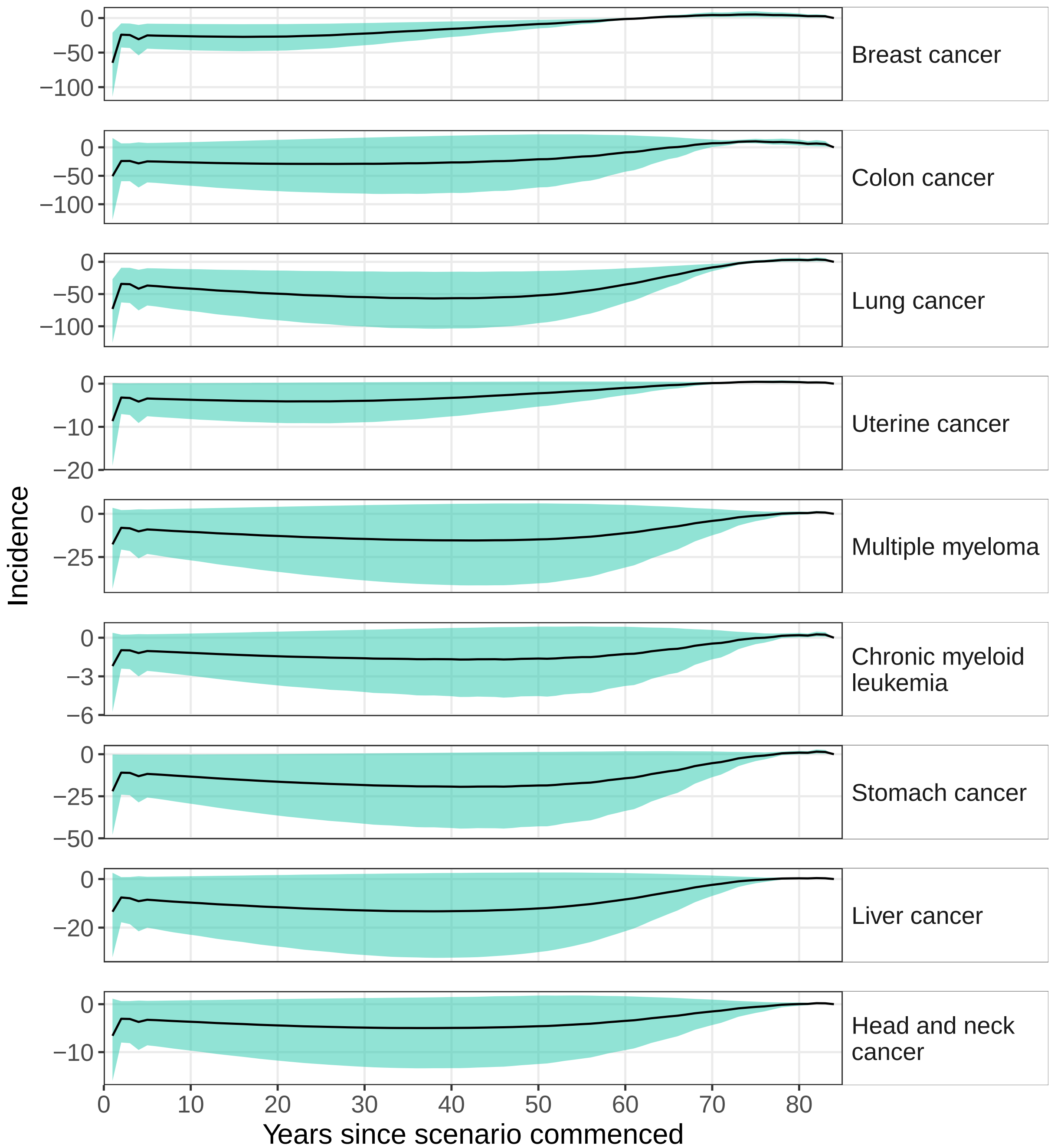

Figure 3.b: Percentage change in incidence for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Mortality

Mortality is the number of deaths due to a given disease over over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of prevented deaths due to increases in physical activity associated with the scenario. Figure 4 presents the total change in mortality over the life course. Figure 5 presents the difference in the number of deaths by year using a snapshot of the population from 2019.

Table 2 shows how the scenario impacts reductions in mortality presented as a percentage and total number of prevented deaths caused by chronic diseases.

Table 2. Percentage reduction in mortality and total number of prevented deaths by chronic disease measured across the years of the simulation.

Disease*	Mortality is reduced by	Total number of prevented deaths aggregated across the simulation
Alzheimer's disease and other dementias	0.33%	800
Breast cancer	0.89%	287
All cancers	2.53%	6,407
Colon cancer	0.63%	269
Chronic myeloid leukemia	3.12%	64
Diabetes type 2	5.31%	2,626
Depression	0.00%	0
Head and neck cancer	6.67%	265
Ischemic heart disease	3.03%	11,370
Liver cancer	4.21%	719
Multiple myeloma	4.38%	763
Stomach cancer	4.53%	957
Stroke	3.41%	5,964
Lung cancer	2.70%	2,940
Uterine cancer	1.95%	140

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

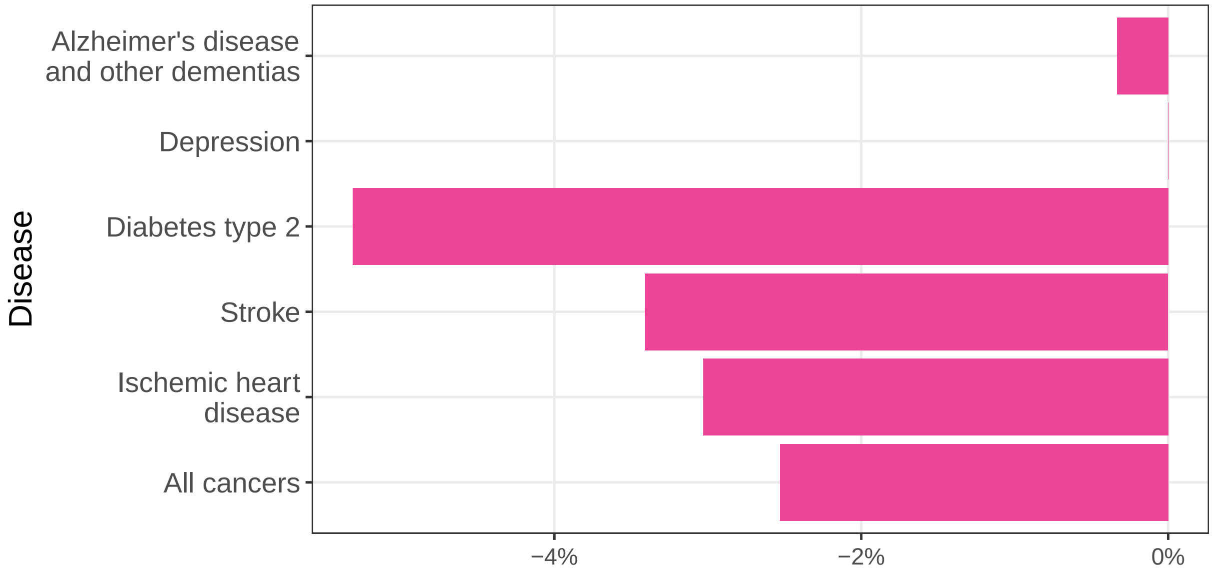

Figure 4.a: Percentage change in mortality by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

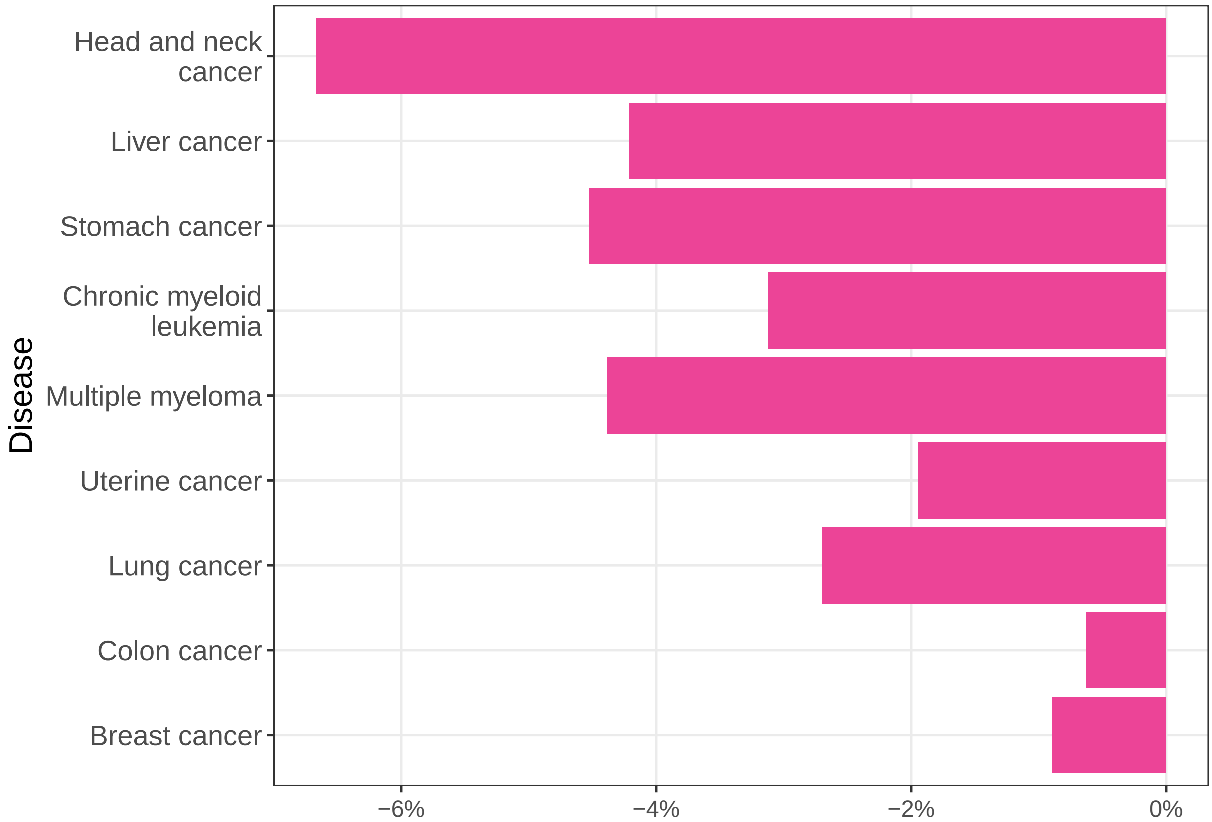

Figure 4.b: Percentage change in mortality for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

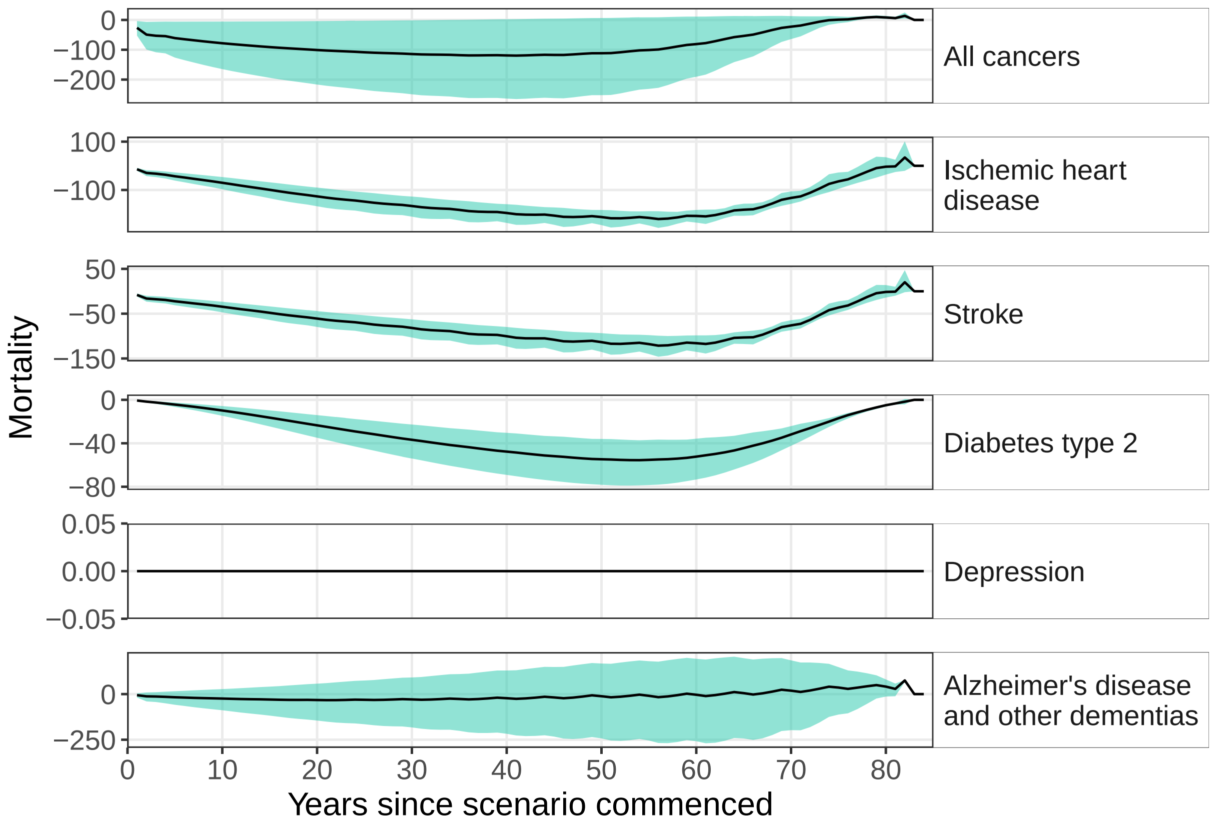

Figure 5.a: The change in mortality over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

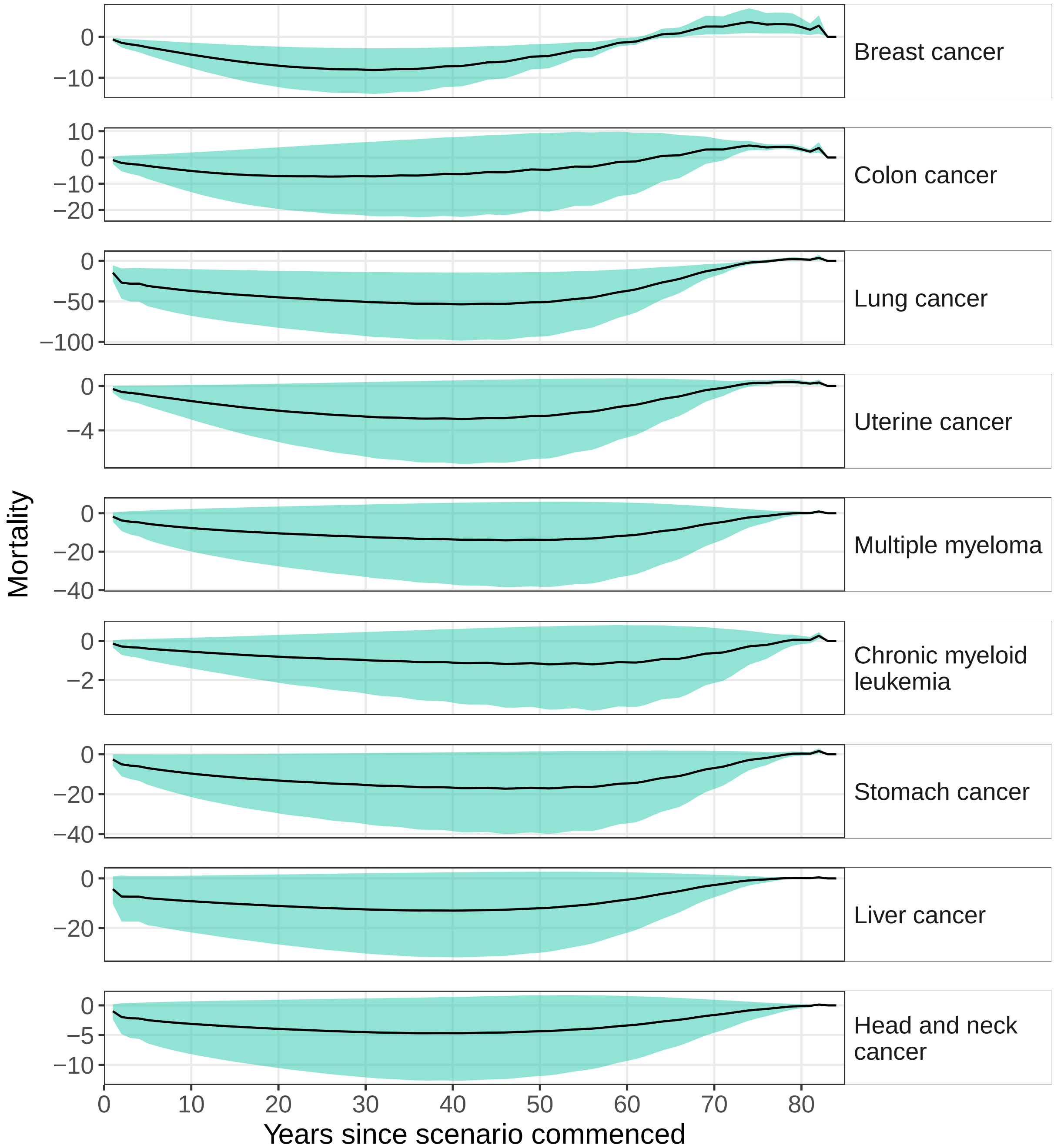

Figure 5.b: Percentage change in mortality for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Health

Figures 6 and 7 below show the change in Health Adjusted Life Years (HALYs)[1] and Life Years[2] for a snapshot of the population from 2019 for the scenario. Both figures show that the greatest gains from increasing physical activity occur midway through the life cycle with most of the gains occurring cumulatively in the long term. The decline from the mid-point onwards is due to individuals dying from natural causes within the model.

HALYS

The model estimates a total of **750,457** HALYs for the scenario population, which is **373** HALYs per 1,000 members of the population.

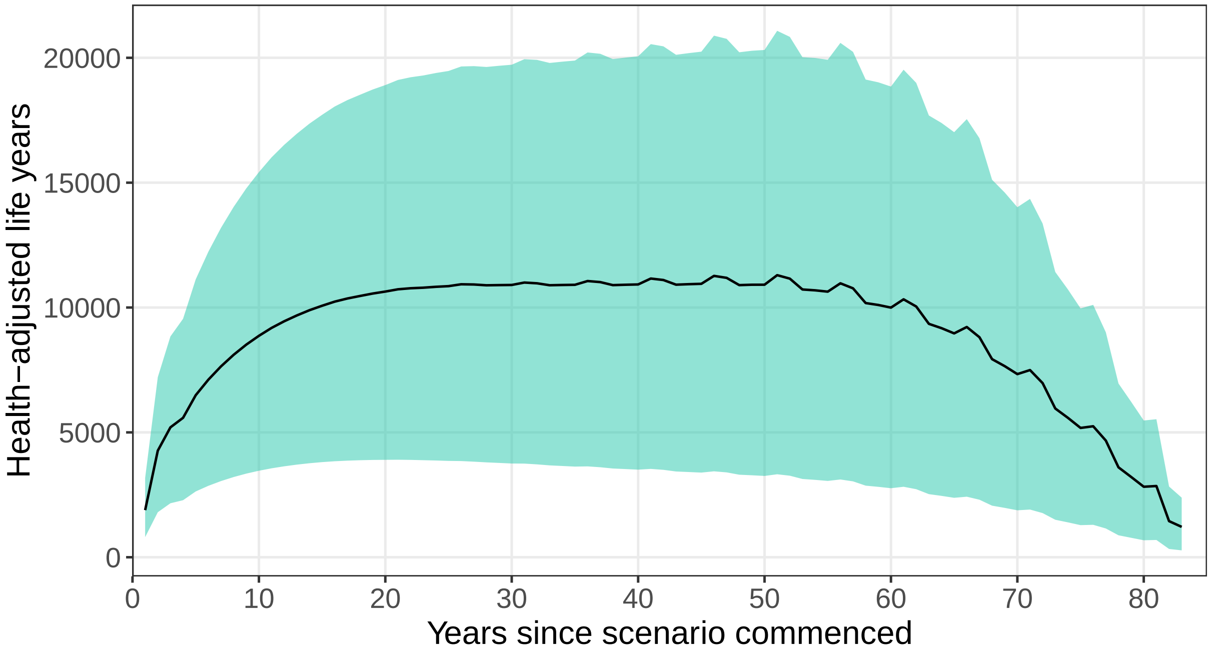

Figure 6. Total health-adjusted life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

[1]Health Adjusted Life Years are holistic measures of health that account for morbidity, mortality and quality of life.

[2]Life Years are similar to a HALYs however they exclude the quality of life component.

Life Years

The model estimates a total of **455,788** Life Years for the scenario population, which is **226** Life Years per 1,000 members of the population.

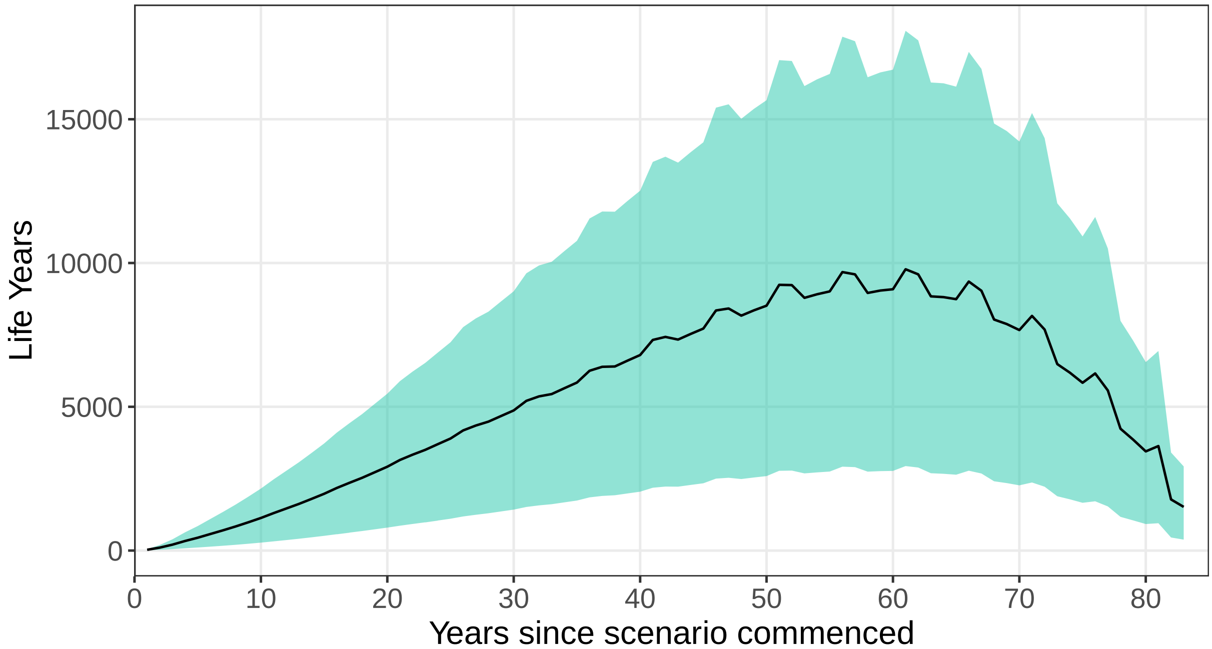

Figure 7. Total life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Value

The value of improvements to community health can be calculated**[a]** by translating the Health Adjusted Life Years (HALYs) from each scenario into dollar terms using the value of a statistical life year**[b]**. The value of a statistical life year is an estimate of the amount a society is willing to trade to reduce the risk of death for one year.

In the simulation model, HALYs are generated across time and are cumulative. Thus, to help us understand the value of HALYs across time in present day terms, it is necessary to use discounting**[c]** to reduce HALYs generated at the future point in time. Discounted HALYs from these future points can be added up to give the aggregate value of HALYs in today's terms as a measure of the value of improvements to community health arising from the chosen scenario.

The size of the discount rate can impact the aggregated value of HALYs and there is considerable debate on what discount rates should be used (with some arguing that health should not be discounted at all).[2] Hence, it is common to use a variety of discount rates to allow for differing risks, preferences and sensitivity when valuing health. The figures presented below were calculated using discount rates of 3%, 5% and 7% based on recent recommendations [3, 4] and represent the value of HALYs in present day terms resulting from an increase in physical activity from the chosen scenario.

The value of improvements to community health

The model estimates a total of **HALYs,** Health Adjusted Life Years (HALYs) gained for the scenario population, which is **373** HALYs per 1,000 members of the scenario population. The figures below represent the value of improvements to community health from the chosen scenario. These figures can be used in summary reports and for advocacy purposes**[d]**.

The HALYs gained in this scenario have a statistical value of:

- **29,410,801** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **18,200,631** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **12,495,037** per 1,000 members of the population, when calculated using a discount rate of 7%.

a. What is meant by value and how can it be measured?

Value is conceptual and measures a sense of worth or usefulness of something to individuals or to a society. Measuring the value of something, such as health, enables it to be included in assessments or analyses such as cost-benefit analyses to recognise its relative importance.

Value can be derived in many ways and a common approach is to use monetary terms, such as dollars. Valuing something using dollars is not the same as equating it with its price. Prices represent the amount at which something can be traded, prices therefore represent the amount of money for buying or selling something such as food, clothing or to pay bills. One way is to evaluate health in dollar terms is to use the Value of a Statistical Life and Value of a Statistical Life Year**[b]**.

b. What is the Value of a Statistical Life and Value of a Statistical Life Year?

The value of a **statistical life** is the estimated amount that a society is willing to trade to reduce the risk of death. The word 'Statistical' refers to the average value for life and therefore means the value of a statistical life doesn't relate to any specific individual. This value can change across risk factors and different societies who may value life differently. There are various ways of measuring the value of a statistical life with most approaches using revealed or stated preference approaches.[3] In Australia, the Office of Best Practice Regulation estimates a statistical life at $5.3M in 2022 dollar terms, and assumes that the life is of a young person with at least another 40 years to live.[5, 6]

Value of a Statistical Life Year

The value of a statistical life year is the estimated amount that a society is willing to trade to reduce the risk of death over **one year.** It can be derived from the value of a statistical life or measured directly using surveys or willingness to pay techniques.[5] The current value of a **statistical life year** is $227,000 in 2022 dollars based on current estimates from the Office of Best Practice Regulation.[6] The value of a statistical life year is useful for evaluating small increases in life years instead of evaluating full life expectancy. It is appropriate for valuing the Health Adjusted Life Years estimated from the scenarios and modelling presented in this tool. For the modelling and results presented here, the value of $227,000 was converted to 2019 dollars based on the Wage Price Index for Brisbane.

c. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

d. Application in advocacy and reporting

This section uses figures to show how the value of community health (estimated from HALYs and the value of statistical life year) can be used for reporting and advocacy purposes.

The simulation model uses **population-based estimates** for disease morbidity and mortality and is best applied to larger groups of people. It also assumes that the people of interest have similar characteristics and behaviours to the population data used in the simulation model and scenarios. The **example** below shows results from a scenario that replaces car trips with walking trips for distances of 0-2 km for All age groups.

Example:

The HALYs gained in this scenario have a statistical value of:

- **$10,859,605** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **$6,662,541** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **$4,533,392** per 1,000 members of the population, when calculated using a discount rate of 7%.

This **example** shows that the HALYs gained in this scenario have a statistical value of $10,859,605 per 1,000 members of the population using a discount of 3%.

This figure can be divided by 1,000 to give a per person figure. Once a per person figure is established, it can be multiplied by the number of people in any population size of interest for use in reports or as evidence to advocate for benefits associated with shifts to active transport modes.

$10,859,605 / 1,000 = $10,859.61 per person value

A good example of how this model can be applied links to previous research that investigated the impact of new more walkable development in Altona North on a population of 21,000 people [11]. If we assume that these people have similar characteristics to the underlying population based estimates and behaviours based on the travel survey data in the simulation model underlying this tool, then the value of community health according to the chosen scenario can be calculated as:

21,000 (people) x $10,859 (statistical value from HALYs gained) = $228 M.

Savings

An increase in physical activity due to the chosen scenario reduces chronic disease cases across a lifetime and reduces spending for each disease within the health care system resulting in overall health care cost savings**[a]**.

Table 3 provides estimated health care cost savings associated with the prevented cases of chronic diseases per 1,000 members of the population according to the selected scenario. These figures are based on applying average health care system costs per prevalent case of disease and using three alternative discount rates**[b]**:

Table 3. Total health care cost savings by disease per 1,000 members of the population.

Disease	3% discount rate	5% discount rate	7% discount rate
Alzheimer's disease and other dementias	$23,613	$14,435	$9,653
Breast cancer	$233,904	$148,757	$101,064
All cancers	$523,661	$334,677	$229,638
Colon cancer	$114,571	$75,712	$52,884
Chronic myeloid leukemia	$26,587	$16,001	$10,566
Diabetes type 2	$141,126	$83,775	$54,203
Depression	$747,255	$571,301	$448,157
Head and neck cancer	$4,311	$2,803	$1,982
Ischemic heart disease	$285,840	$169,764	$110,457
Liver cancer	$4,303	$2,832	$2,022
Multiple myeloma	$63,430	$39,808	$27,264
Stomach cancer	$27,088	$16,925	$11,561
Stroke	$43,820	$25,817	$16,732
Lung cancer	$38,057	$24,684	$17,419
Uterine cancer	$11,449	$7,210	$4,887

a. What do we mean by health care cost savings?

To calculate health care cost savings for each disease, the annual costs for each disease in each year is multiplied by the number of prevented cases of each disease for each scenario. This results in a total saving in spending for each disease by year. The savings in spending for future years are discounted**[b]** with annual savings aggregated to give a total amount saved for each disease. Total savings are presented as the amount saved per 1,000 members of the population to enable comparisons against populations of different sizes.

We use the term **health care cost saving** because it represents a reduction in health spending. However, the Australian Institute of Health and Welfare (AIHW) stress that the term cost is broad and not representative of the full cost experienced by individuals, families, or the health system, consequently AIHW use the term spending.[8]

These figures use AIHW estimates of the amounts spent through the health system in 2018-19 for each case of disease. This is extracted from Health system spending per case of disease and for certain risk factors, Table 1 – Estimates of health system spending per case, by burden of disease group, condition and sex, Australia 2018-2019.[9]. For head and neck cancers, supplementary figures were obtained from the Global Burden of Disease incidence data.[10]

b. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

References

1. Gold, M. R., Stevenson, D., & Fryback, D. G. (2002). *HALYS and QALYS and DALYS, Oh My: similarities and differences in summary measures of population Health.* Annual review of public health, 23(1), 115-134.
2. Attema, A.E., Brouwer, W.B. & Claxton, K. (2018). *Discounting in economic evaluations.* Pharmacoeconomics. 36: p. 745-758.
3. Ananthapavan, J., Moodie, M., Milat, A.J., & Carter, R. (2021). *Systematic review to update 'value of a statistical life' estimates for Australia.* International journal of environmental research and public health, 2021. 18(11): p. 6168.
4. Terrill, M. & Batrouney, H. (2018). *Unfreezing discount rates: Transport infrastructure for tomorrow.* Grattan Institute.
5. Abelson, P. (2008). *Establishing a monetary value for lives saved: issues and controversies.* Canberra: Office of Best Practice Regulation, Department of Finance and Deregulation.
6. Department of the Prime Minister and Cabinet. (2022). *Best practice regulation guidance note: Value of statistical life.* Australian Government.
7. Haacker, M., Hallett, T.B. & Atun, R. (2020). *On discount rates for economic evaluations in global health.* Health Policy and Planning, 2020. 35(1): p. 107-114.
8. Australian Institute of Health and Welfare (2023). Technical Notes: Estimating Spending per prevalent case of disease. Health system spending per case of disease and for certain risk factors, Estimating the spending per prevalent case of disease - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
9. Australian Institute of Health and Welfare (2023). Health system spending per case of disease and for certain risk factors. Health system spending per case of disease and for certain risk factors, Data - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
10. Global Burden of Disease (2019). Global Health Data Exchange. https://vizhub.healthdata.org/gbd-results. Accessed September 20, 2023.
11. Zapata-Diomedi, B., Boulangé, C., Giles-Corti, B., Phelan, K., Washington, S., Veerman, L.J., & Gunn, L. (2019). Physical activity-related health and economic benefits of building walkable neighbourhoods: A modelled comparison between brownfield and greenfield developments. International Journal of Behavioural Nutrition and Physical Activity.
12. Khorasani, E., Davari, M., Kebriaeezadeh, A., Fatemi, F., Akbari Sari, A., & Varahrami, V. (2022). A comprehensive review of official discount rates in guidelines of health economic evaluations over time: the trends and roots. The European Journal of Health Economics, 23(9), 1577-1590.

Scenario: replacing car trips under 2km with walking, and car trips between 2 and 10km with cycling for all trip purposes

This scenario shows the results of replacing car trips under 2km with walking and replacing car trips between 2km and 10km with cycling for leisure, shopping, work, education or other purposes for all adults of all ages.

This implies that the selected scenario results in a mode shift in walking from 16.8% to 28.9%; cycling from 1.3% to 38.8%; and, from 74.7% to 25.0% for car trips taken as either a driver or passenger.

Increases in walking and cycling translate into a shift from 47.9% to 75.3% of the population accumulating the required minutes spent being moderately (150 – 300 mins) or vigorously physically active (75 – 150 mins) or an equivalent combination of both contributing to recommended levels as detailed in the Physical Activity Guidelines.

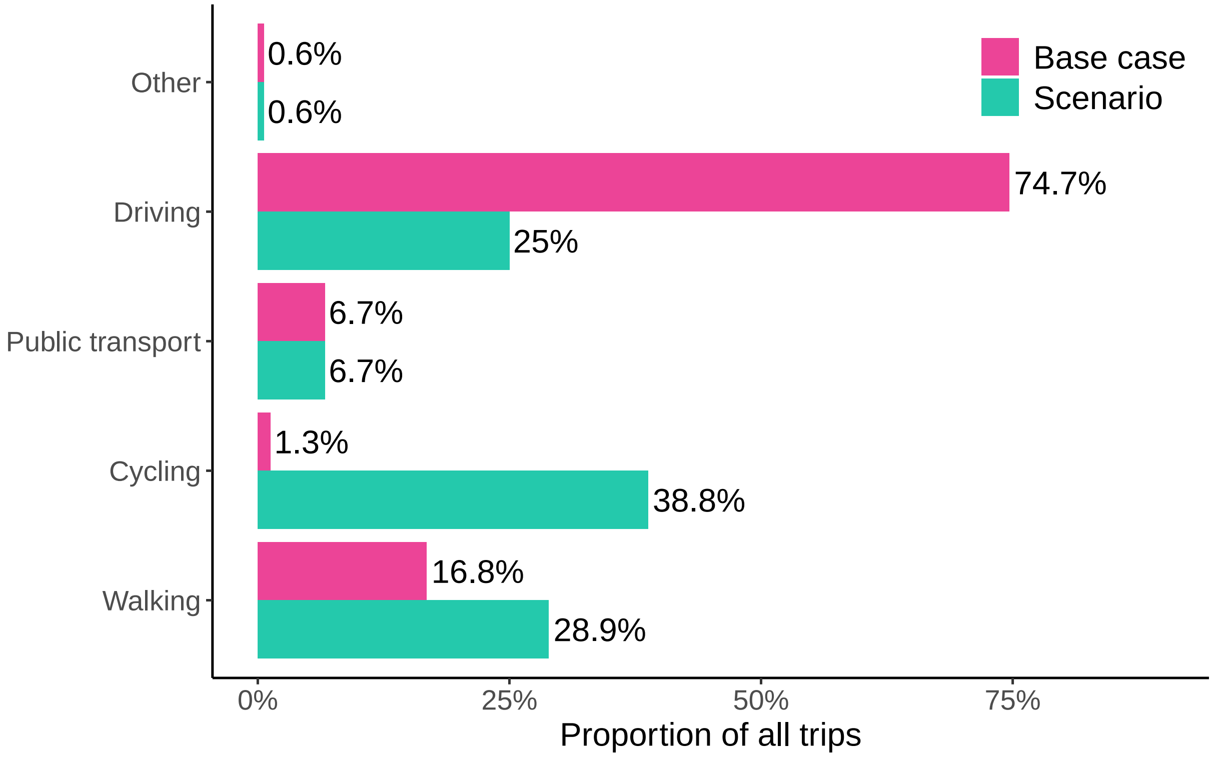

Figure 1: Distribution of base case and scenario trips.

Incidence

Incidence describes the rate of occurrence of new cases of a disease over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of disease prevented, due to increases in physical activity associated with the scenario. Figure 2 presents the change (%) in the disease incidence across the life course. Figure 3 presents how the difference in disease incidence changes over time, by year, using a snapshot of the population from 2019.

Table 1 shows how the scenario impacts the incidence of chronic diseases as both as a percentage and total number of prevented cases.

Table 1. Chronic disease incidence reduction and total number of prevented cases of disease measured across the years of the simulation

Disease*	Incidence of disease is reduced by	Total number of prevented cases of disease aggregated across the simulation
Alzheimer's disease and other dementias	1.71%	10,863
Breast cancer	2.17%	1,592
All cancers	3.05%	12,020
Colon cancer	1.49%	1,925
Chronic myeloid leukemia	4.64%	127
Diabetes type 2	9.55%	31,522
Depression	2.00%	32,012
Head and neck cancer	8.79%	388
Ischemic heart disease	4.64%	40,838
Liver cancer	5.77%	1,015
Multiple myeloma	5.72%	1,110
Stomach cancer	6.21%	1,483
Stroke	5.12%	13,320
Lung cancer	3.57%	4,108
Uterine cancer	3.19%	271

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

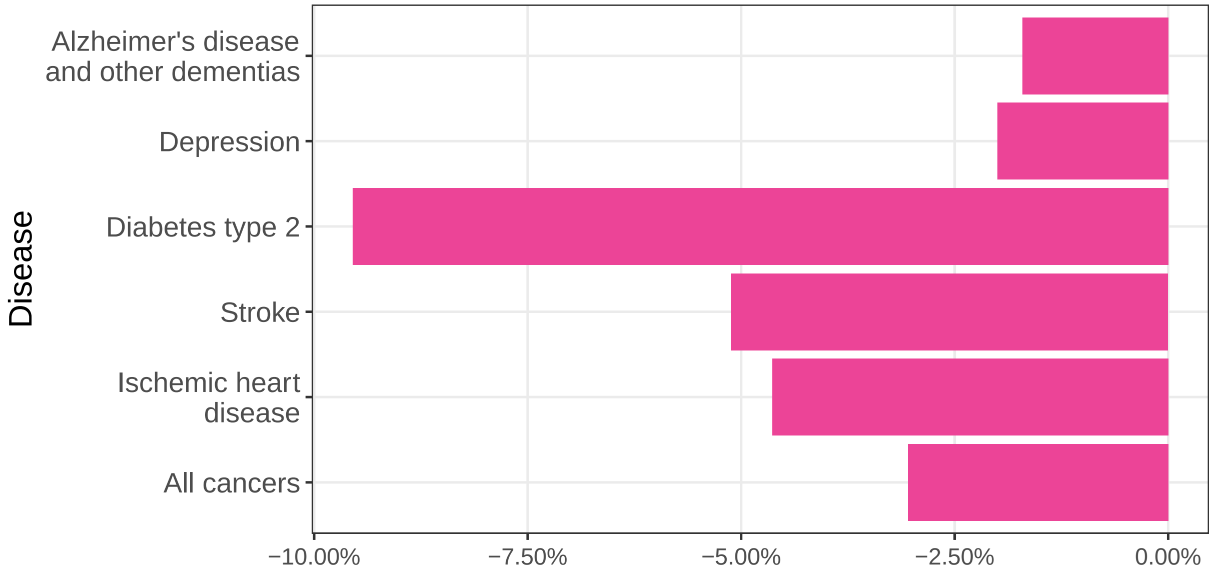

Figure 2.a: Percentage change in incidence by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

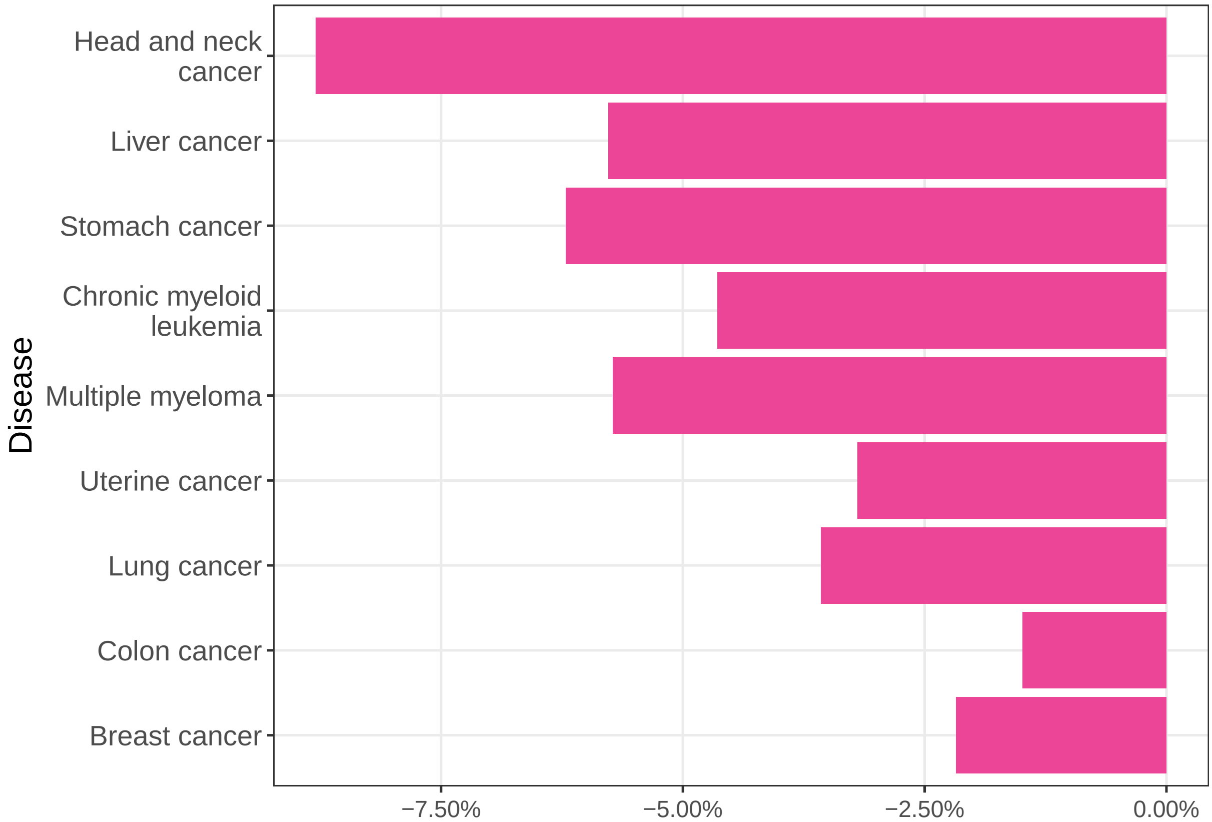

Figure 2.b: Percentage change in incidence for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

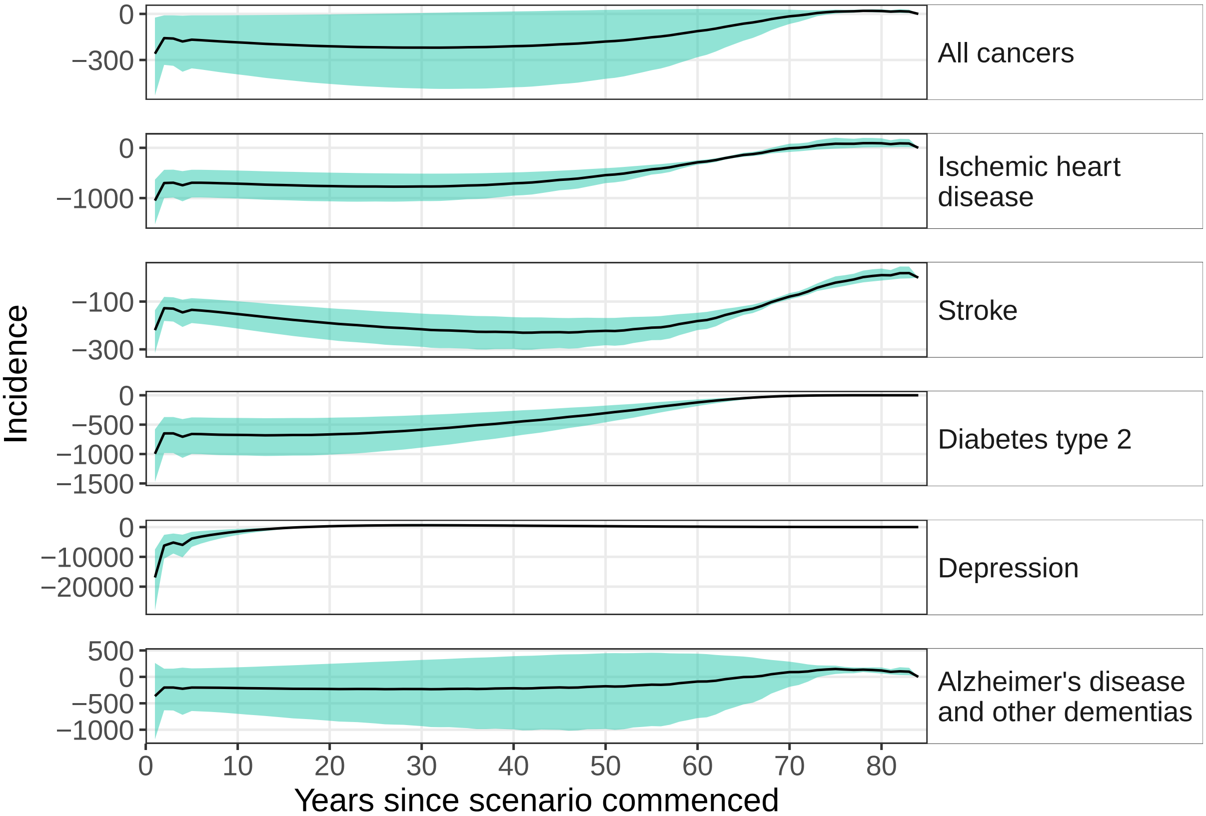

Figure 3.a: The change in incidence over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

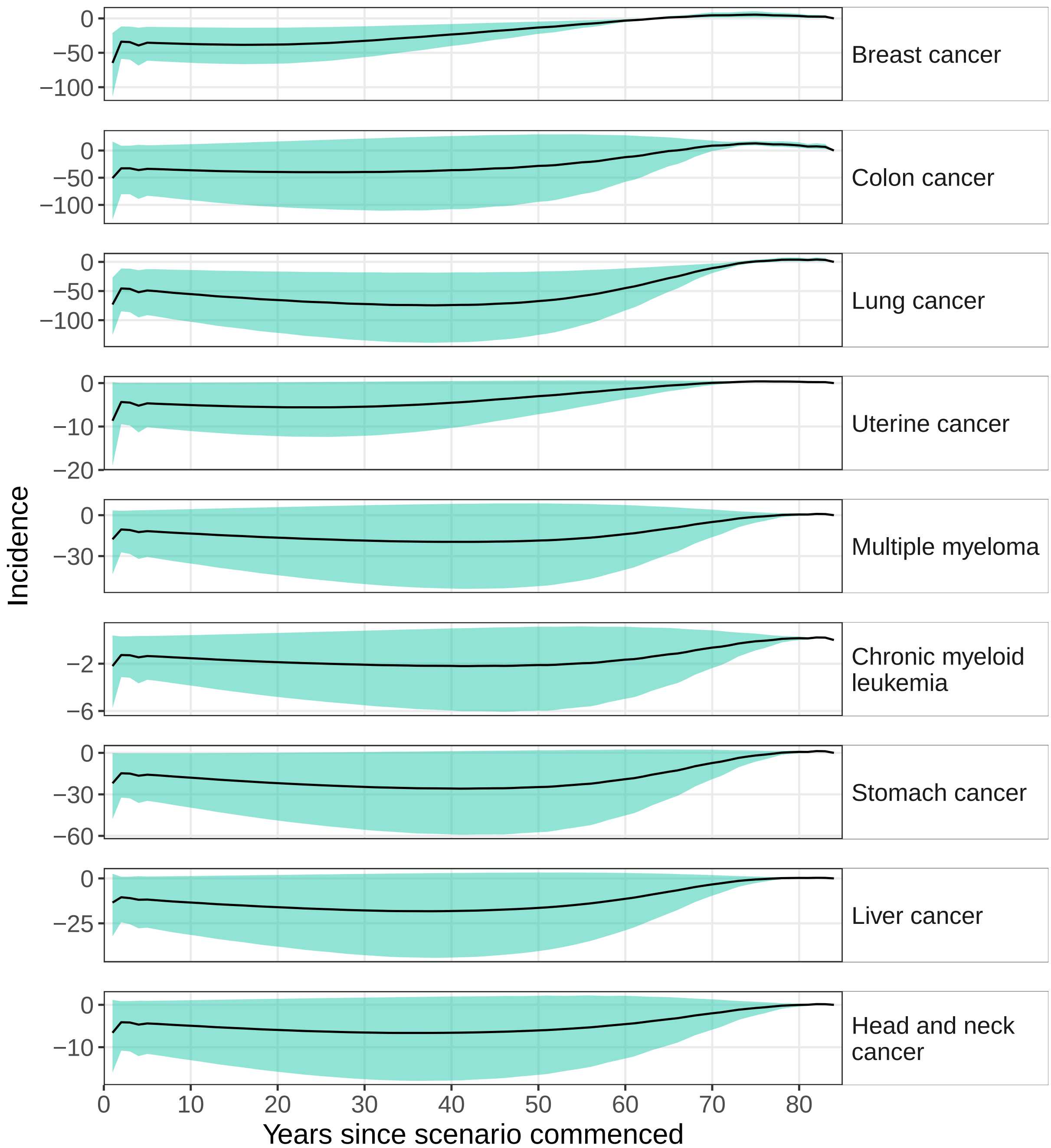

Figure 3.b: Percentage change in incidence for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Mortality

Mortality is the number of deaths due to a given disease over over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of prevented deaths due to increases in physical activity associated with the scenario. Figure 4 presents the total change in mortality over the life course. Figure 5 presents the difference in the number of deaths by year using a snapshot of the population from 2019.

Table 2 shows how the scenario impacts reductions in mortality presented as a percentage and total number of prevented deaths caused by chronic diseases.

Table 2. Percentage reduction in mortality and total number of prevented deaths by chronic disease measured across the years of the simulation.

Disease*	Mortality is reduced by	Total number of prevented deaths aggregated across the simulation
Alzheimer's disease and other dementias	0.41%	986
Breast cancer	1.37%	441
All cancers	3.34%	8,470
Colon cancer	0.86%	369
Chronic myeloid leukemia	4.02%	83
Diabetes type 2	7.38%	3,647
Depression	0.00%	0
Head and neck cancer	8.80%	350
Ischemic heart disease	4.15%	15,580
Liver cancer	5.75%	981
Multiple myeloma	5.53%	963
Stomach cancer	6.01%	1,271
Stroke	4.52%	7,913
Lung cancer	3.50%	3,818
Uterine cancer	2.67%	193

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

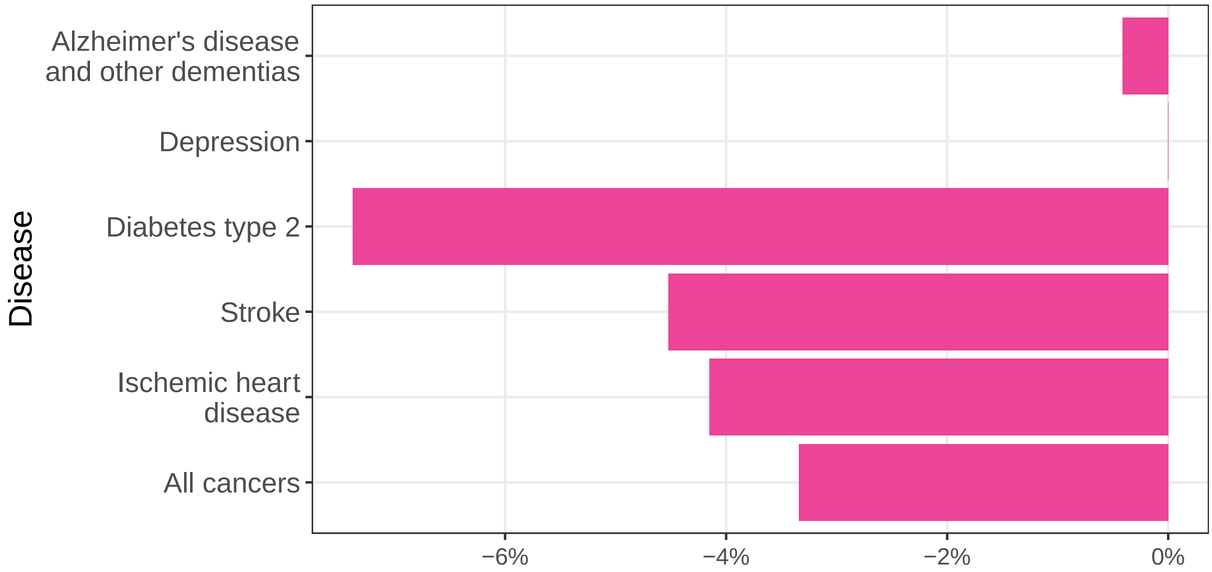

Figure 4.a: Percentage change in mortality by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

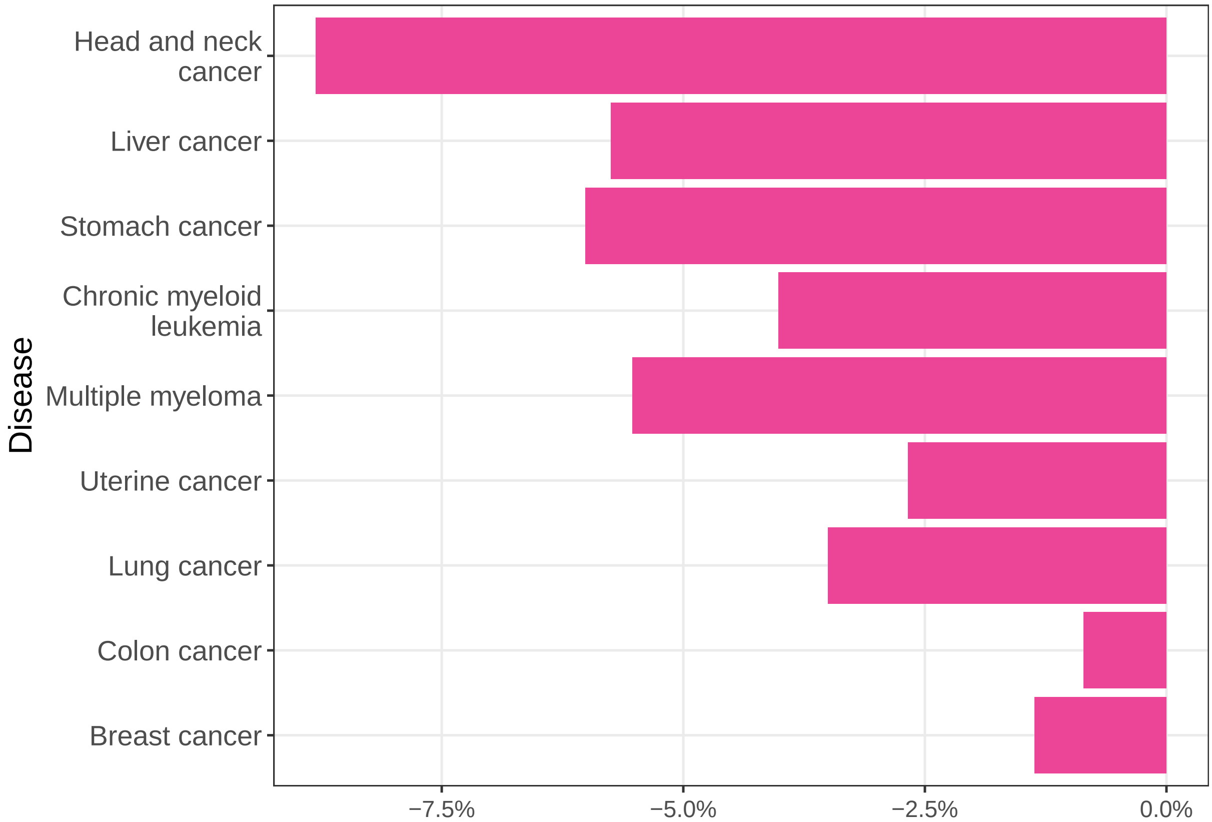

Figure 4.b: Percentage change in mortality for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

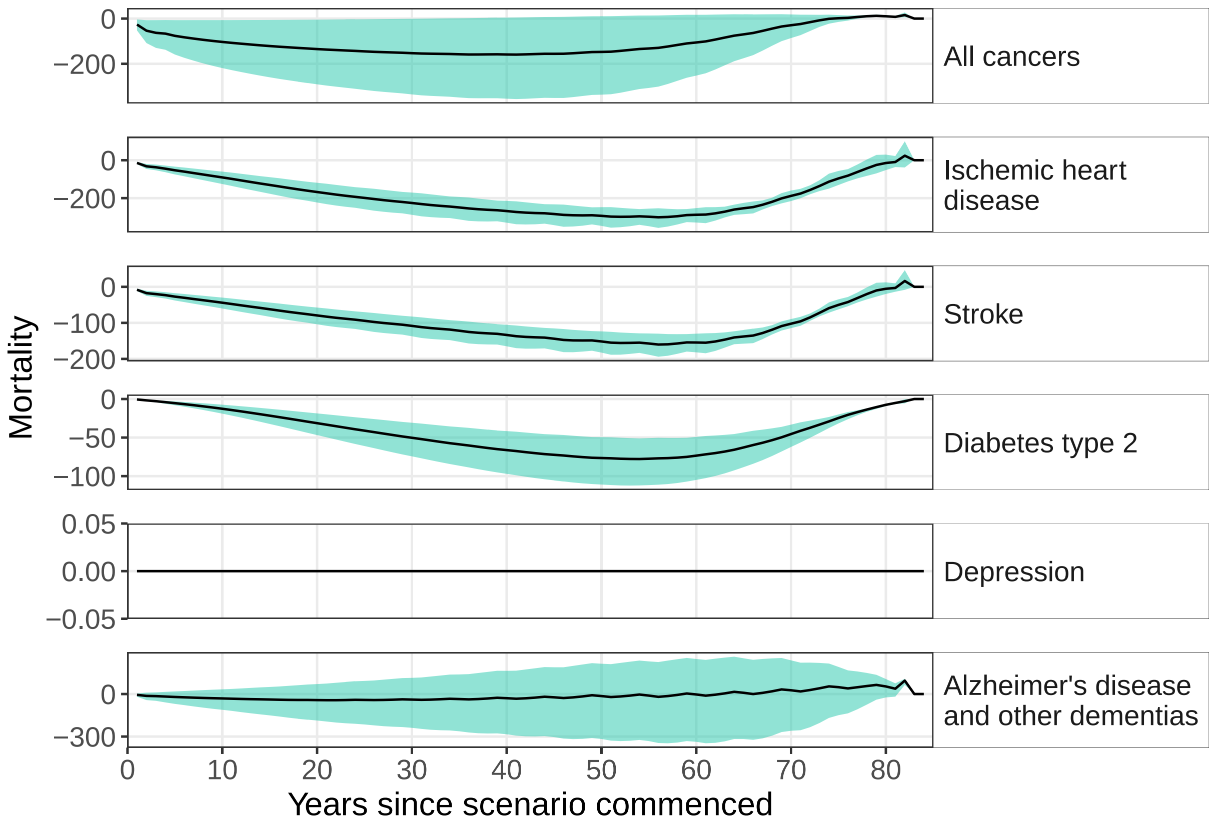

Figure 5.a: The change in mortality over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

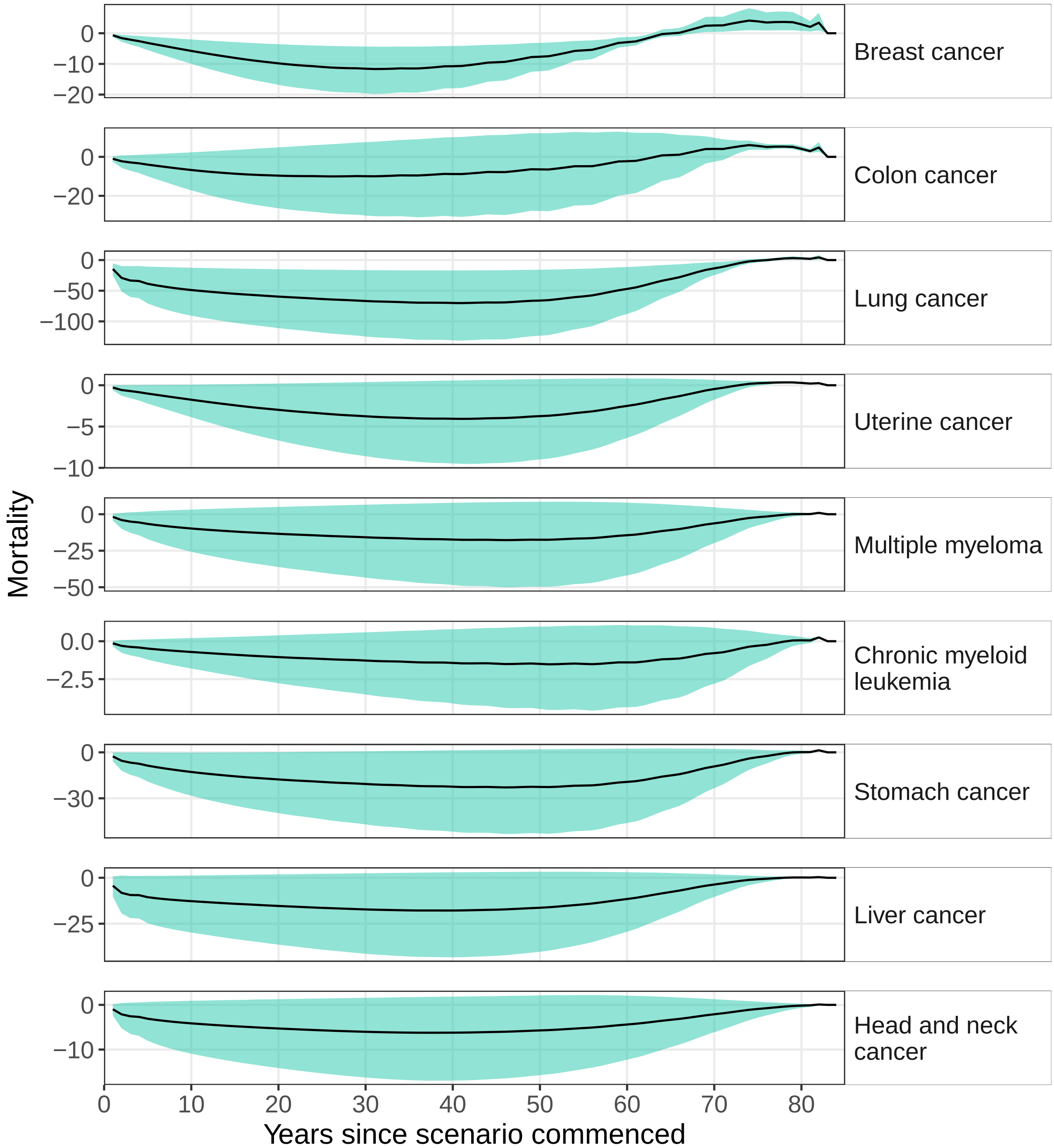

Figure 5.b: Percentage change in mortality for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Health

Figures 6 and 7 below show the change in Health Adjusted Life Years (HALYs)[1] and Life Years[2] for a snapshot of the population from 2019 for the scenario. Both figures show that the greatest gains from increasing physical activity occur midway through the life cycle with most of the gains occurring cumulatively in the long term. The decline from the mid-point onwards is due to individuals dying from natural causes within the model.

HALYS

The model estimates a total of **998,331** HALYs for the scenario population, which is **496** HALYs per 1,000 members of the population.

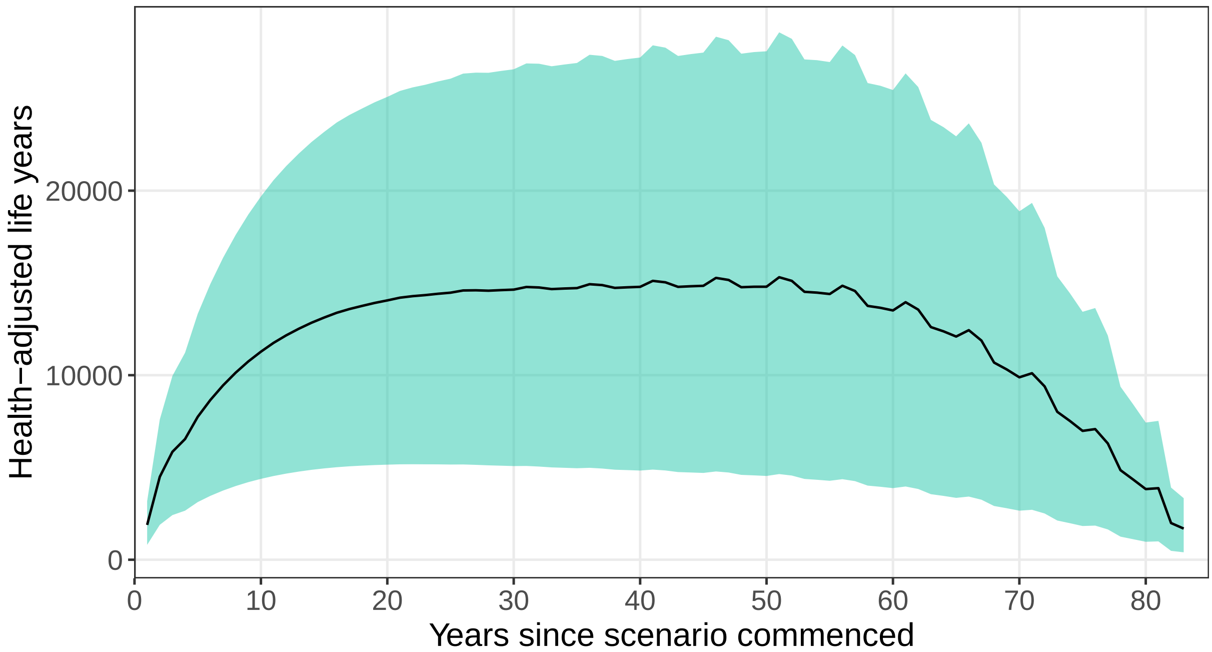

Figure 6. Total health-adjusted life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

[1] Health Adjusted Life Years are holistic measures of health that account for morbidity, mortality and quality of life.

[2] Life Years are similar to a HALYs however they exclude the quality of life component.

Life Years

The model estimates a total of **610,316** Life Years for the scenario population, which is **303** Life Years per 1,000 members of the population.

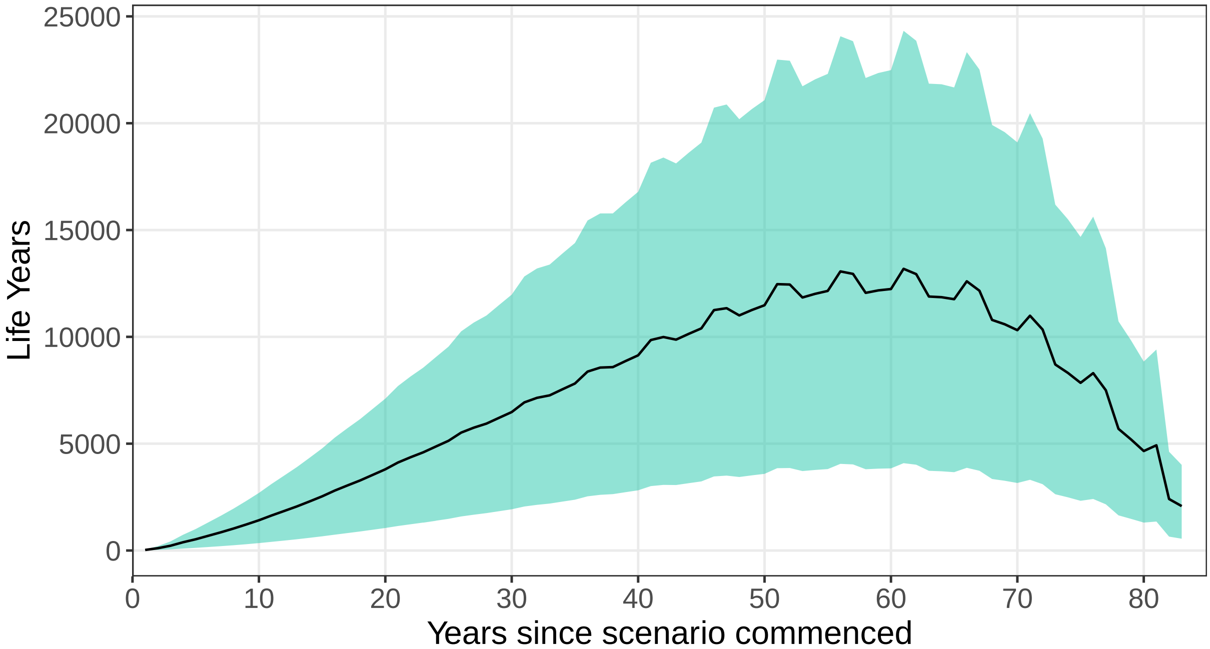

Figure 7. Total life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Value

The value of improvements to community health can be calculated**[a]** by translating the Health Adjusted Life Years (HALYs) from each scenario into dollar terms using the value of a statistical life year**[b]**. The value of a statistical life year is an estimate of the amount a society is willing to trade to reduce the risk of death for one year.

In the simulation model, HALYs are generated across time and are cumulative. Thus, to help us understand the value of HALYs across time in present day terms, it is necessary to use discounting**[c]** to reduce HALYs generated at the future point in time. Discounted HALYs from these future points can be added up to give the aggregate value of HALYs in today's terms as a measure of the value of improvements to community health arising from the chosen scenario.

The size of the discount rate can impact the aggregated value of HALYs and there is considerable debate on what discount rates should be used (with some arguing that health should not be discounted at all).[2] Hence, it is common to use a variety of discount rates to allow for differing risks, preferences and sensitivity when valuing health. The figures presented below were calculated using discount rates of 3%, 5% and 7% based on recent recommendations [3, 4] and represent the value of HALYs in present day terms resulting from an increase in physical activity from the chosen scenario.

The value of improvements to community health

The model estimates a total of **HALYs,** Health Adjusted Life Years (HALYs) gained for the scenario population, which is **496** HALYs per 1,000 members of the scenario population. The figures below represent the value of improvements to community health from the chosen scenario. These figures can be used in summary reports and for advocacy purposes**[d]**.

The HALYs gained in this scenario have a statistical value of:

- **38,471,515** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **23,512,769** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **15,949,603** per 1,000 members of the population, when calculated using a discount rate of 7%.

a. What is meant by value and how can it be measured?

Value is conceptual and measures a sense of worth or usefulness of something to individuals or to a society. Measuring the value of something, such as health, enables it to be included in assessments or analyses such as cost-benefit analyses to recognise its relative importance.

Value can be derived in many ways and a common approach is to use monetary terms, such as dollars. Valuing something using dollars is not the same as equating it with its price. Prices represent the amount at which something can be traded, prices therefore represent the amount of money for buying or selling something such as food, clothing or to pay bills. One way is to evaluate health in dollar terms is to use the Value of a Statistical Life and Value of a Statistical Life Year**[b]**.

b. What is the Value of a Statistical Life and Value of a Statistical Life Year?

The value of a **statistical life** is the estimated amount that a society is willing to trade to reduce the risk of death. The word 'Statistical' refers to the average value for life and therefore means the value of a statistical life doesn't relate to any specific individual. This value can change across risk factors and different societies who may value life differently. There are various ways of measuring the value of a statistical life with most approaches using revealed or stated preference approaches.[3] In Australia, the Office of Best Practice Regulation estimates a statistical life at $5.3M in 2022 dollar terms, and assumes that the life is of a young person with at least another 40 years to live.[5, 6]

Value of a Statistical Life Year

The value of a statistical life year is the estimated amount that a society is willing to trade to reduce the risk of death over **one year.** It can be derived from the value of a statistical life or measured directly using surveys or willingness to pay techniques.[5] The current value of a **statistical life year** is $227,000 in 2022 dollars based on current estimates from the Office of Best Practice Regulation.[6] The value of a statistical life year is useful for evaluating small increases in life years instead of evaluating full life expectancy. It is appropriate for valuing the Health Adjusted Life Years estimated from the scenarios and modelling presented in this tool. For the modelling and results presented here, the value of $227,000 was converted to 2019 dollars based on the Wage Price Index for Brisbane.

c. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

d. Application in advocacy and reporting

This section uses figures to show how the value of community health (estimated from HALYs and the value of statistical life year) can be used for reporting and advocacy purposes.

The simulation model uses **population-based estimates** for disease morbidity and mortality and is best applied to larger groups of people. It also assumes that the people of interest have similar characteristics and behaviours to the population data used in the simulation model and scenarios. The **example** below shows results from a scenario that replaces car trips with walking trips for distances of 0-2 km for All age groups.

Example:

The HALYs gained in this scenario have a statistical value of:

- **$10,859,605** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **$6,662,541** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **$4,533,392** per 1,000 members of the population, when calculated using a discount rate of 7%.

This **example** shows that the HALYs gained in this scenario have a statistical value of $10,859,605 per 1,000 members of the population using a discount of 3%.

This figure can be divided by 1,000 to give a per person figure. Once a per person figure is established, it can be multiplied by the number of people in any population size of interest for use in reports or as evidence to advocate for benefits associated with shifts to active transport modes.

$10,859,605 / 1,000 = $10,859.61 per person value

A good example of how this model can be applied links to previous research that investigated the impact of new more walkable development in Altona North on a population of 21,000 people [11]. If we assume that these people have similar characteristics to the underlying population based estimates and behaviours based on the travel survey data in the simulation model underlying this tool, then the value of community health according to the chosen scenario can be calculated as:

21,000 (people) x $10,859 (statistical value from HALYs gained) = $228 M.

Savings

An increase in physical activity due to the chosen scenario reduces chronic disease cases across a lifetime and reduces spending for each disease within the health care system resulting in overall health care cost savings**[a]**.

Table 3 provides estimated health care cost savings associated with the prevented cases of chronic diseases per 1,000 members of the population according to the selected scenario. These figures are based on applying average health care system costs per prevalent case of disease and using three alternative discount rates**[b]**:

Table 3. Total health care cost savings by disease per 1,000 members of the population.

Disease	3% discount rate	5% discount rate	7% discount rate
Alzheimer's disease and other dementias	$30,975	$18,830	$12,503
Breast cancer	$325,174	$203,753	$136,630
All cancers	$707,775	$447,877	$304,320
Colon cancer	$154,702	$101,373	$70,196
Chronic myeloid leukemia	$33,842	$20,263	$13,300
Diabetes type 2	$192,892	$113,599	$72,897
Depression	$949,655	$719,344	$559,301
Head and neck cancer	$5,669	$3,668	$2,578
Ischemic heart disease	$388,941	$229,306	$147,977
Liver cancer	$5,934	$3,890	$2,764
Multiple myeloma	$81,278	$50,820	$34,624
Stomach cancer	$36,000	$22,389	$15,201
Stroke	$57,365	$33,558	$21,581
Lung cancer	$49,985	$32,286	$22,653
Uterine cancer	$15,239	$9,516	$6,393

a. What do we mean by health care cost savings?

To calculate health care cost savings for each disease, the annual costs for each disease in each year is multiplied by the number of prevented cases of each disease for each scenario. This results in a total saving in spending for each disease by year. The savings in spending for future years are discounted**[b]** with annual savings aggregated to give a total amount saved for each disease. Total savings are presented as the amount saved per 1,000 members of the population to enable comparisons against populations of different sizes.

We use the term **health care cost saving** because it represents a reduction in health spending. However, the Australian Institute of Health and Welfare (AIHW) stress that the term cost is broad and not representative of the full cost experienced by individuals, families, or the health system, consequently AIHW use the term spending.[8]

These figures use AIHW estimates of the amounts spent through the health system in 2018-19 for each case of disease. This is extracted from Health system spending per case of disease and for certain risk factors, Table 1 – Estimates of health system spending per case, by burden of disease group, condition and sex, Australia 2018-2019.[9]. For head and neck cancers, supplementary figures were obtained from the Global Burden of Disease incidence data.[10]

b. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

References

1. Gold, M. R., Stevenson, D., & Fryback, D. G. (2002). *HALYS and QALYS and DALYS, Oh My: similarities and differences in summary measures of population Health.* Annual review of public health, 23(1), 115-134.
2. Attema, A.E., Brouwer, W.B. & Claxton, K. (2018). *Discounting in economic evaluations.* Pharmacoeconomics. 36: p. 745-758.
3. Ananthapavan, J., Moodie, M., Milat, A.J., & Carter, R. (2021). *Systematic review to update 'value of a statistical life' estimates for Australia.* International journal of environmental research and public health, 2021. 18(11): p. 6168.
4. Terrill, M. & Batrouney, H. (2018). *Unfreezing discount rates: Transport infrastructure for tomorrow.* Grattan Institute.
5. Abelson, P. (2008). *Establishing a monetary value for lives saved: issues and controversies.* Canberra: Office of Best Practice Regulation, Department of Finance and Deregulation.
6. Department of the Prime Minister and Cabinet. (2022). *Best practice regulation guidance note: Value of statistical life.* Australian Government.
7. Haacker, M., Hallett, T.B. & Atun, R. (2020). *On discount rates for economic evaluations in global health.* Health Policy and Planning, 2020. 35(1): p. 107-114.
8. Australian Institute of Health and Welfare (2023). Technical Notes: Estimating Spending per prevalent case of disease. Health system spending per case of disease and for certain risk factors, Estimating the spending per prevalent case of disease - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
9. Australian Institute of Health and Welfare (2023). Health system spending per case of disease and for certain risk factors. Health system spending per case of disease and for certain risk factors, Data - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
10. Global Burden of Disease (2019). Global Health Data Exchange. https://vizhub.healthdata.org/gbd-results. Accessed September 20, 2023.
11. Zapata-Diomedi, B., Boulangé, C., Giles-Corti, B., Phelan, K., Washington, S., Veerman, L.J., & Gunn, L. (2019). Physical activity-related health and economic benefits of building walkable neighbourhoods: A modelled comparison between brownfield and greenfield developments. International Journal of Behavioural Nutrition and Physical Activity.
12. Khorasani, E., Davari, M., Kebriaeezadeh, A., Fatemi, F., Akbari Sari, A., & Varahrami, V. (2022). A comprehensive review of official discount rates in guidelines of health economic evaluations over time: the trends and roots. The European Journal of Health Economics, 23(9), 1577-1590.

Scenario: replacing car trips under 1km with walking, and car trips between 1 and 2km with cycling for commuting trip purposes

This scenario shows the results of replacing car trips under 1km with walking and replacing car trips between 1km and 2km with cycling for work related or education purposes for all adults of all ages.

This implies that the selected scenario results in a mode shift in walking from 16.8% to 17.2%; cycling from 1.3% to 2.6%; and, from 74.7% to 72.9% for car trips taken as either a driver or passenger.

Increases in walking and cycling translate into a shift from 47.9% to 49.0% of the population accumulating the required minutes spent being moderately (150 – 300 mins) or vigorously physically active (75 – 150 mins) or an equivalent combination of both contributing to recommended levels as detailed in the Physical Activity Guidelines.

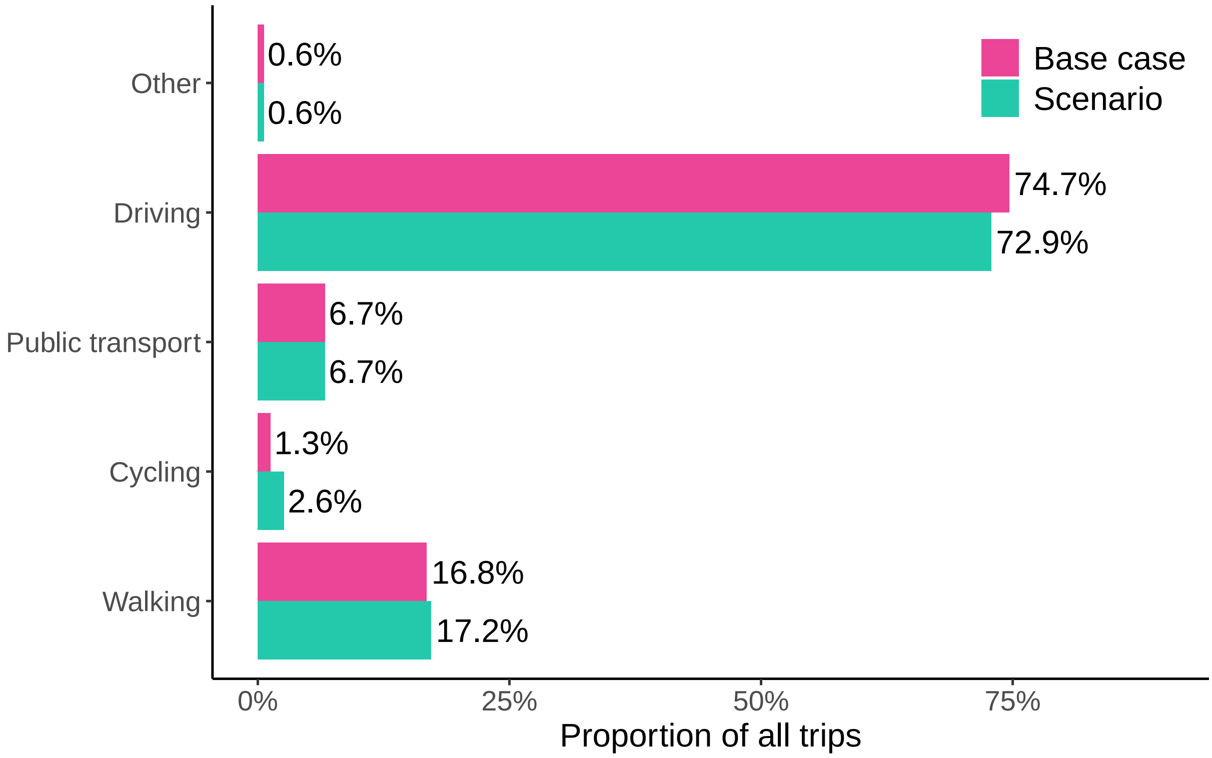

Figure 1: Distribution of base case and scenario trips.

Incidence

Incidence describes the rate of occurrence of new cases of a disease over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of disease prevented, due to increases in physical activity associated with the scenario. Figure 2 presents the change (%) in the disease incidence across the life course. Figure 3 presents how the difference in disease incidence changes over time, by year, using a snapshot of the population from 2019.

Table 1 shows how the scenario impacts the incidence of chronic diseases as both as a percentage and total number of prevented cases.

Table 1. Chronic disease incidence reduction and total number of prevented cases of disease measured across the years of the simulation

Disease*	Incidence of disease is reduced by	Total number of prevented cases of disease aggregated across the simulation
Alzheimer's disease and other dementias	-0.02%	-103
Breast cancer	0.03%	24
All cancers	0.03%	130
Colon cancer	0.01%	7
Chronic myeloid leukemia	0.03%	1
Diabetes type 2	0.23%	744
Depression	0.04%	686
Head and neck cancer	0.13%	6
Ischemic heart disease	0.06%	565
Liver cancer	0.07%	12
Multiple myeloma	0.07%	13
Stomach cancer	0.06%	14
Stroke	0.05%	136
Lung cancer	0.04%	49
Uterine cancer	0.06%	5

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

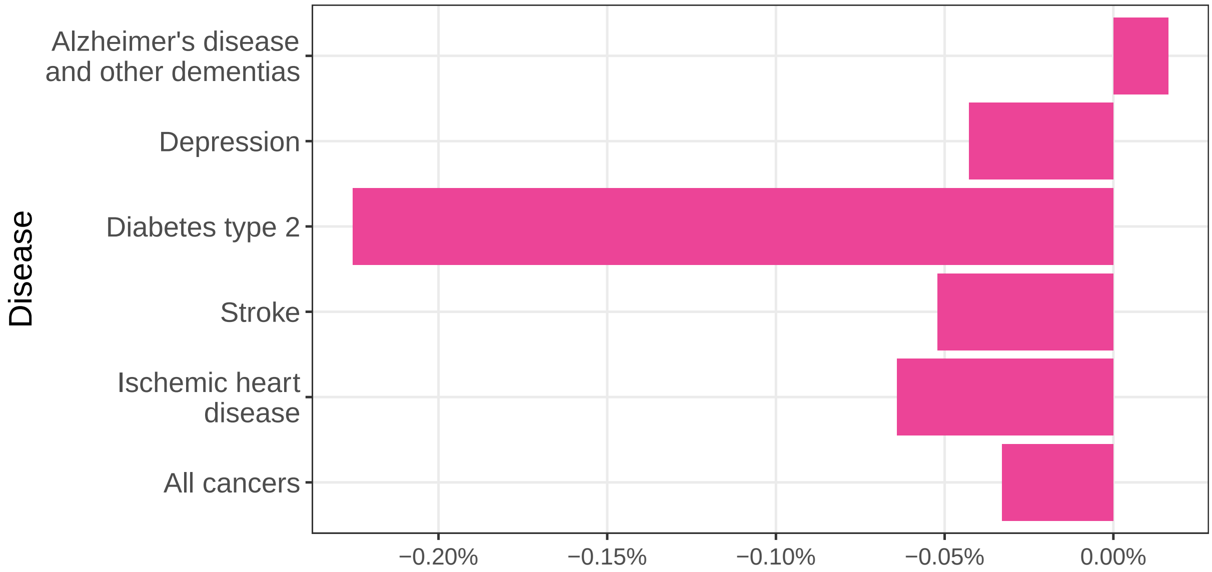

Figure 2.a: Percentage change in incidence by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

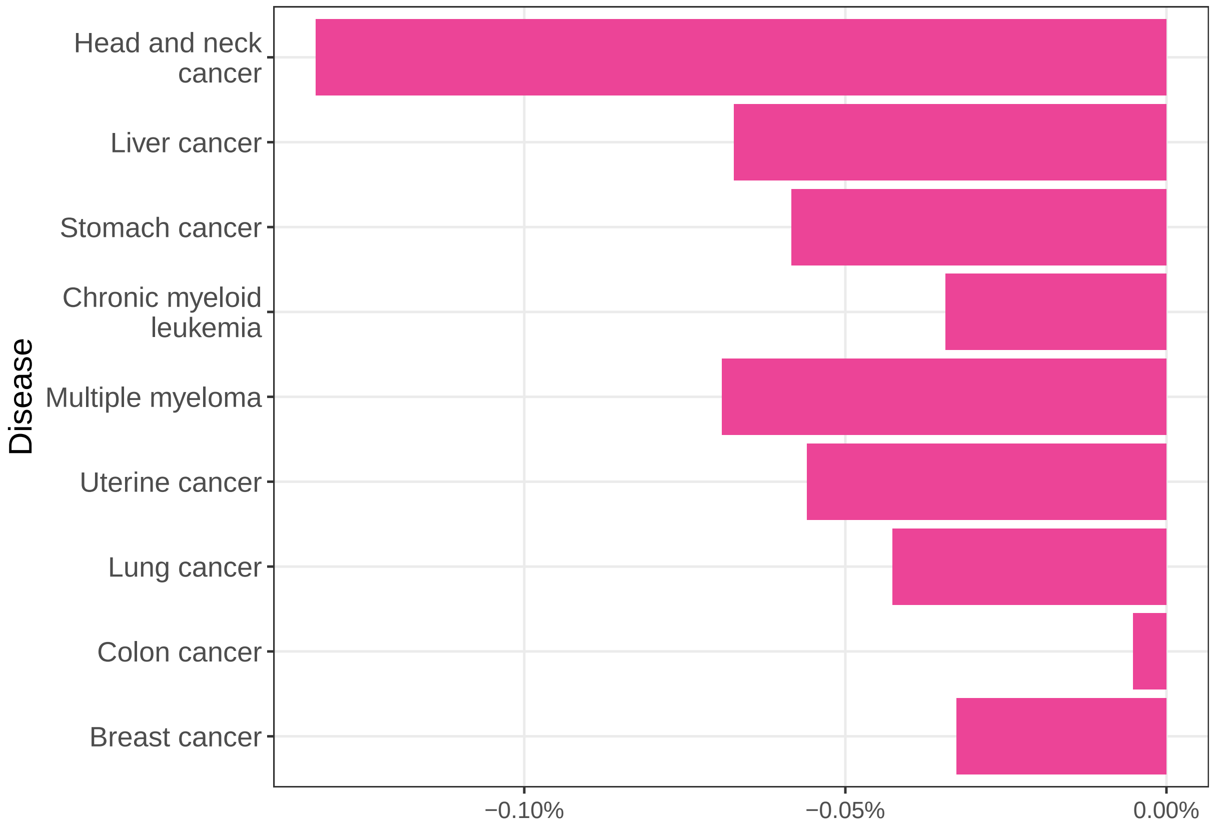

Figure 2.b: Percentage change in incidence for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

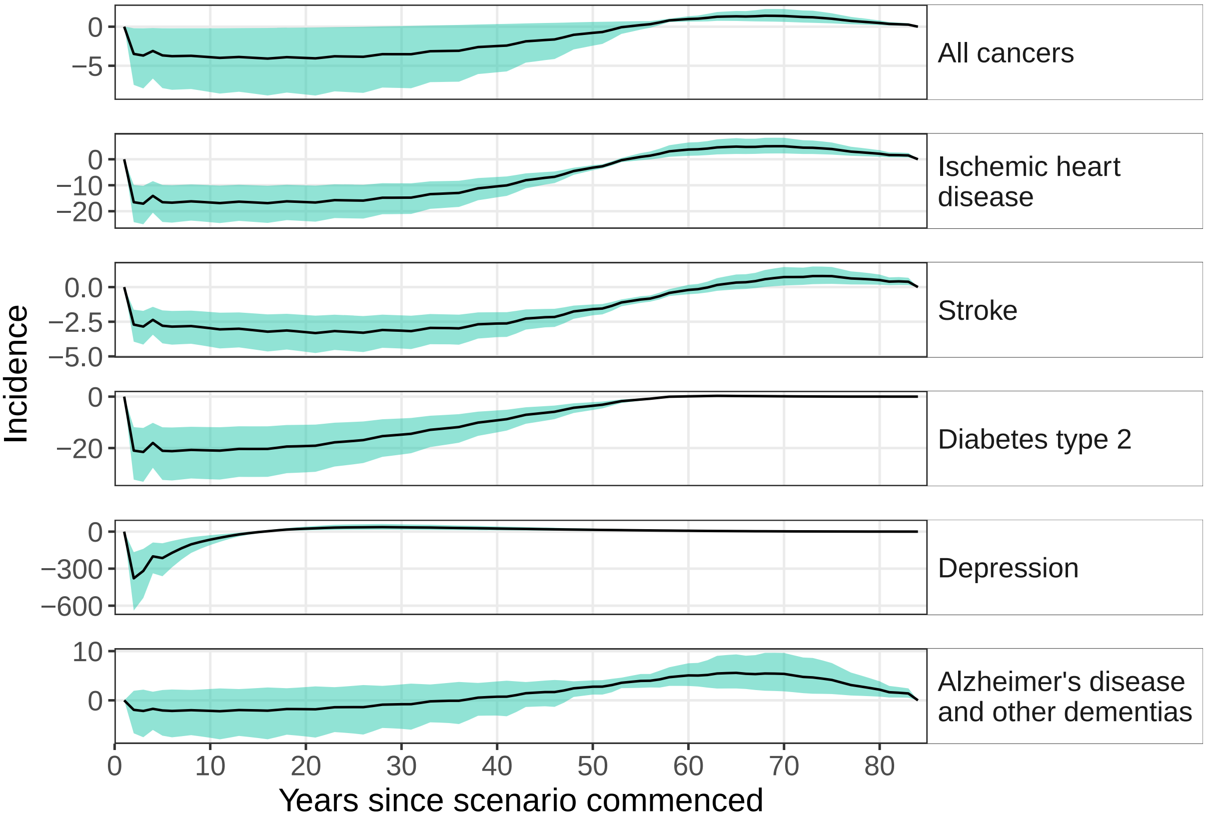

Figure 3.a: The change in incidence over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

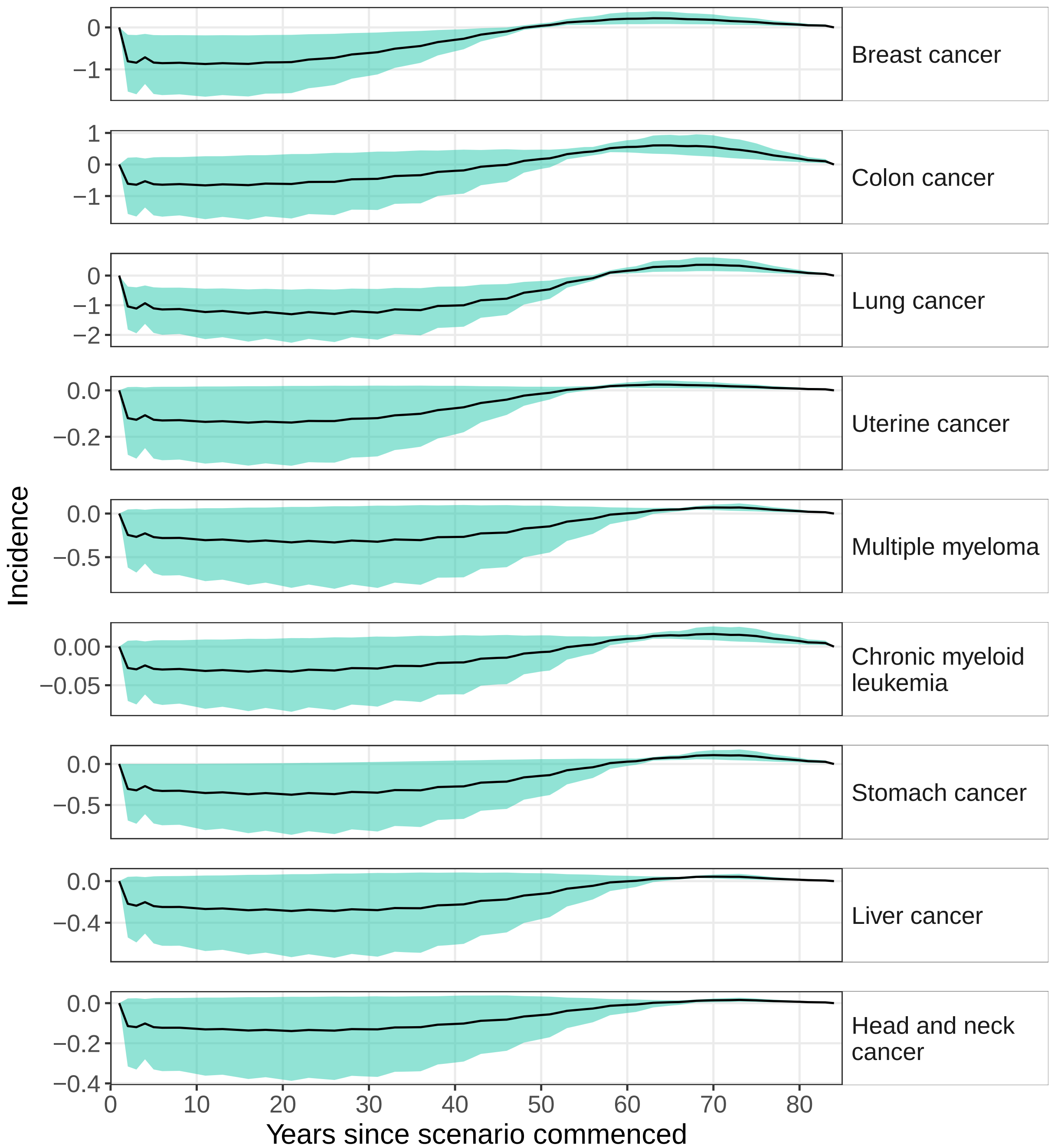

Figure 3.b: Percentage change in incidence for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Mortality

Mortality is the number of deaths due to a given disease over over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of prevented deaths due to increases in physical activity associated with the scenario. Figure 4 presents the total change in mortality over the life course. Figure 5 presents the difference in the number of deaths by year using a snapshot of the population from 2019.

Table 2 shows how the scenario impacts reductions in mortality presented as a percentage and total number of prevented deaths caused by chronic diseases.

Table 2. Percentage reduction in mortality and total number of prevented deaths by chronic disease measured across the years of the simulation.

Disease*	Mortality is reduced by	Total number of prevented deaths aggregated across the simulation
Alzheimer's disease and other dementias	-0.04%	-87
Breast cancer	0.03%	10
All cancers	0.04%	105
Colon cancer	0.01%	3
Chronic myeloid leukemia	0.03%	1
Diabetes type 2	0.20%	99
Depression	0.00%	0
Head and neck cancer	0.14%	6
Ischemic heart disease	0.06%	239
Liver cancer	0.07%	12
Multiple myeloma	0.07%	12
Stomach cancer	0.06%	12
Stroke	0.05%	79
Lung cancer	0.04%	46
Uterine cancer	0.05%	3

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

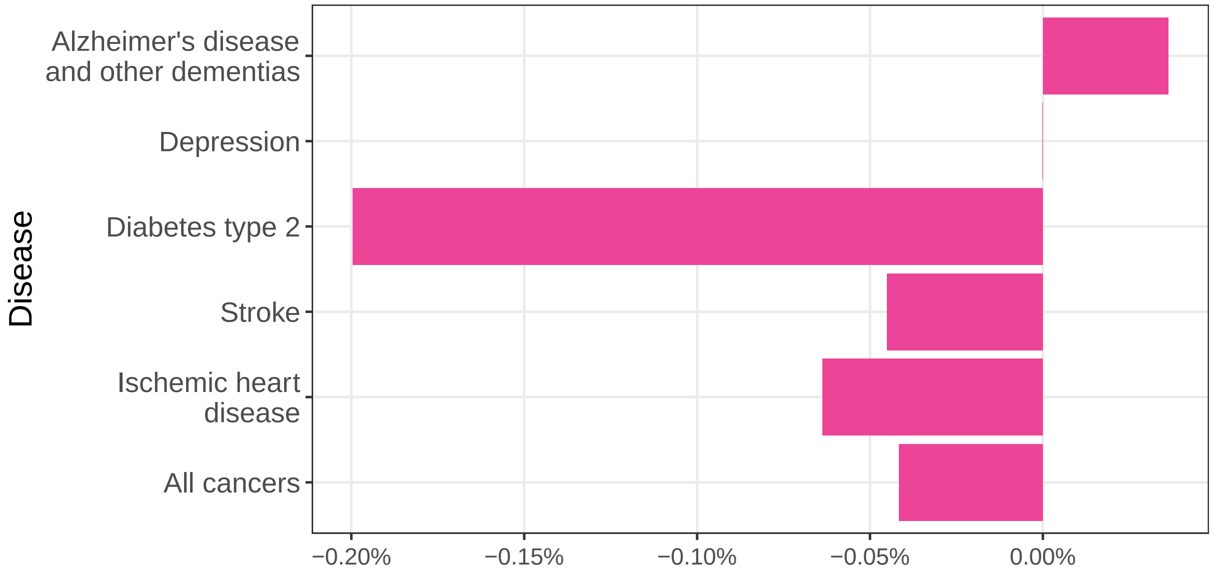

Figure 4.a: Percentage change in mortality by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

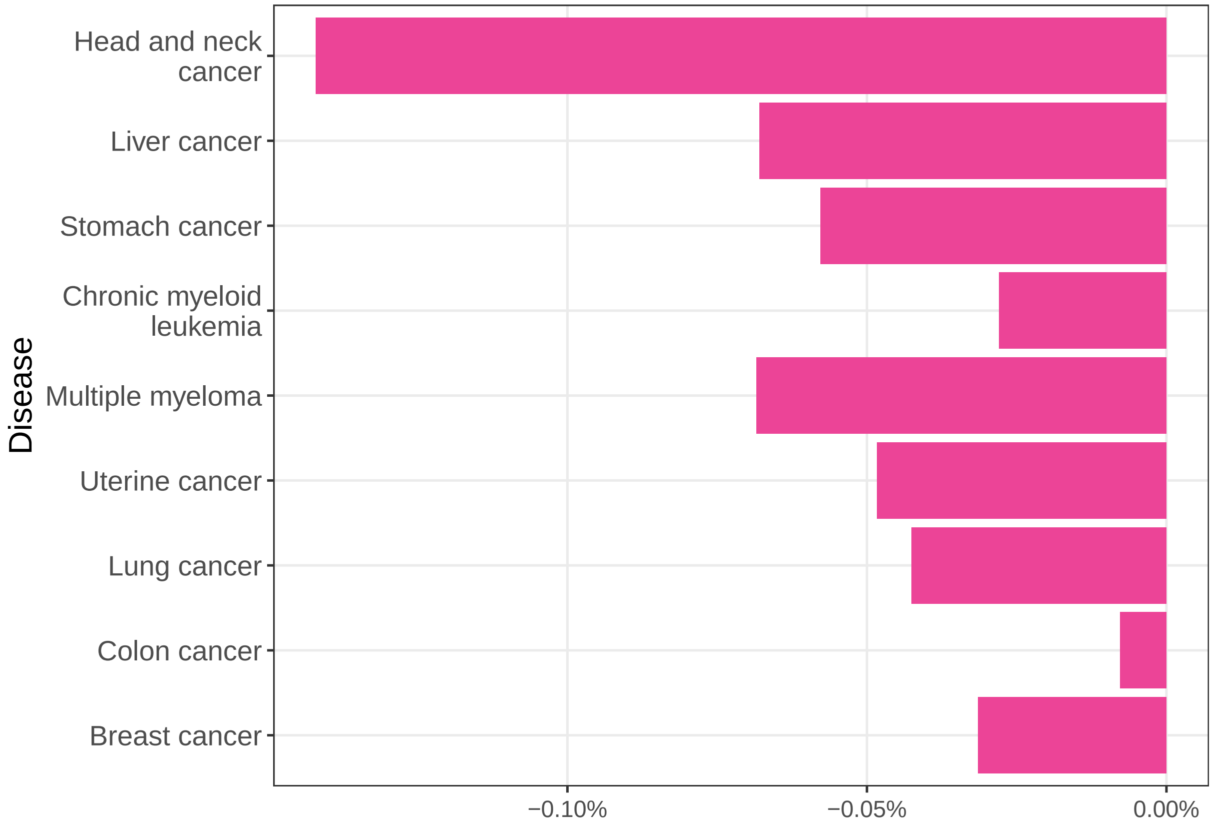

Figure 4.b: Percentage change in mortality for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

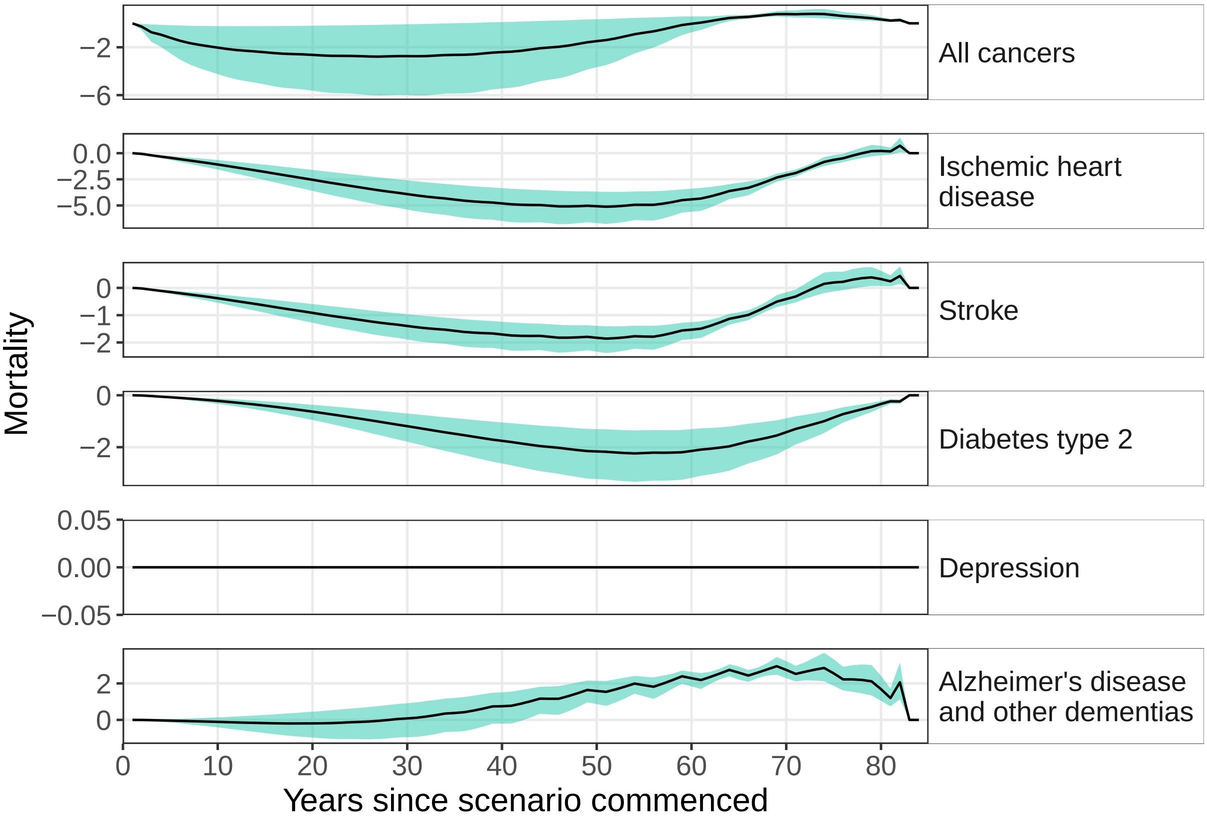

Figure 5.a: The change in mortality over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

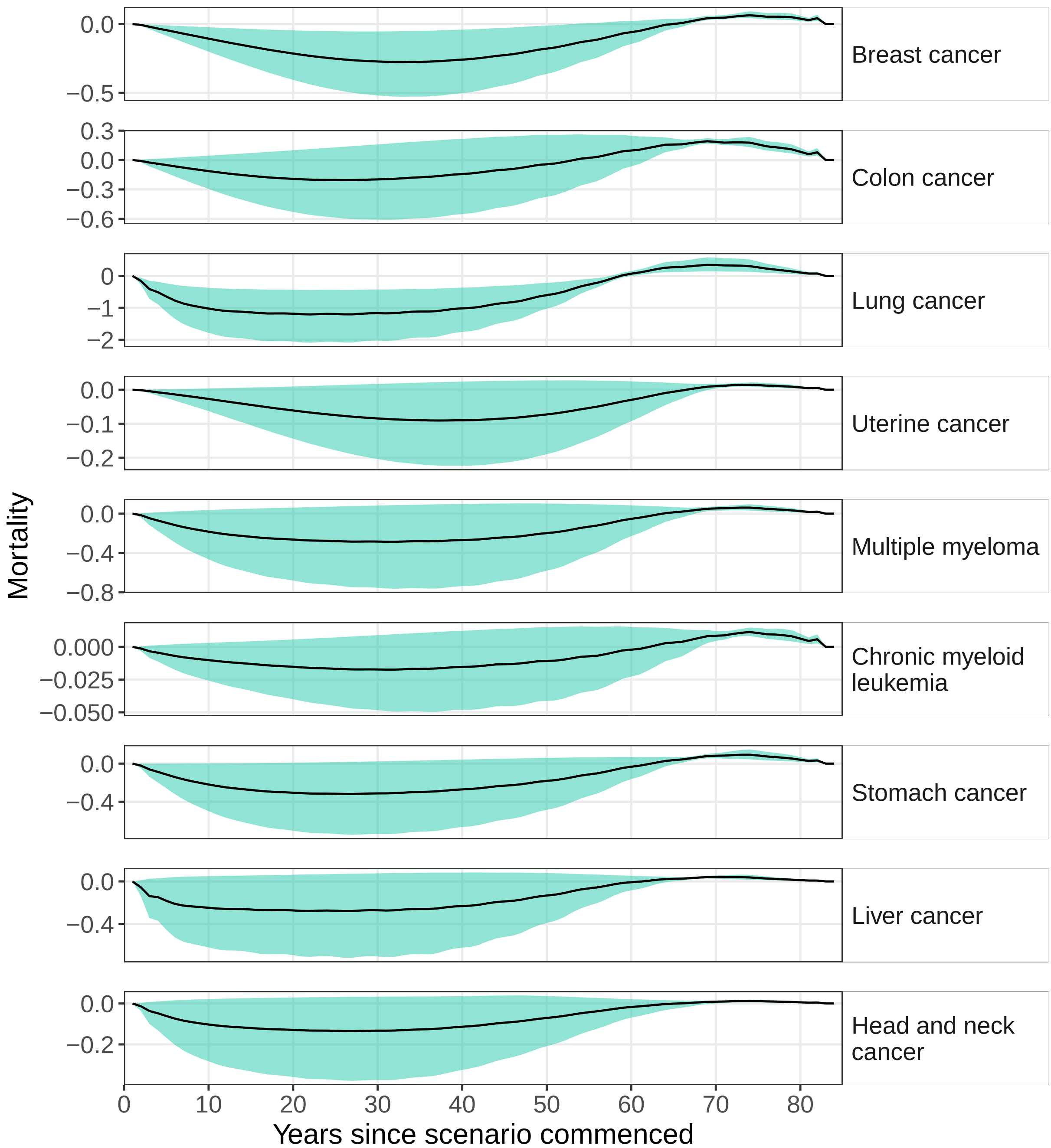

Figure 5.b: Percentage change in mortality for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Health

Figures 6 and 7 below show the change in Health Adjusted Life Years (HALYs)[1] and Life Years[2] for a snapshot of the population from 2019 for the scenario. Both figures show that the greatest gains from increasing physical activity occur midway through the life cycle with most of the gains occurring cumulatively in the long term. The decline from the mid-point onwards is due to individuals dying from natural causes within the model.

HALYS

The model estimates a total of **24,282** HALYs for the scenario population, which is **12** HALYs per 1,000 members of the population.

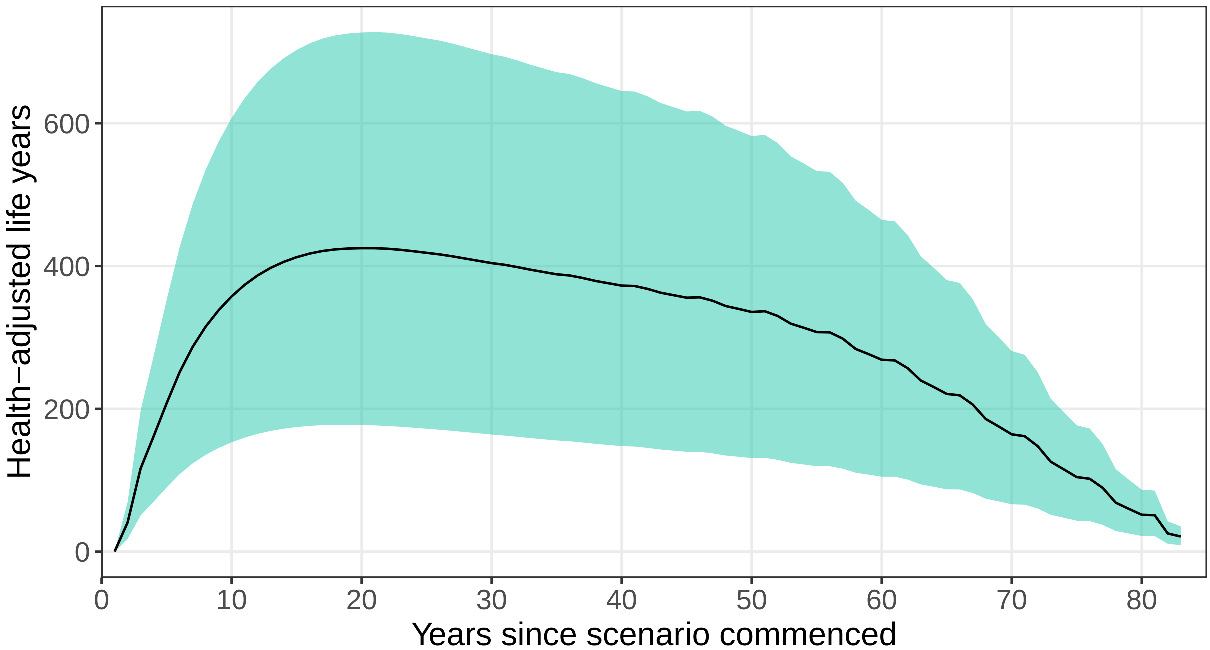

Figure 6. Total health-adjusted life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

[1]Health Adjusted Life Years are holistic measures of health that account for morbidity, mortality and quality of life.

[2]Life Years are similar to a HALYs however they exclude the quality of life component.

Life Years

The model estimates a total of **11,058** Life Years for the scenario population, which is **5.5** Life Years per 1,000 members of the population.

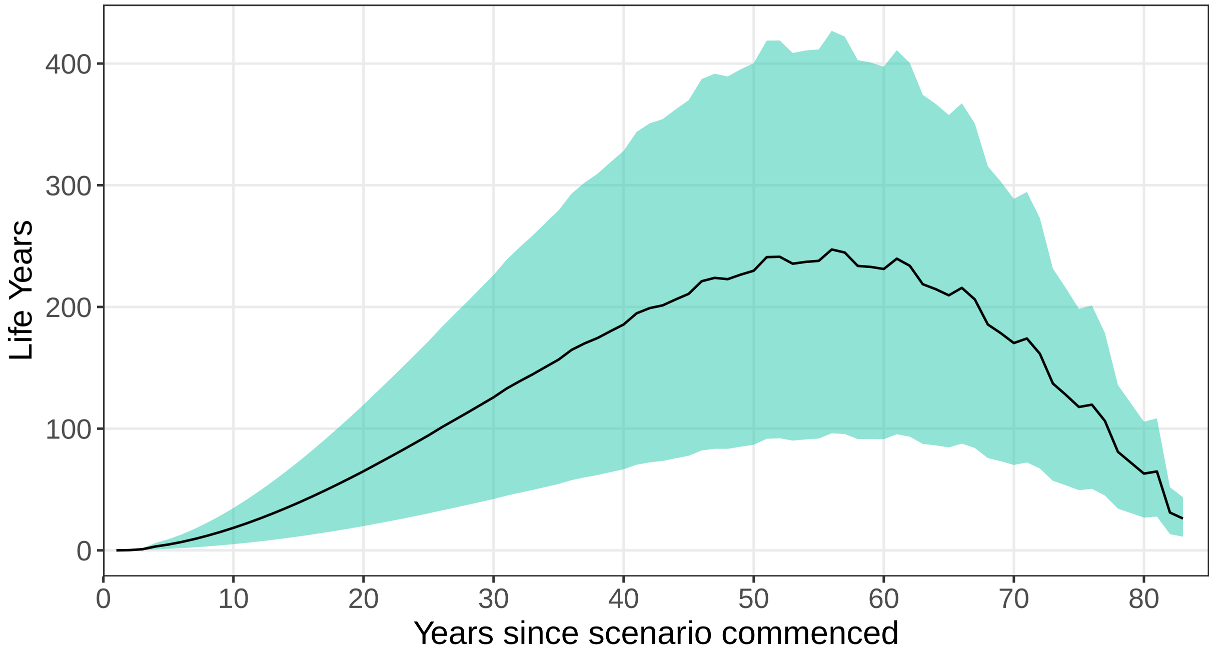

Figure 7. Total life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Value

The value of improvements to community health can be calculated**[a]** by translating the Health Adjusted Life Years (HALYs) from each scenario into dollar terms using the value of a statistical life year**[b]**. The value of a statistical life year is an estimate of the amount a society is willing to trade to reduce the risk of death for one year.

In the simulation model, HALYs are generated across time and are cumulative. Thus, to help us understand the value of HALYs across time in present day terms, it is necessary to use discounting**[c]** to reduce HALYs generated at the future point in time. Discounted HALYs from these future points can be added up to give the aggregate value of HALYs in today's terms as a measure of the value of improvements to community health arising from the chosen scenario.

The size of the discount rate can impact the aggregated value of HALYs and there is considerable debate on what discount rates should be used (with some arguing that health should not be discounted at all).[2] Hence, it is common to use a variety of discount rates to allow for differing risks, preferences and sensitivity when valuing health. The figures presented below were calculated using discount rates of 3%, 5% and 7% based on recent recommendations [3, 4] and represent the value of HALYs in present day terms resulting from an increase in physical activity from the chosen scenario.

The value of improvements to community health

The model estimates a total of **HALYs,** Health Adjusted Life Years (HALYs) gained for the scenario population, which is **12** HALYs per 1,000 members of the scenario population. The figures below represent the value of improvements to community health from the chosen scenario. These figures can be used in summary reports and for advocacy purposes**[d]**.

The HALYs gained in this scenario have a statistical value of:

- **1,028,474** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **649,894** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **447,444** per 1,000 members of the population, when calculated using a discount rate of 7%.

a. What is meant by value and how can it be measured?

Value is conceptual and measures a sense of worth or usefulness of something to individuals or to a society. Measuring the value of something, such as health, enables it to be included in assessments or analyses such as cost-benefit analyses to recognise its relative importance.

Value can be derived in many ways and a common approach is to use monetary terms, such as dollars. Valuing something using dollars is not the same as equating it with its price. Prices represent the amount at which something can be traded, prices therefore represent the amount of money for buying or selling something such as food, clothing or to pay bills. One way is to evaluate health in dollar terms is to use the Value of a Statistical Life and Value of a Statistical Life Year**[b]**.

b. What is the Value of a Statistical Life and Value of a Statistical Life Year?

The value of a **statistical life** is the estimated amount that a society is willing to trade to reduce the risk of death. The word 'Statistical' refers to the average value for life and therefore means the value of a statistical life doesn't relate to any specific individual. This value can change across risk factors and different societies who may value life differently. There are various ways of measuring the value of a statistical life with most approaches using revealed or stated preference approaches.[3] In Australia, the Office of Best Practice Regulation estimates a statistical life at $5.3M in 2022 dollar terms, and assumes that the life is of a young person with at least another 40 years to live.[5, 6]

Value of a Statistical Life Year

The value of a statistical life year is the estimated amount that a society is willing to trade to reduce the risk of death over **one year.** It can be derived from the value of a statistical life or measured directly using surveys or willingness to pay techniques.[5] The current value of a **statistical life year** is $227,000 in 2022 dollars based on current estimates from the Office of Best Practice Regulation.[6] The value of a statistical life year is useful for evaluating small increases in life years instead of evaluating full life expectancy. It is appropriate for valuing the Health Adjusted Life Years estimated from the scenarios and modelling presented in this tool. For the modelling and results presented here, the value of $227,000 was converted to 2019 dollars based on the Wage Price Index for Brisbane.

c. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

d. Application in advocacy and reporting

This section uses figures to show how the value of community health (estimated from HALYs and the value of statistical life year) can be used for reporting and advocacy purposes.

The simulation model uses **population-based estimates** for disease morbidity and mortality and is best applied to larger groups of people. It also assumes that the people of interest have similar characteristics and behaviours to the population data used in the simulation model and scenarios. The **example** below shows results from a scenario that replaces car trips with walking trips for distances of 0-2 km for All age groups.

Example:

The HALYs gained in this scenario have a statistical value of:

- **$10,859,605** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **$6,662,541** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **$4,533,392** per 1,000 members of the population, when calculated using a discount rate of 7%.

This **example** shows that the HALYs gained in this scenario have a statistical value of $10,859,605 per 1,000 members of the population using a discount of 3%.

This figure can be divided by 1,000 to give a per person figure. Once a per person figure is established, it can be multiplied by the number of people in any population size of interest for use in reports or as evidence to advocate for benefits associated with shifts to active transport modes.

$10,859,605 / 1,000 = $10,859.61 per person value

A good example of how this model can be applied links to previous research that investigated the impact of new more walkable development in Altona North on a population of 21,000 people [11]. If we assume that these people have similar characteristics to the underlying population based estimates and behaviours based on the travel survey data in the simulation model underlying this tool, then the value of community health according to the chosen scenario can be calculated as:

21,000 (people) x $10,859 (statistical value from HALYs gained) = $228 M.

Savings

An increase in physical activity due to the chosen scenario reduces chronic disease cases across a lifetime and reduces spending for each disease within the health care system resulting in overall health care cost savings**[a]**.

Table 3 provides estimated health care cost savings associated with the prevented cases of chronic diseases per 1,000 members of the population according to the selected scenario. These figures are based on applying average health care system costs per prevalent case of disease and using three alternative discount rates**[b]**:

Table 3. Total health care cost savings by disease per 1,000 members of the population.

Disease	3% discount rate	5% discount rate	7% discount rate
Alzheimer's disease and other dementias	$277	$194	$137
Breast cancer	$7,542	$4,629	$3,027
All cancers	$15,672	$9,955	$6,696
Colon cancer	$2,763	$1,889	$1,318
Chronic myeloid leukemia	$826	$499	$324
Diabetes type 2	$5,820	$3,379	$2,129
Depression	$33,823	$24,626	$18,571
Head and neck cancer	$142	$97	$69
Ischemic heart disease	$10,062	$5,880	$3,719
Liver cancer	$119	$82	$59
Multiple myeloma	$2,001	$1,280	$874
Stomach cancer	$731	$471	$324
Stroke	$1,385	$810	$513
Lung cancer	$1,117	$746	$529
Uterine cancer	$429	$264	$174

a. What do we mean by health care cost savings?

To calculate health care cost savings for each disease, the annual costs for each disease in each year is multiplied by the number of prevented cases of each disease for each scenario. This results in a total saving in spending for each disease by year. The savings in spending for future years are discounted**[b]** with annual savings aggregated to give a total amount saved for each disease. Total savings are presented as the amount saved per 1,000 members of the population to enable comparisons against populations of different sizes.

We use the term **health care cost saving** because it represents a reduction in health spending. However, the Australian Institute of Health and Welfare (AIHW) stress that the term cost is broad and not representative of the full cost experienced by individuals, families, or the health system, consequently AIHW use the term spending.[8]

These figures use AIHW estimates of the amounts spent through the health system in 2018-19 for each case of disease. This is extracted from Health system spending per case of disease and for certain risk factors, Table 1 – Estimates of health system spending per case, by burden of disease group, condition and sex, Australia 2018-2019.[9]. For head and neck cancers, supplementary figures were obtained from the Global Burden of Disease incidence data.[10]

b. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

References

1. Gold, M. R., Stevenson, D., & Fryback, D. G. (2002). *HALYS and QALYS and DALYS, Oh My: similarities and differences in summary measures of population Health.* Annual review of public health, 23(1), 115-134.
2. Attema, A.E., Brouwer, W.B. & Claxton, K. (2018). *Discounting in economic evaluations.* Pharmacoeconomics. 36: p. 745-758.
3. Ananthapavan, J., Moodie, M., Milat, A.J., & Carter, R. (2021). *Systematic review to update 'value of a statistical life' estimates for Australia.* International journal of environmental research and public health, 2021. 18(11): p. 6168.
4. Terrill, M. & Batrouney, H. (2018). *Unfreezing discount rates: Transport infrastructure for tomorrow.* Grattan Institute.
5. Abelson, P. (2008). *Establishing a monetary value for lives saved: issues and controversies.* Canberra: Office of Best Practice Regulation, Department of Finance and Deregulation.
6. Department of the Prime Minister and Cabinet. (2022). *Best practice regulation guidance note: Value of statistical life.* Australian Government.
7. Haacker, M., Hallett, T.B. & Atun, R. (2020). *On discount rates for economic evaluations in global health.* Health Policy and Planning, 2020. 35(1): p. 107-114.
8. Australian Institute of Health and Welfare (2023). Technical Notes: Estimating Spending per prevalent case of disease. Health system spending per case of disease and for certain risk factors, Estimating the spending per prevalent case of disease - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
9. Australian Institute of Health and Welfare (2023). Health system spending per case of disease and for certain risk factors. Health system spending per case of disease and for certain risk factors, Data - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
10. Global Burden of Disease (2019). Global Health Data Exchange. https://vizhub.healthdata.org/gbd-results. Accessed September 20, 2023.
11. Zapata-Diomedi, B., Boulangé, C., Giles-Corti, B., Phelan, K., Washington, S., Veerman, L.J., & Gunn, L. (2019). Physical activity-related health and economic benefits of building walkable neighbourhoods: A modelled comparison between brownfield and greenfield developments. International Journal of Behavioural Nutrition and Physical Activity.
12. Khorasani, E., Davari, M., Kebriaeezadeh, A., Fatemi, F., Akbari Sari, A., & Varahrami, V. (2022). A comprehensive review of official discount rates in guidelines of health economic evaluations over time: the trends and roots. The European Journal of Health Economics, 23(9), 1577-1590.

Scenario: replacing car trips under 1km with walking, and car trips between 1 and 5km with cycling for commuting trip purposes

This scenario shows the results of replacing car trips under 1km with walking and replacing car trips between 1km and 5km with cycling for work related or education purposes for all adults of all ages.

This implies that the selected scenario results in a mode shift in walking from 16.8% to 17.2%; cycling from 1.3% to 7.2%; and, from 74.7% to 68.2% for car trips taken as either a driver or passenger.

Increases in walking and cycling translate into a shift from 47.9% to 53.2% of the population accumulating the required minutes spent being moderately (150 – 300 mins) or vigorously physically active (75 – 150 mins) or an equivalent combination of both contributing to recommended levels as detailed in the Physical Activity Guidelines.

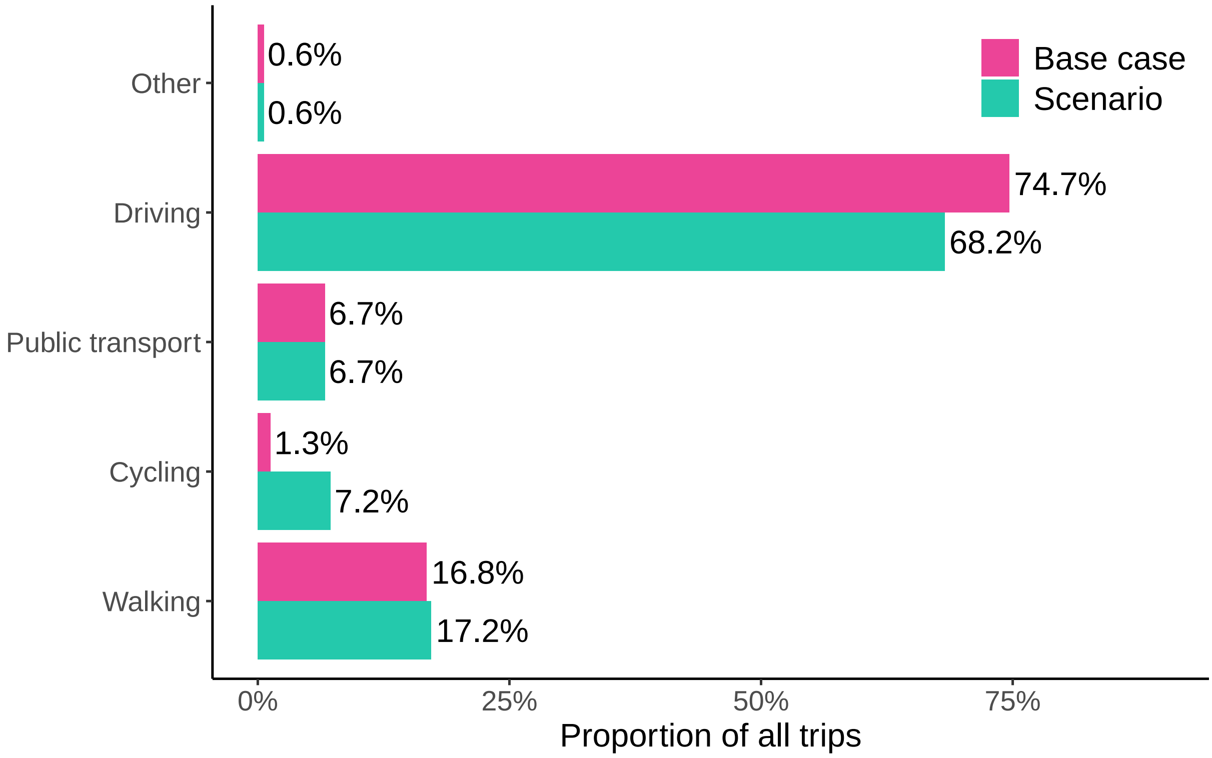

Figure 1: Distribution of base case and scenario trips.

Incidence

Incidence describes the rate of occurrence of new cases of a disease over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of disease prevented, due to increases in physical activity associated with the scenario. Figure 2 presents the change (%) in the disease incidence across the life course. Figure 3 presents how the difference in disease incidence changes over time, by year, using a snapshot of the population from 2019.

Table 1 shows how the scenario impacts the incidence of chronic diseases as both as a percentage and total number of prevented cases.

Table 1. Chronic disease incidence reduction and total number of prevented cases of disease measured across the years of the simulation

Disease*	Incidence of disease is reduced by	Total number of prevented cases of disease aggregated across the simulation
Alzheimer's disease and other dementias	-0.07%	-437
Breast cancer	0.18%	131
All cancers	0.12%	486
Colon cancer	0.02%	22
Chronic myeloid leukemia	0.09%	3
Diabetes type 2	1.01%	3,340
Depression	0.17%	2,747
Head and neck cancer	0.47%	21
Ischemic heart disease	0.27%	2,347
Liver cancer	0.28%	49
Multiple myeloma	0.21%	42
Stomach cancer	0.21%	50
Stroke	0.21%	548
Lung cancer	0.13%	149
Uterine cancer	0.25%	21

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

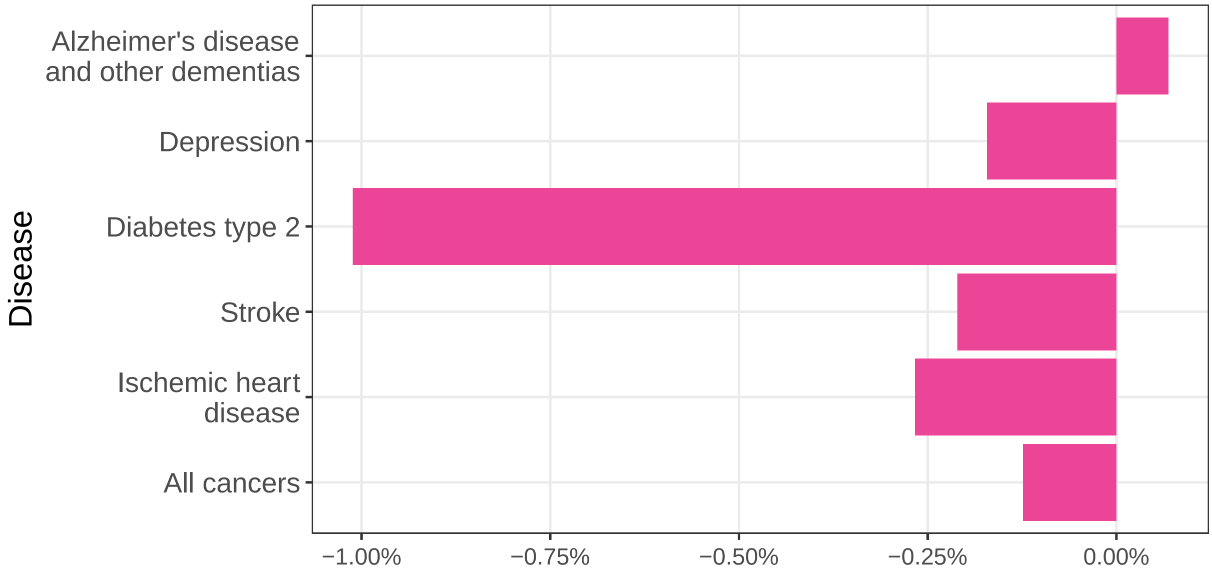

Figure 2.a: Percentage change in incidence by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

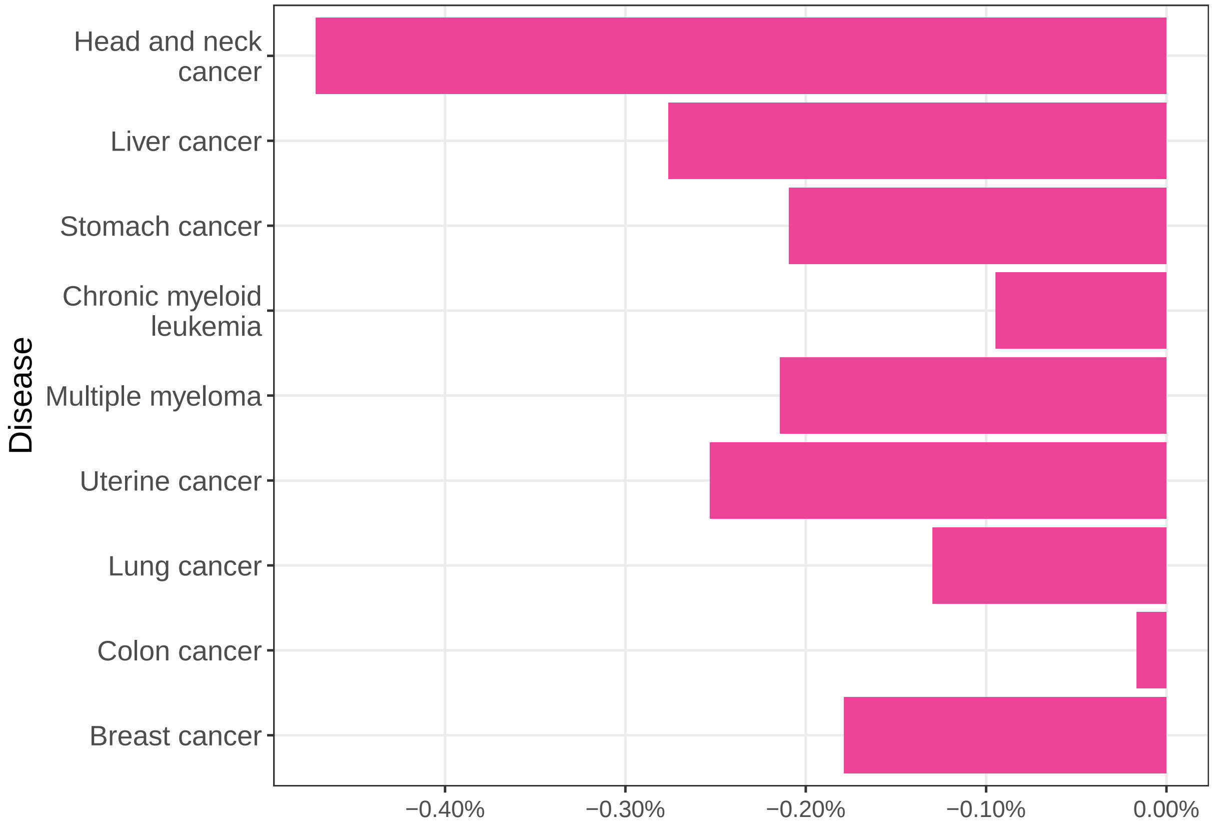

Figure 2.b: Percentage change in incidence for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

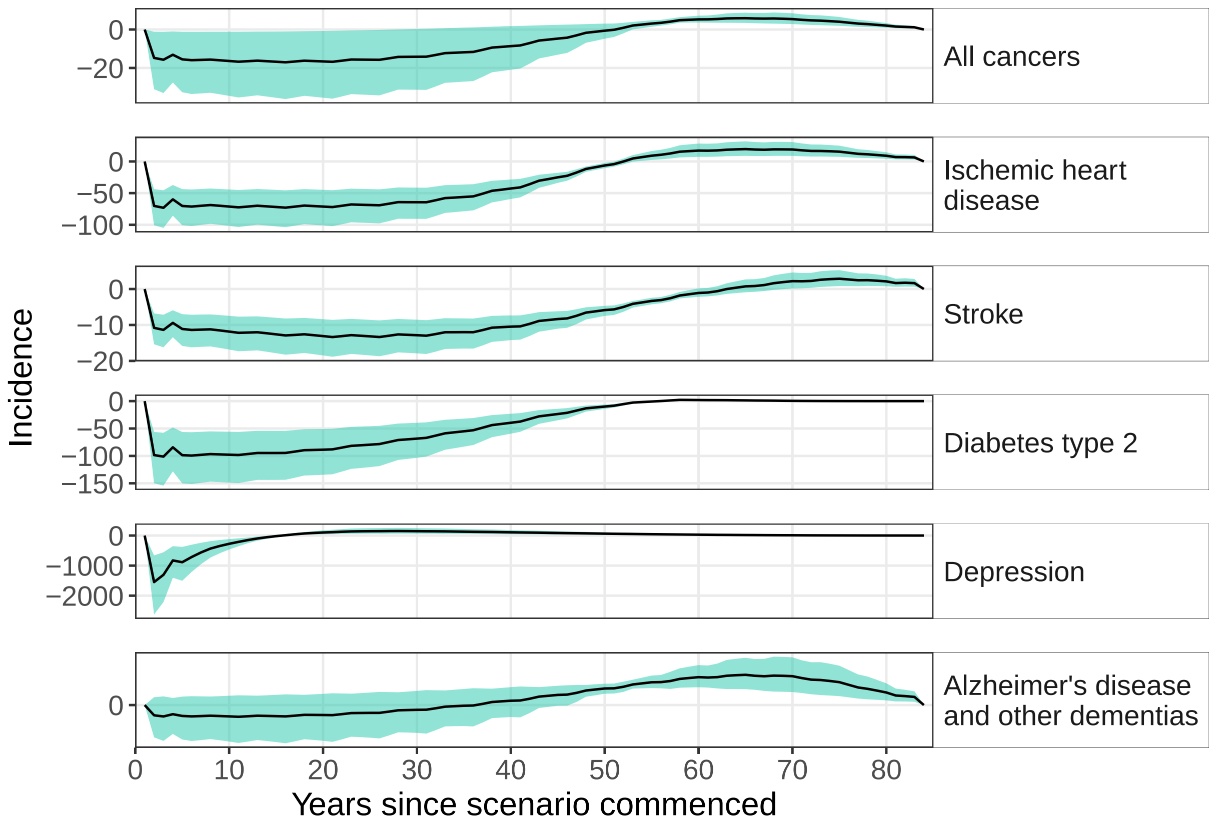

Figure 3.a: The change in incidence over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

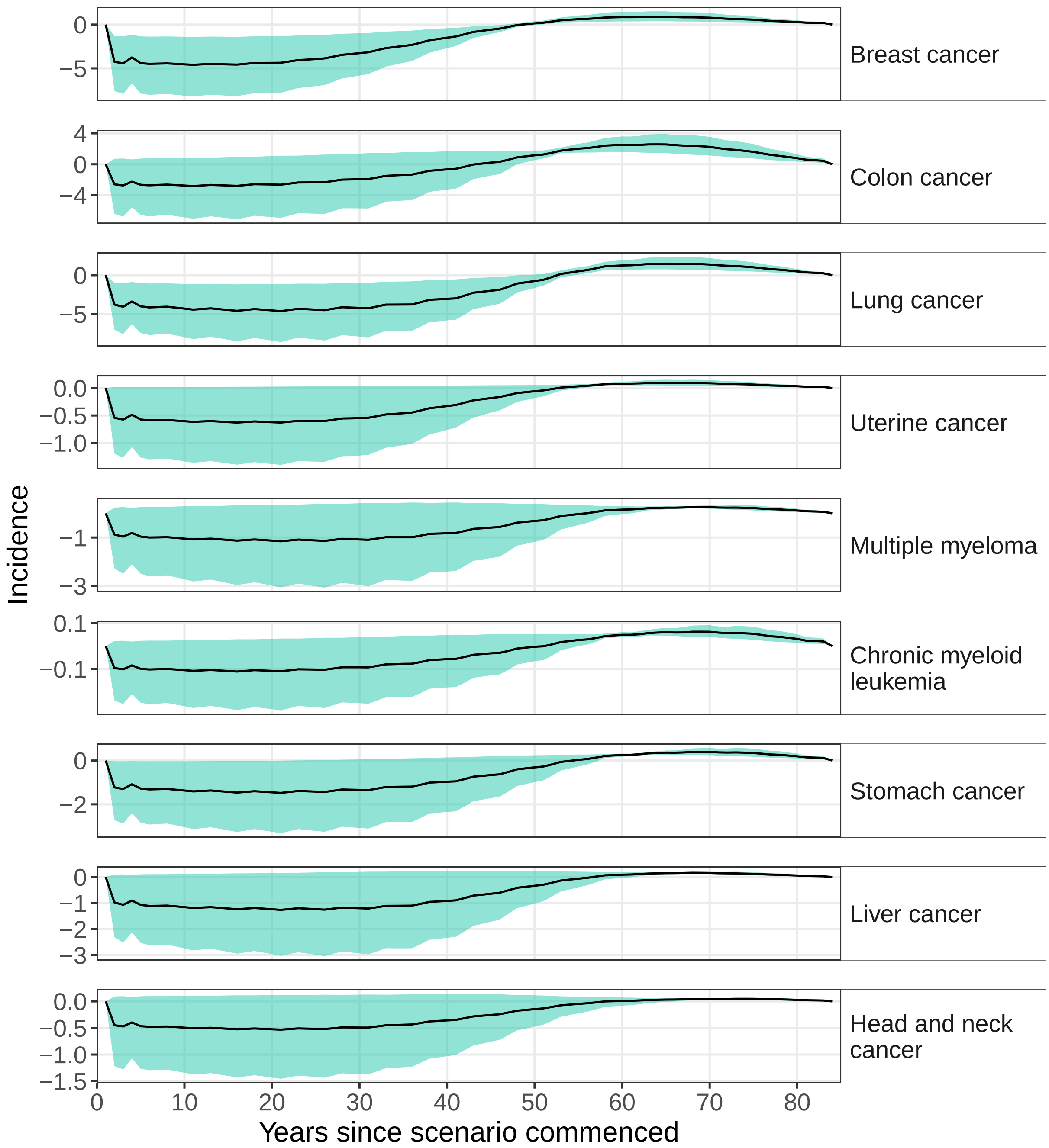

Figure 3.b: Percentage change in incidence for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Mortality

Mortality is the number of deaths due to a given disease over over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of prevented deaths due to increases in physical activity associated with the scenario. Figure 4 presents the total change in mortality over the life course. Figure 5 presents the difference in the number of deaths by year using a snapshot of the population from 2019.

Table 2 shows how the scenario impacts reductions in mortality presented as a percentage and total number of prevented deaths caused by chronic diseases.

Table 2. Percentage reduction in mortality and total number of prevented deaths by chronic disease measured across the years of the simulation.

Disease*	Mortality is reduced by	Total number of prevented deaths aggregated across the simulation
Alzheimer's disease and other dementias	-0.15%	-358
Breast cancer	0.19%	60
All cancers	0.15%	378
Colon cancer	0.03%	13
Chronic myeloid leukemia	0.06%	1
Diabetes type 2	0.92%	455
Depression	0.00%	0
Head and neck cancer	0.51%	20
Ischemic heart disease	0.27%	1,017
Liver cancer	0.28%	48
Multiple myeloma	0.21%	37
Stomach cancer	0.21%	44
Stroke	0.18%	317
Lung cancer	0.13%	140
Uterine cancer	0.22%	16

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

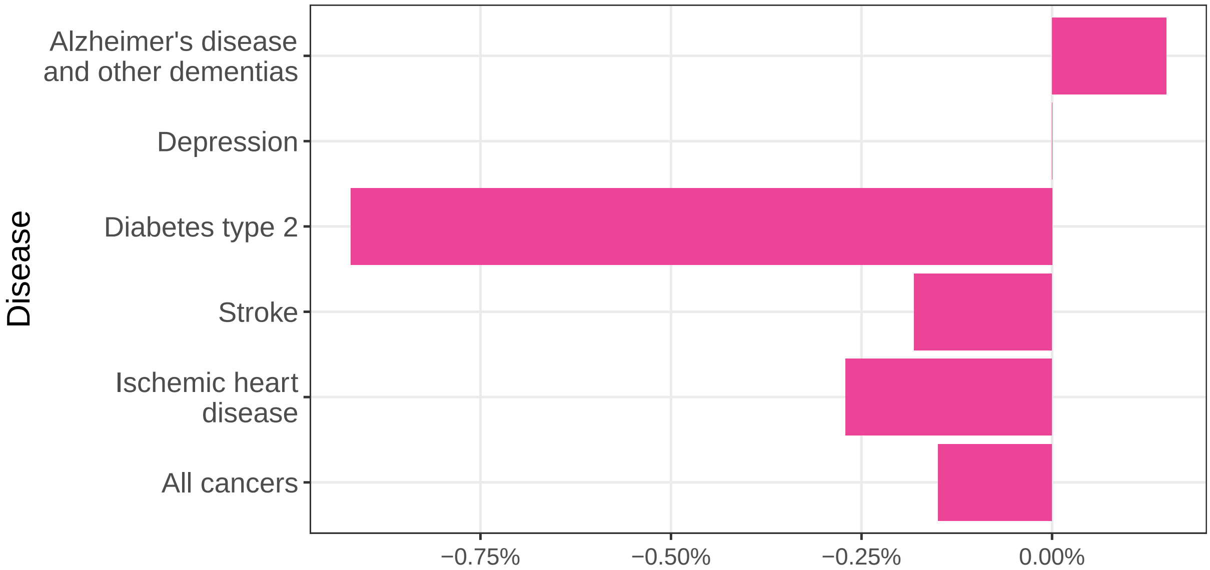

Figure 4.a: Percentage change in mortality by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

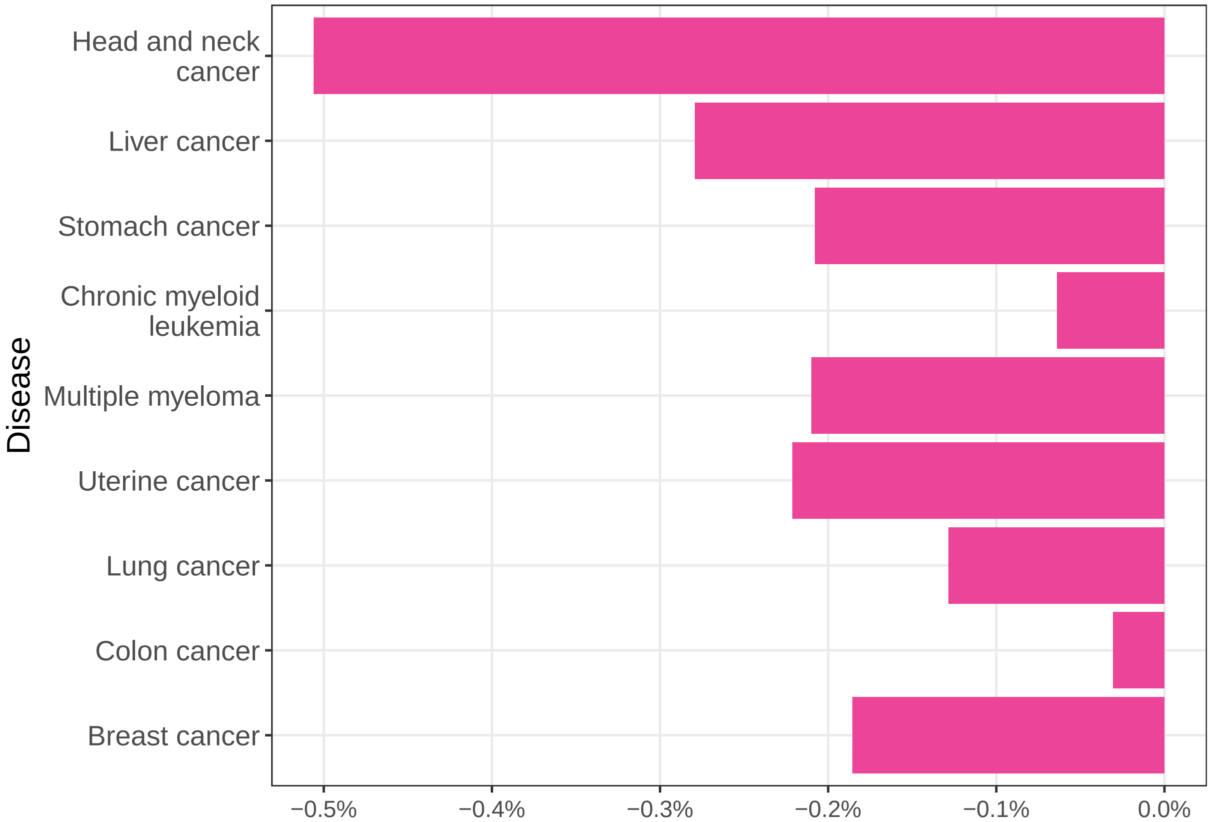

Figure 4.b: Percentage change in mortality for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

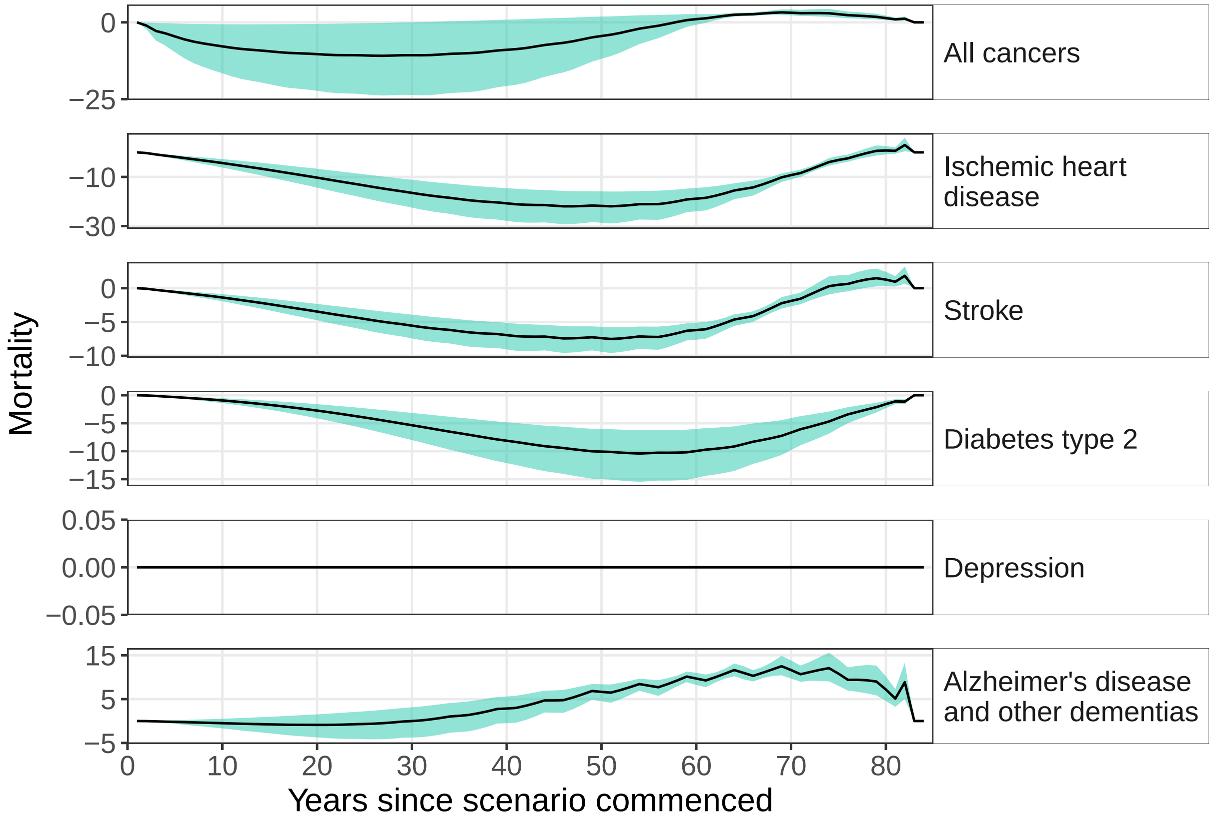

Figure 5.a: The change in mortality over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

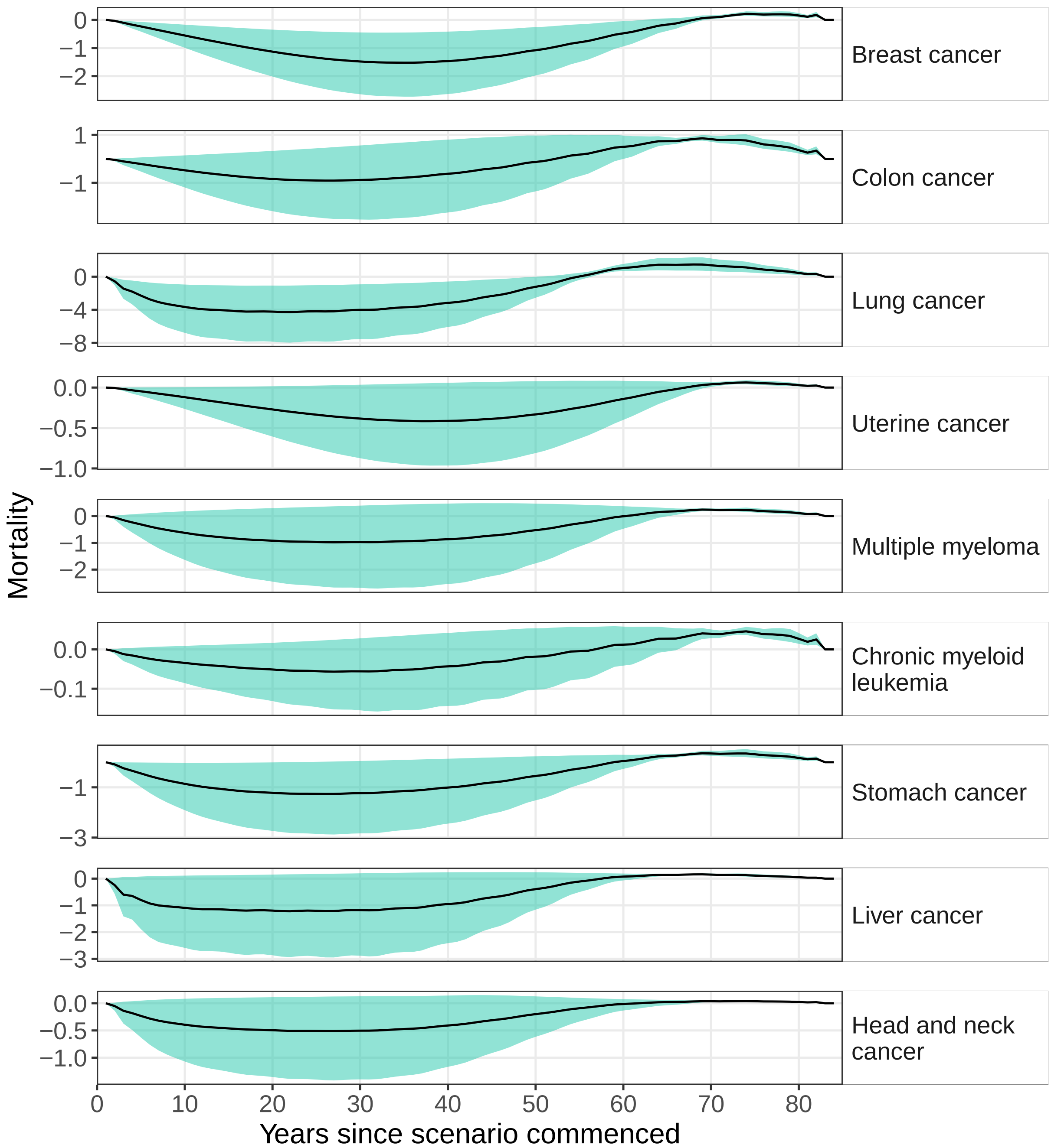

Figure 5.b: Percentage change in mortality for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Health

Figures 6 and 7 below show the change in Health Adjusted Life Years (HALYs)[1] and Life Years[2] for a snapshot of the population from 2019 for the scenario. Both figures show that the greatest gains from increasing physical activity occur midway through the life cycle with most of the gains occurring cumulatively in the long term. The decline from the mid-point onwards is due to individuals dying from natural causes within the model.

HALYS

The model estimates a total of **102,986** HALYs for the scenario population, which is **51** HALYs per 1,000 members of the population.

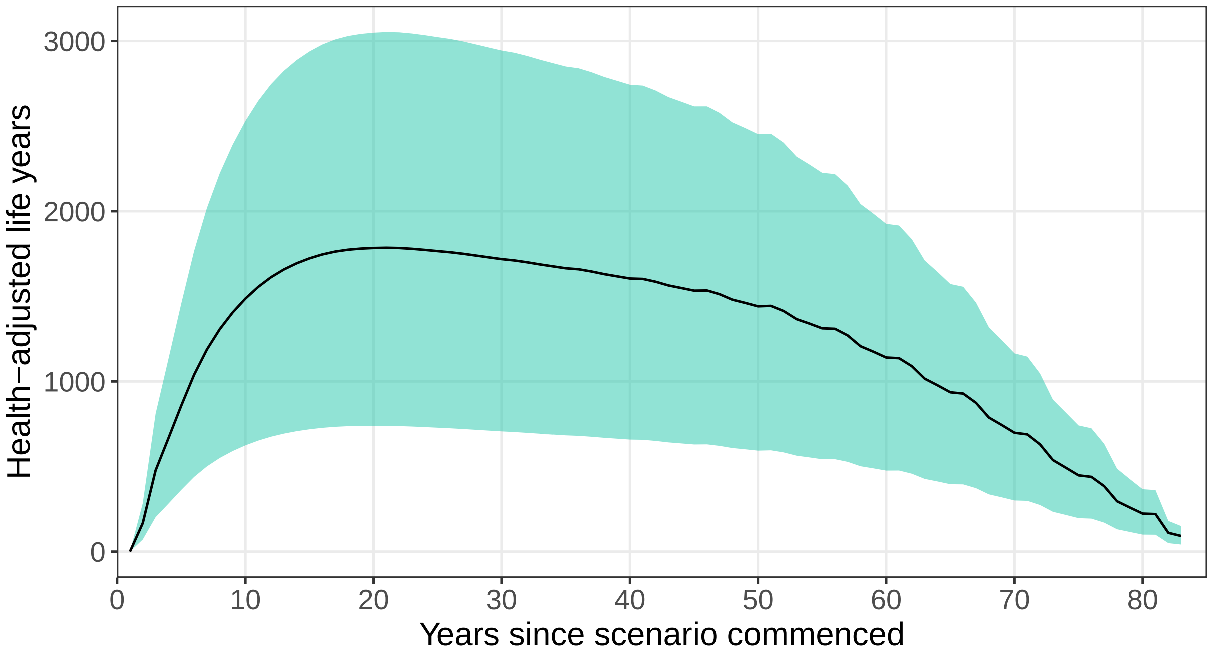

Figure 6. Total health-adjusted life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

[1]Health Adjusted Life Years are holistic measures of health that account for morbidity, mortality and quality of life.

[2]Life Years are similar to a HALYs however they exclude the quality of life component.

Life Years

The model estimates a total of **46,550** Life Years for the scenario population, which is **23** Life Years per 1,000 members of the population.

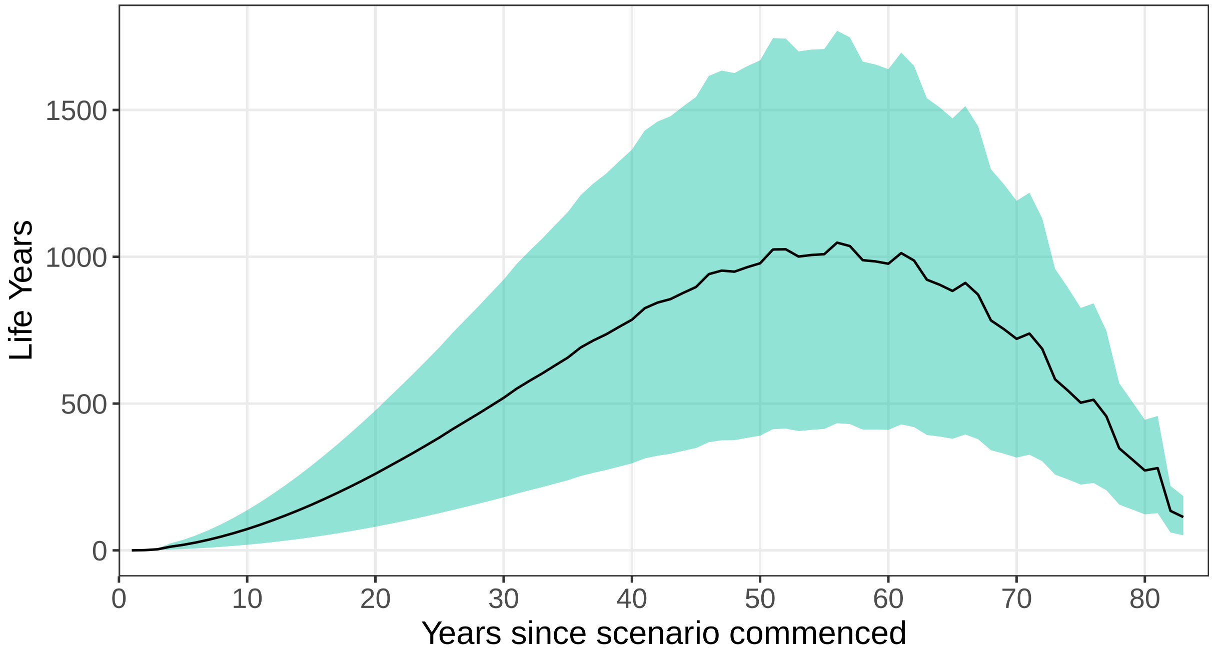

Figure 7. Total life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Value

The value of improvements to community health can be calculated**[a]** by translating the Health Adjusted Life Years (HALYs) from each scenario into dollar terms using the value of a statistical life year**[b]**. The value of a statistical life year is an estimate of the amount a society is willing to trade to reduce the risk of death for one year.

In the simulation model, HALYs are generated across time and are cumulative. Thus, to help us understand the value of HALYs across time in present day terms, it is necessary to use discounting**[c]** to reduce HALYs generated at the future point in time. Discounted HALYs from these future points can be added up to give the aggregate value of HALYs in today's terms as a measure of the value of improvements to community health arising from the chosen scenario.

The size of the discount rate can impact the aggregated value of HALYs and there is considerable debate on what discount rates should be used (with some arguing that health should not be discounted at all).[2] Hence, it is common to use a variety of discount rates to allow for differing risks, preferences and sensitivity when valuing health. The figures presented below were calculated using discount rates of 3%, 5% and 7% based on recent recommendations [3, 4] and represent the value of HALYs in present day terms resulting from an increase in physical activity from the chosen scenario.

The value of improvements to community health

The model estimates a total of **HALYs,** Health Adjusted Life Years (HALYs) gained for the scenario population, which is **51** HALYs per 1,000 members of the scenario population. The figures below represent the value of improvements to community health from the chosen scenario. These figures can be used in summary reports and for advocacy purposes**[d]**.

The HALYs gained in this scenario have a statistical value of:

- **4,336,658** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **2,730,485** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **1,874,086** per 1,000 members of the population, when calculated using a discount rate of 7%.

a. What is meant by value and how can it be measured?

Value is conceptual and measures a sense of worth or usefulness of something to individuals or to a society. Measuring the value of something, such as health, enables it to be included in assessments or analyses such as cost-benefit analyses to recognise its relative importance.

Value can be derived in many ways and a common approach is to use monetary terms, such as dollars. Valuing something using dollars is not the same as equating it with its price. Prices represent the amount at which something can be traded, prices therefore represent the amount of money for buying or selling something such as food, clothing or to pay bills. One way is to evaluate health in dollar terms is to use the Value of a Statistical Life and Value of a Statistical Life Year**[b]**.

b. What is the Value of a Statistical Life and Value of a Statistical Life Year?

The value of a **statistical life** is the estimated amount that a society is willing to trade to reduce the risk of death. The word 'Statistical' refers to the average value for life and therefore means the value of a statistical life doesn't relate to any specific individual. This value can change across risk factors and different societies who may value life differently. There are various ways of measuring the value of a statistical life with most approaches using revealed or stated preference approaches.[3] In Australia, the Office of Best Practice Regulation estimates a statistical life at $5.3M in 2022 dollar terms, and assumes that the life is of a young person with at least another 40 years to live.[5, 6]

Value of a Statistical Life Year

The value of a statistical life year is the estimated amount that a society is willing to trade to reduce the risk of death over **one year.** It can be derived from the value of a statistical life or measured directly using surveys or willingness to pay techniques.[5] The current value of a **statistical life year** is $227,000 in 2022 dollars based on current estimates from the Office of Best Practice Regulation.[6] The value of a statistical life year is useful for evaluating small increases in life years instead of evaluating full life expectancy. It is appropriate for valuing the Health Adjusted Life Years estimated from the scenarios and modelling presented in this tool. For the modelling and results presented here, the value of $227,000 was converted to 2019 dollars based on the Wage Price Index for Brisbane.

c. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

d. Application in advocacy and reporting

This section uses figures to show how the value of community health (estimated from HALYs and the value of statistical life year) can be used for reporting and advocacy purposes.

The simulation model uses **population-based estimates** for disease morbidity and mortality and is best applied to larger groups of people. It also assumes that the people of interest have similar characteristics and behaviours to the population data used in the simulation model and scenarios. The **example** below shows results from a scenario that replaces car trips with walking trips for distances of 0-2 km for All age groups.

Example:

The HALYs gained in this scenario have a statistical value of:

- **$10,859,605** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **$6,662,541** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **$4,533,392** per 1,000 members of the population, when calculated using a discount rate of 7%.

This **example** shows that the HALYs gained in this scenario have a statistical value of $10,859,605 per 1,000 members of the population using a discount of 3%.

This figure can be divided by 1,000 to give a per person figure. Once a per person figure is established, it can be multiplied by the number of people in any population size of interest for use in reports or as evidence to advocate for benefits associated with shifts to active transport modes.

$10,859,605 / 1,000 = $10,859.61 per person value

A good example of how this model can be applied links to previous research that investigated the impact of new more walkable development in Altona North on a population of 21,000 people [11]. If we assume that these people have similar characteristics to the underlying population based estimates and behaviours based on the travel survey data in the simulation model underlying this tool, then the value of community health according to the chosen scenario can be calculated as:

21,000 (people) x $10,859 (statistical value from HALYs gained) = $228 M.

Savings

An increase in physical activity due to the chosen scenario reduces chronic disease cases across a lifetime and reduces spending for each disease within the health care system resulting in overall health care cost savings**[a]**.

Table 3 provides estimated health care cost savings associated with the prevented cases of chronic diseases per 1,000 members of the population according to the selected scenario. These figures are based on applying average health care system costs per prevalent case of disease and using three alternative discount rates**[b]**:

Table 3. Total health care cost savings by disease per 1,000 members of the population.

Disease	3% discount rate	5% discount rate	7% discount rate
Alzheimer's disease and other dementias	$1,044	$754	$537
Breast cancer	$41,036	$24,985	$16,250
All cancers	$73,001	$46,168	$30,922
Colon cancer	$11,935	$8,210	$5,738
Chronic myeloid leukemia	$2,796	$1,702	$1,111
Diabetes type 2	$27,564	$16,001	$10,076
Depression	$140,499	$102,147	$76,932
Head and neck cancer	$555	$380	$273
Ischemic heart disease	$44,540	$26,000	$16,433
Liver cancer	$543	$377	$275
Multiple myeloma	$7,203	$4,661	$3,203
Stomach cancer	$2,934	$1,911	$1,322
Stroke	$5,681	$3,321	$2,099
Lung cancer	$4,023	$2,735	$1,959
Uterine cancer	$1,966	$1,211	$795

a. What do we mean by health care cost savings?

To calculate health care cost savings for each disease, the annual costs for each disease in each year is multiplied by the number of prevented cases of each disease for each scenario. This results in a total saving in spending for each disease by year. The savings in spending for future years are discounted**[b]** with annual savings aggregated to give a total amount saved for each disease. Total savings are presented as the amount saved per 1,000 members of the population to enable comparisons against populations of different sizes.

We use the term **health care cost saving** because it represents a reduction in health spending. However, the Australian Institute of Health and Welfare (AIHW) stress that the term cost is broad and not representative of the full cost experienced by individuals, families, or the health system, consequently AIHW use the term spending.[8]

These figures use AIHW estimates of the amounts spent through the health system in 2018-19 for each case of disease. This is extracted from Health system spending per case of disease and for certain risk factors, Table 1 – Estimates of health system spending per case, by burden of disease group, condition and sex, Australia 2018-2019.[9]. For head and neck cancers, supplementary figures were obtained from the Global Burden of Disease incidence data.[10]

b. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

References

1. Gold, M. R., Stevenson, D., & Fryback, D. G. (2002). *HALYS and QALYS and DALYS, Oh My: similarities and differences in summary measures of population Health.* Annual review of public health, 23(1), 115-134.
2. Attema, A.E., Brouwer, W.B. & Claxton, K. (2018). *Discounting in economic evaluations.* Pharmacoeconomics. 36: p. 745-758.
3. Ananthapavan, J., Moodie, M., Milat, A.J., & Carter, R. (2021). *Systematic review to update 'value of a statistical life' estimates for Australia.* International journal of environmental research and public health, 2021. 18(11): p. 6168.
4. Terrill, M. & Batrouney, H. (2018). *Unfreezing discount rates: Transport infrastructure for tomorrow.* Grattan Institute.
5. Abelson, P. (2008). *Establishing a monetary value for lives saved: issues and controversies.* Canberra: Office of Best Practice Regulation, Department of Finance and Deregulation.
6. Department of the Prime Minister and Cabinet. (2022). *Best practice regulation guidance note: Value of statistical life.* Australian Government.
7. Haacker, M., Hallett, T.B. & Atun, R. (2020). *On discount rates for economic evaluations in global health.* Health Policy and Planning, 2020. 35(1): p. 107-114.
8. Australian Institute of Health and Welfare (2023). Technical Notes: Estimating Spending per prevalent case of disease. Health system spending per case of disease and for certain risk factors, Estimating the spending per prevalent case of disease - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
9. Australian Institute of Health and Welfare (2023). Health system spending per case of disease and for certain risk factors. Health system spending per case of disease and for certain risk factors, Data - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
10. Global Burden of Disease (2019). Global Health Data Exchange. https://vizhub.healthdata.org/gbd-results. Accessed September 20, 2023.
11. Zapata-Diomedi, B., Boulangé, C., Giles-Corti, B., Phelan, K., Washington, S., Veerman, L.J., & Gunn, L. (2019). Physical activity-related health and economic benefits of building walkable neighbourhoods: A modelled comparison between brownfield and greenfield developments. International Journal of Behavioural Nutrition and Physical Activity.
12. Khorasani, E., Davari, M., Kebriaeezadeh, A., Fatemi, F., Akbari Sari, A., & Varahrami, V. (2022). A comprehensive review of official discount rates in guidelines of health economic evaluations over time: the trends and roots. The European Journal of Health Economics, 23(9), 1577-1590.

Scenario: replacing car trips under 1km with walking, and car trips between 1 and 10km with cycling for commuting trip purposes

This scenario shows the results of replacing car trips under 1km with walking and replacing car trips between 1km and 10km with cycling for work related or education purposes for all adults of all ages.

This implies that the selected scenario results in a mode shift in walking from 16.8% to 17.2%; cycling from 1.3% to 13.3%; and, from 74.7% to 62.2% for car trips taken as either a driver or passenger.

Increases in walking and cycling translate into a shift from 47.9% to 58.1% of the population accumulating the required minutes spent being moderately (150 – 300 mins) or vigorously physically active (75 – 150 mins) or an equivalent combination of both contributing to recommended levels as detailed in the Physical Activity Guidelines.

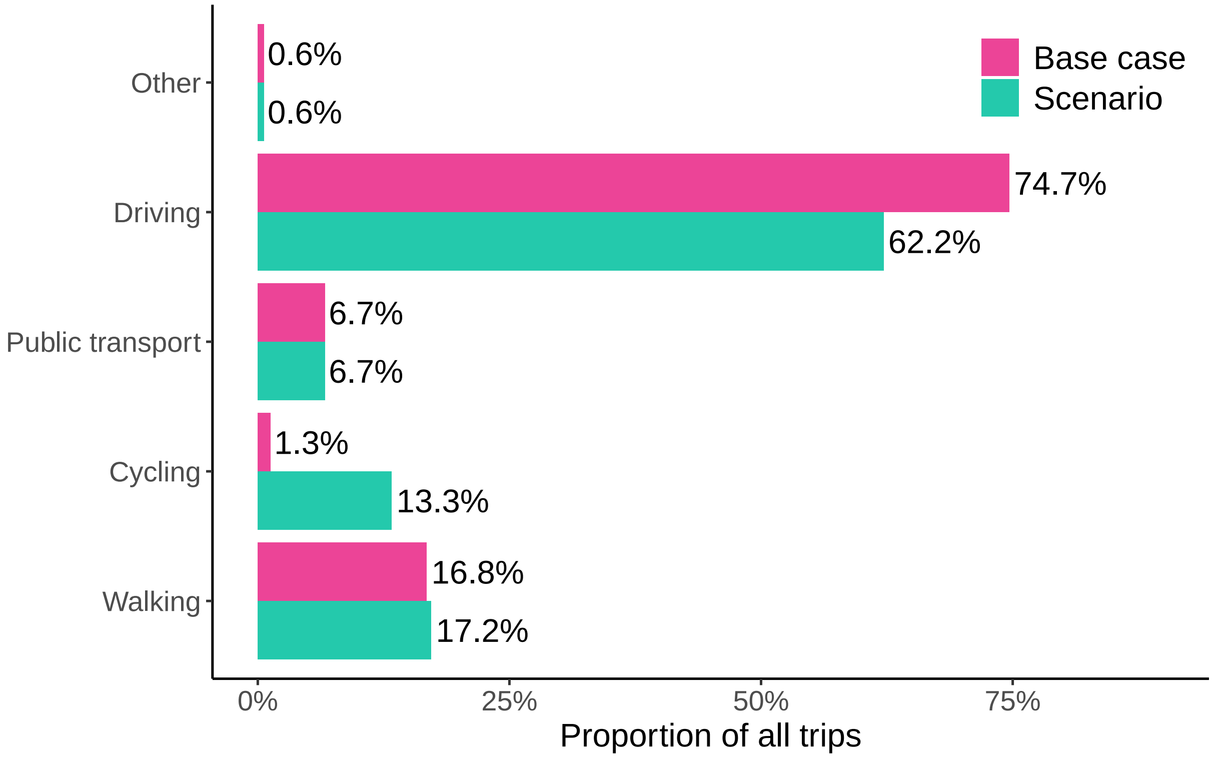

Figure 1: Distribution of base case and scenario trips.

Incidence

Incidence describes the rate of occurrence of new cases of a disease over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of disease prevented, due to increases in physical activity associated with the scenario. Figure 2 presents the change (%) in the disease incidence across the life course. Figure 3 presents how the difference in disease incidence changes over time, by year, using a snapshot of the population from 2019.

Table 1 shows how the scenario impacts the incidence of chronic diseases as both as a percentage and total number of prevented cases.

Table 1. Chronic disease incidence reduction and total number of prevented cases of disease measured across the years of the simulation

Disease*	Incidence of disease is reduced by	Total number of prevented cases of disease aggregated across the simulation
Alzheimer's disease and other dementias	-0.15%	-960
Breast cancer	0.39%	284
All cancers	0.24%	945
Colon cancer	0.03%	37
Chronic myeloid leukemia	0.15%	4
Diabetes type 2	2.06%	6,809
Depression	0.34%	5,477
Head and neck cancer	0.92%	40
Ischemic heart disease	0.53%	4,685
Liver cancer	0.56%	99
Multiple myeloma	0.38%	73
Stomach cancer	0.40%	95
Stroke	0.40%	1,042
Lung cancer	0.24%	271
Uterine cancer	0.50%	42

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

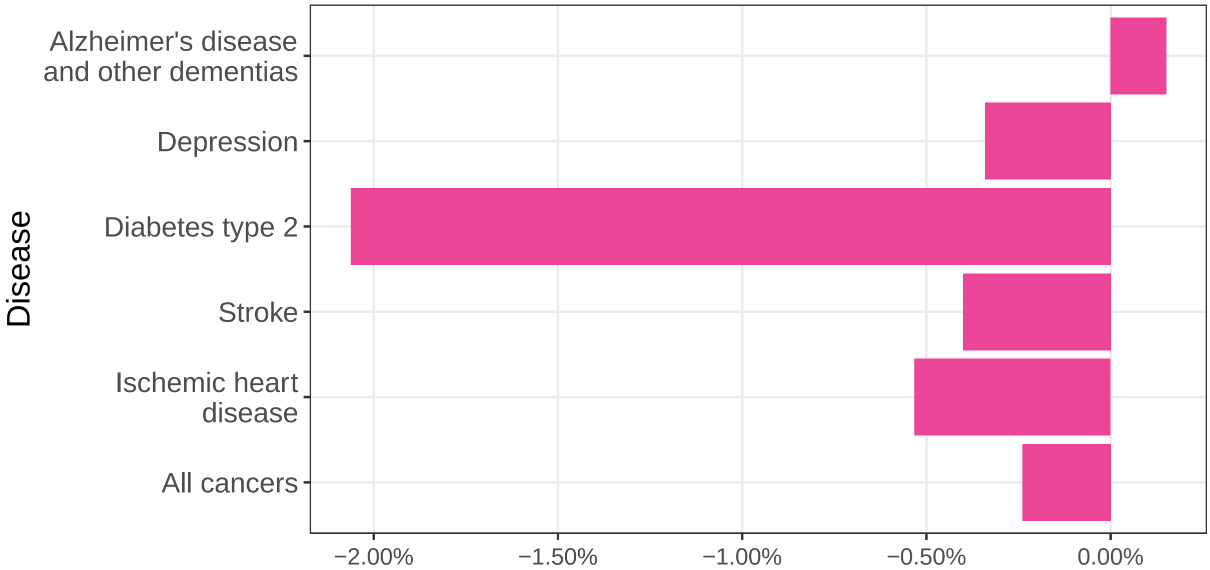

Figure 2.a: Percentage change in incidence by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

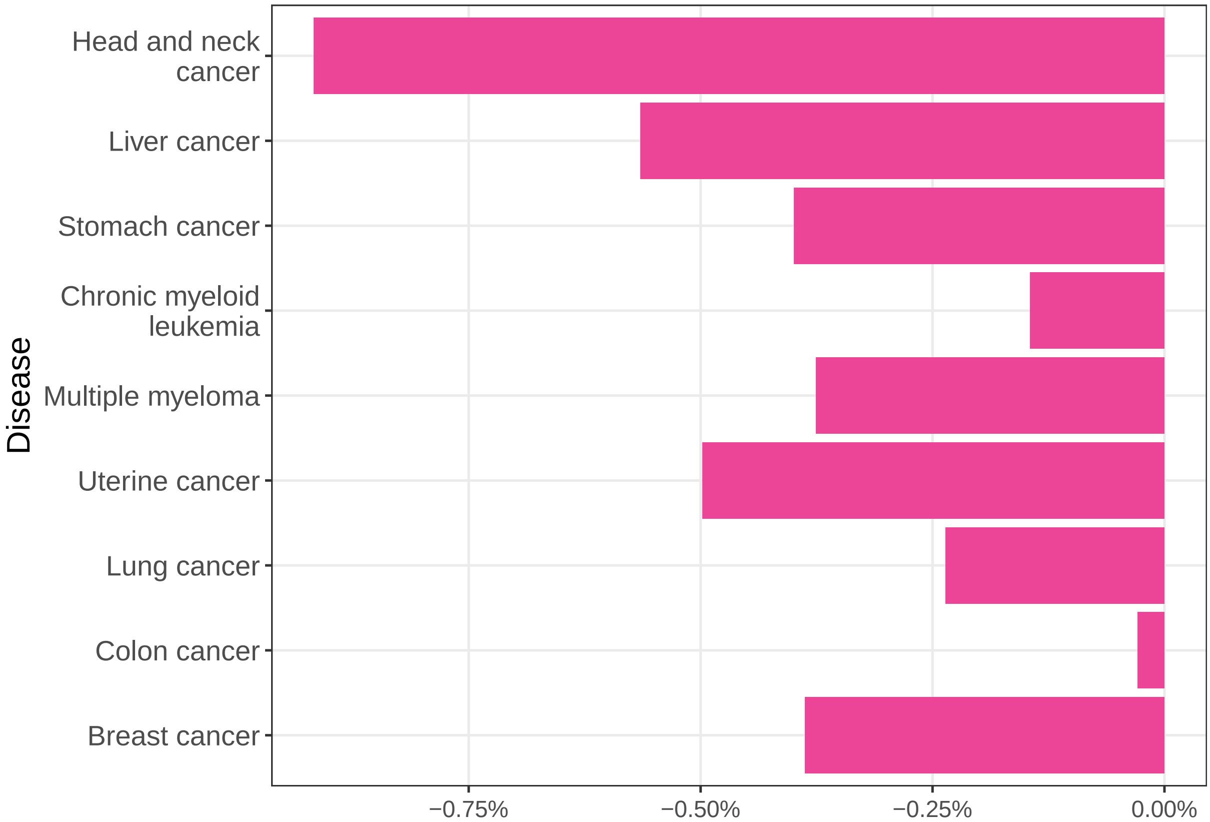

Figure 2.b: Percentage change in incidence for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

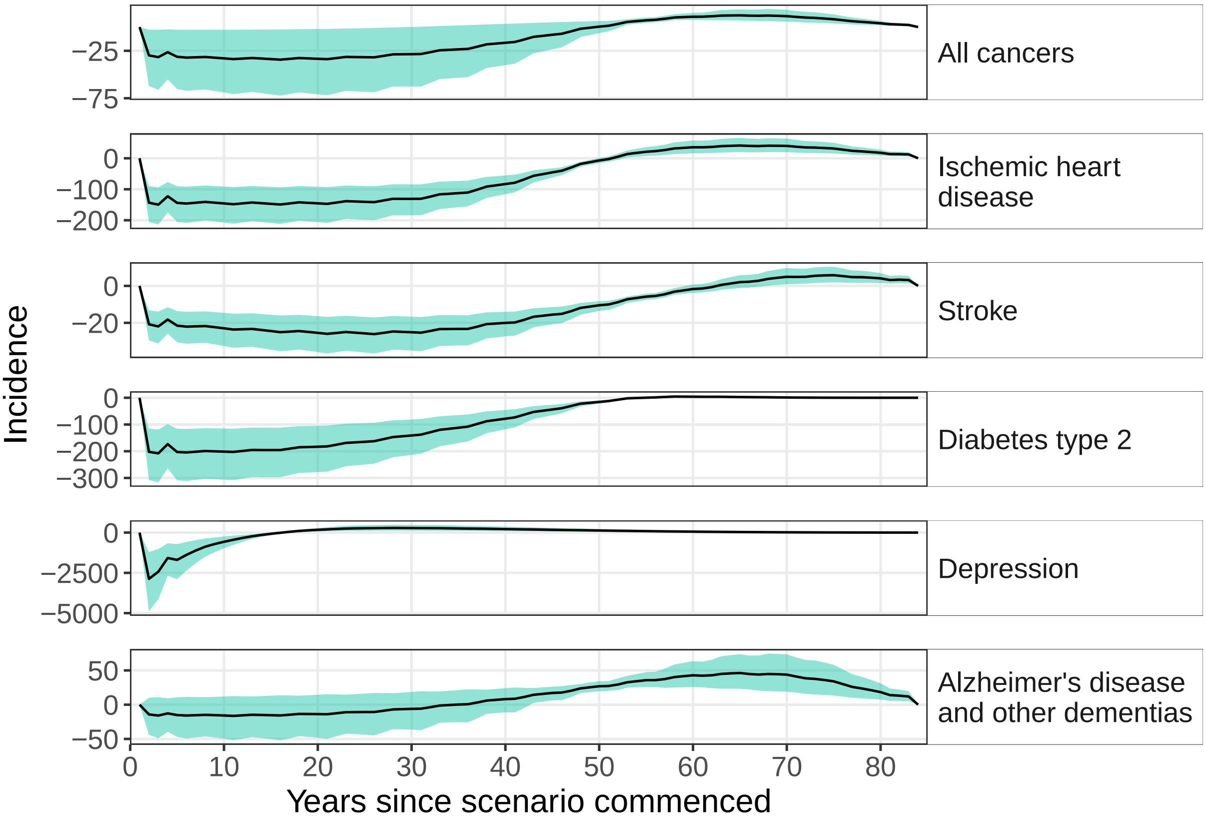

Figure 3.a: The change in incidence over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

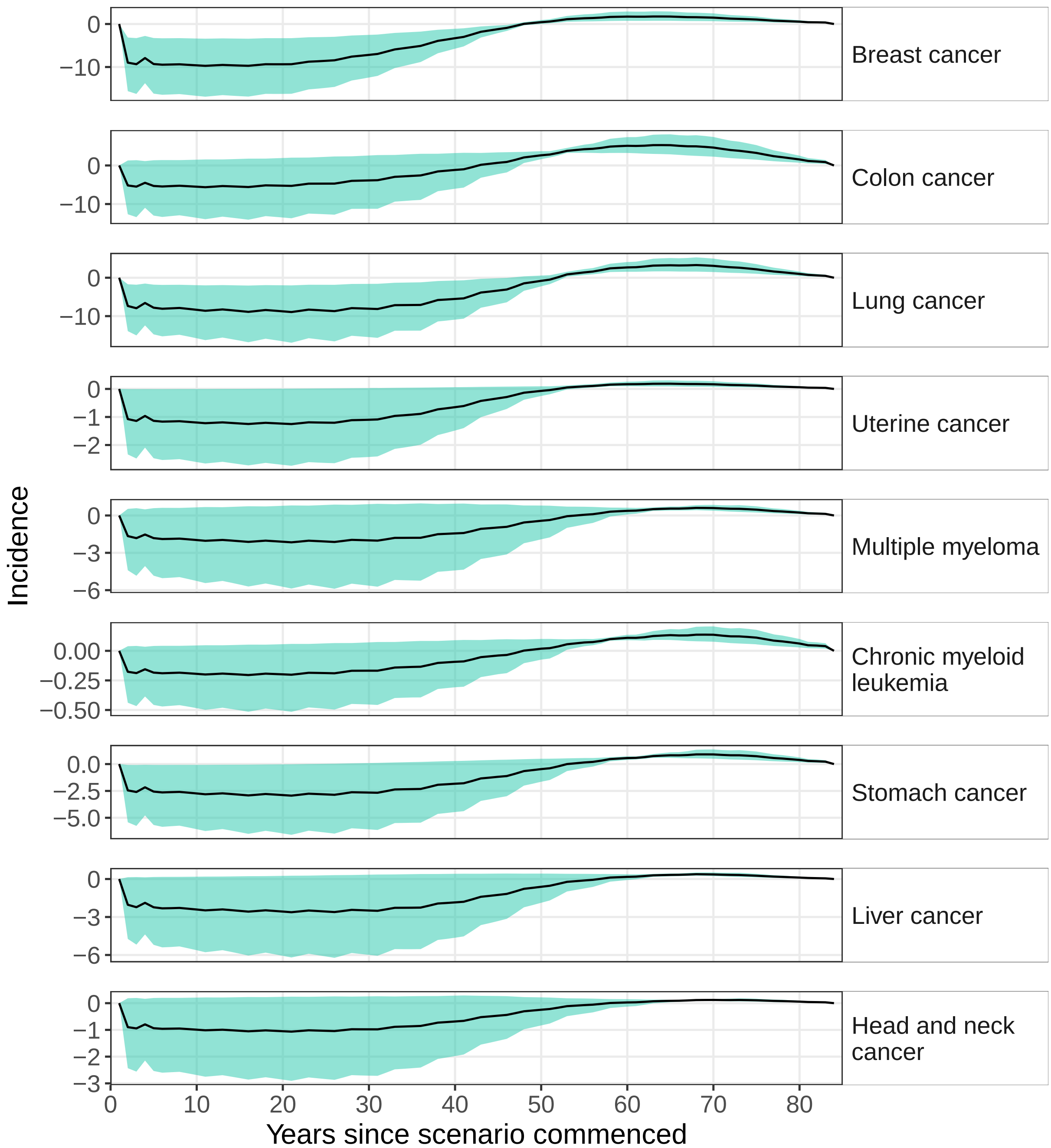

Figure 3.b: Percentage change in incidence for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Mortality

Mortality is the number of deaths due to a given disease over over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of prevented deaths due to increases in physical activity associated with the scenario. Figure 4 presents the total change in mortality over the life course. Figure 5 presents the difference in the number of deaths by year using a snapshot of the population from 2019.

Table 2 shows how the scenario impacts reductions in mortality presented as a percentage and total number of prevented deaths caused by chronic diseases.

Table 2. Percentage reduction in mortality and total number of prevented deaths by chronic disease measured across the years of the simulation.

Disease*	Mortality is reduced by	Total number of prevented deaths aggregated across the simulation
Alzheimer's disease and other dementias	-0.31%	-749
Breast cancer	0.42%	136
All cancers	0.29%	733
Colon cancer	0.06%	26
Chronic myeloid leukemia	0.09%	2
Diabetes type 2	1.89%	936
Depression	0.00%	0
Head and neck cancer	0.99%	39
Ischemic heart disease	0.54%	2,026
Liver cancer	0.57%	97
Multiple myeloma	0.37%	64
Stomach cancer	0.40%	84
Stroke	0.34%	600
Lung cancer	0.23%	254
Uterine cancer	0.44%	32

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

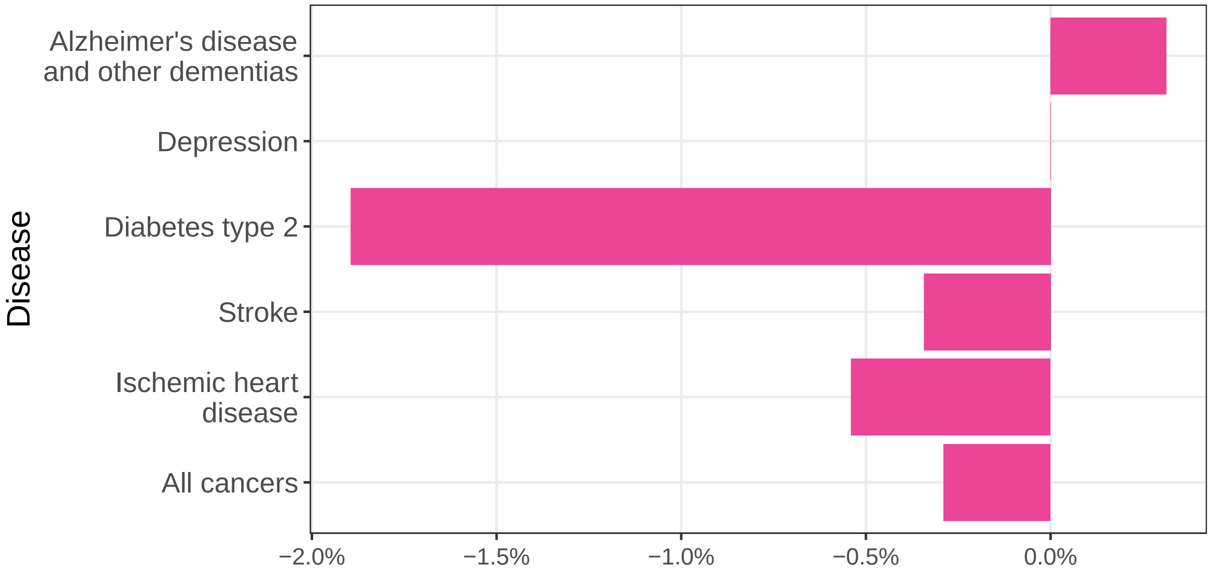

Figure 4.a: Percentage change in mortality by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

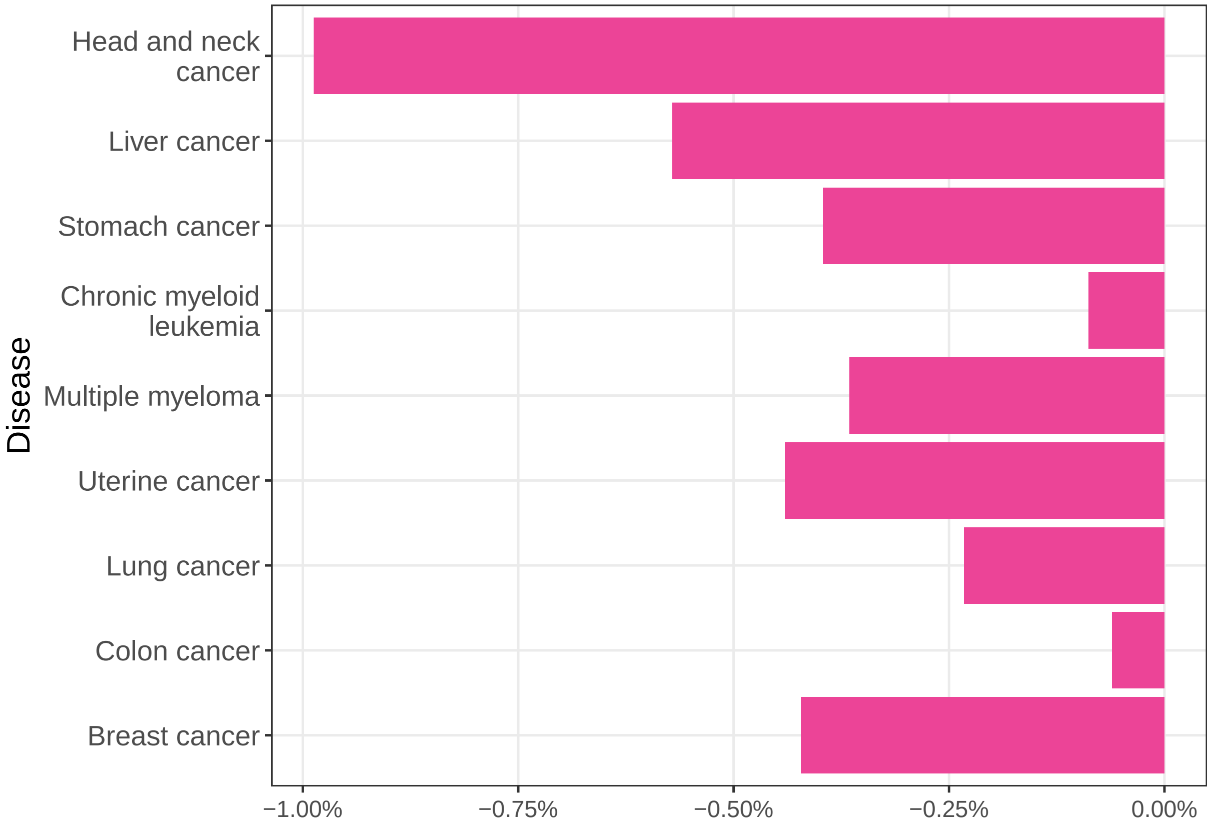

Figure 4.b: Percentage change in mortality for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

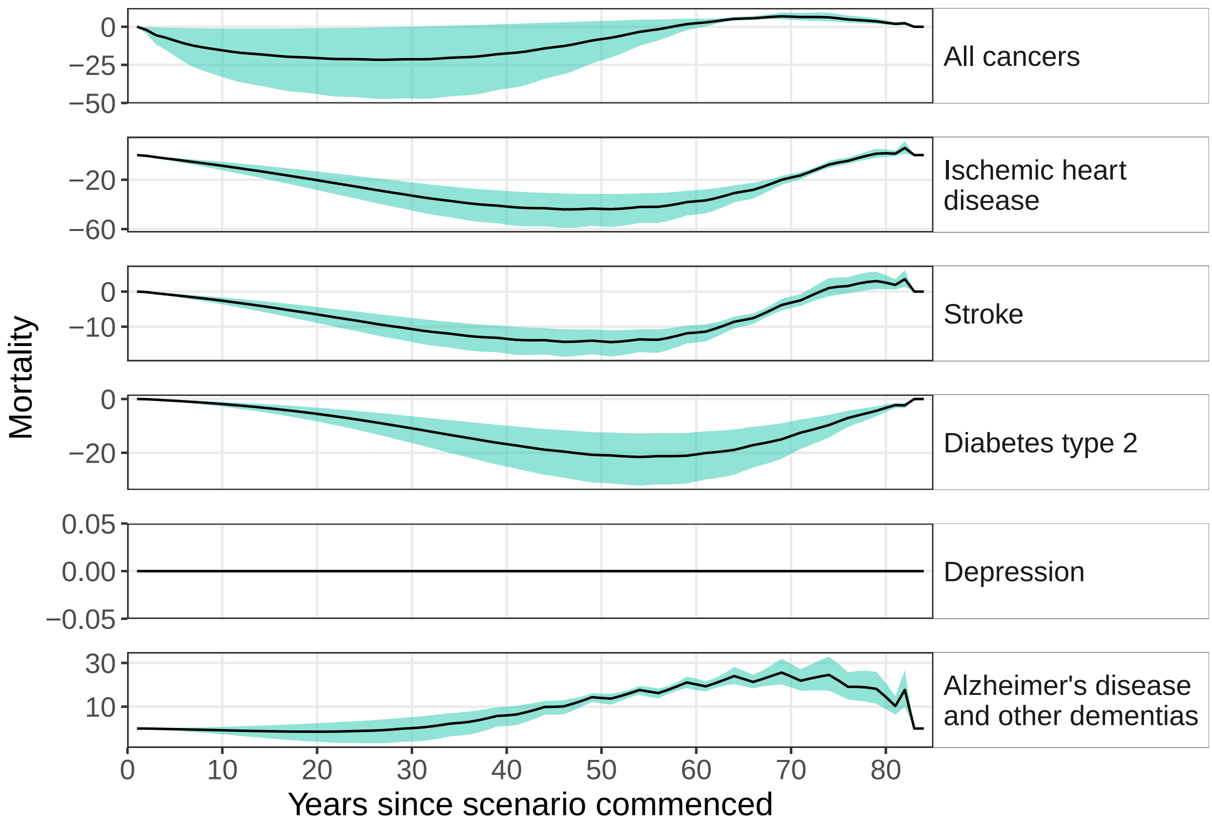

Figure 5.a: The change in mortality over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

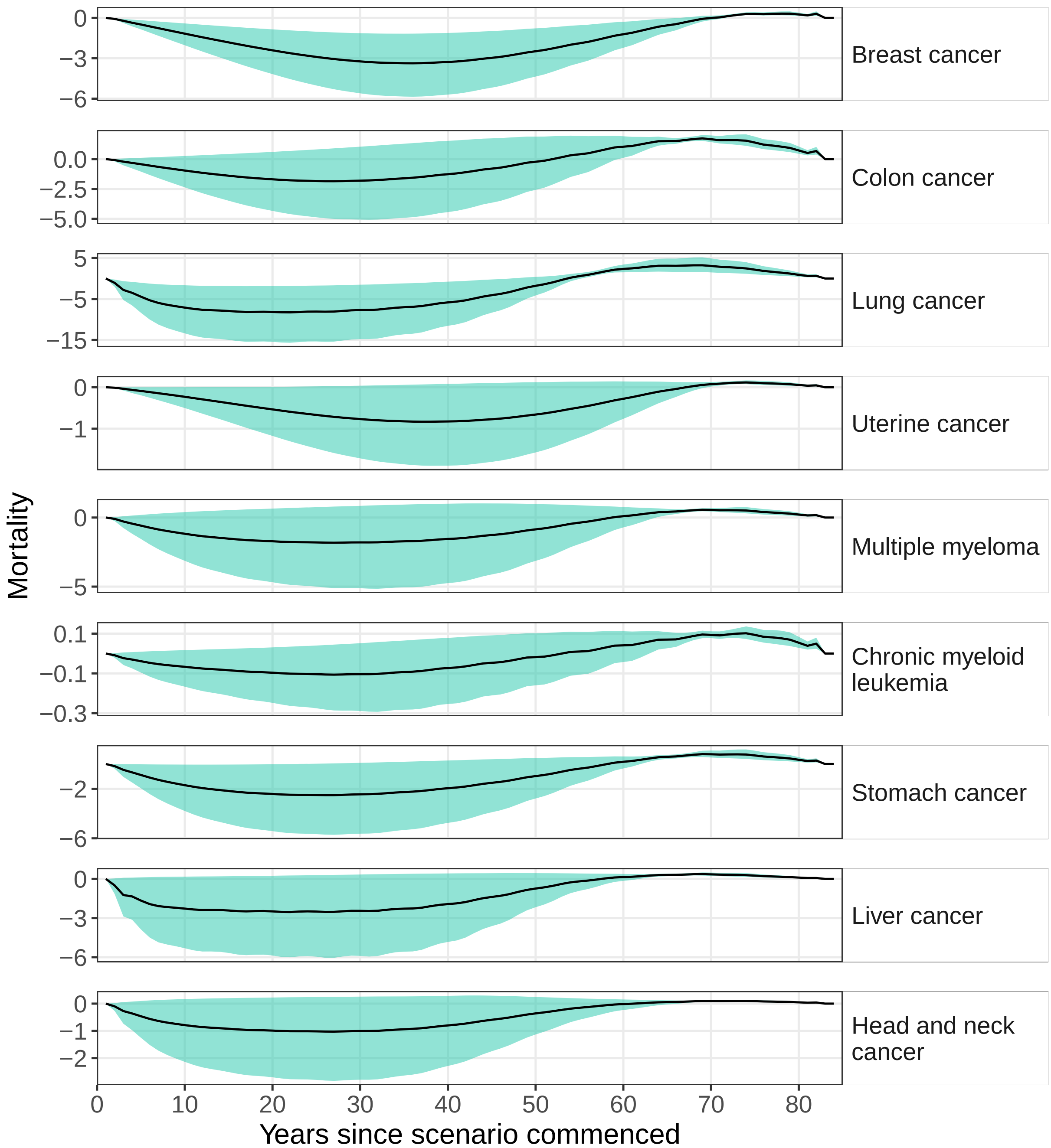

Figure 5.b: Percentage change in mortality for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Health

Figures 6 and 7 below show the change in Health Adjusted Life Years (HALYs)[1] and Life Years[2] for a snapshot of the population from 2019 for the scenario. Both figures show that the greatest gains from increasing physical activity occur midway through the life cycle with most of the gains occurring cumulatively in the long term. The decline from the mid-point onwards is due to individuals dying from natural causes within the model.

HALYS

The model estimates a total of **204,976** HALYs for the scenario population, which is **102** HALYs per 1,000 members of the population.

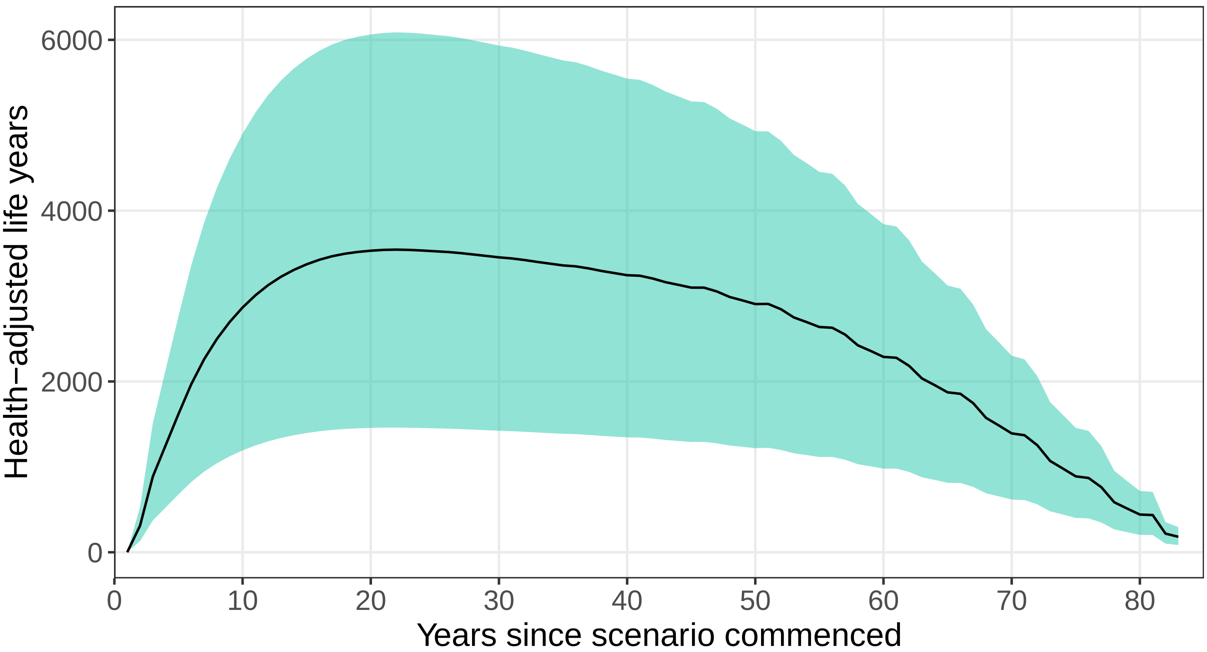

Figure 6. Total health-adjusted life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

[1] Health Adjusted Life Years are holistic measures of health that account for morbidity, mortality and quality of life.

[2] Life Years are similar to a HALYs however they exclude the quality of life component.

Life Years

The model estimates a total of **92,934** Life Years for the scenario population, which is **46** Life Years per 1,000 members of the population.

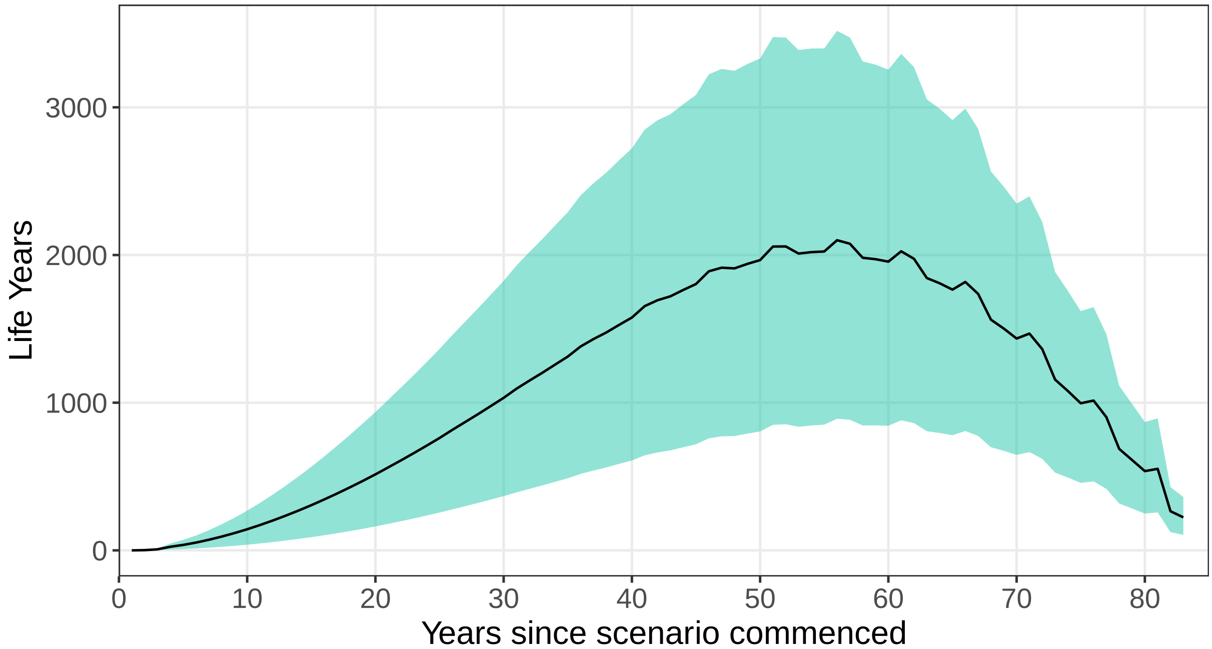

Figure 7. Total life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Value

The value of improvements to community health can be calculated**[a]** by translating the Health Adjusted Life Years (HALYs) from each scenario into dollar terms using the value of a statistical life year**[b]**. The value of a statistical life year is an estimate of the amount a society is willing to trade to reduce the risk of death for one year.

In the simulation model, HALYs are generated across time and are cumulative. Thus, to help us understand the value of HALYs across time in present day terms, it is necessary to use discounting**[c]** to reduce HALYs generated at the future point in time. Discounted HALYs from these future points can be added up to give the aggregate value of HALYs in today's terms as a measure of the value of improvements to community health arising from the chosen scenario.

The size of the discount rate can impact the aggregated value of HALYs and there is considerable debate on what discount rates should be used (with some arguing that health should not be discounted at all).[2] Hence, it is common to use a variety of discount rates to allow for differing risks, preferences and sensitivity when valuing health. The figures presented below were calculated using discount rates of 3%, 5% and 7% based on recent recommendations [3, 4] and represent the value of HALYs in present day terms resulting from an increase in physical activity from the chosen scenario.

The value of improvements to community health

The model estimates a total of **HALYs,** Health Adjusted Life Years (HALYs) gained for the scenario population, which is **102** HALYs per 1,000 members of the scenario population. The figures below represent the value of improvements to community health from the chosen scenario. These figures can be used in summary reports and for advocacy purposes**[d]**.

The HALYs gained in this scenario have a statistical value of:

- **8,565,317** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **5,363,149** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **3,662,033** per 1,000 members of the population, when calculated using a discount rate of 7%.

a. What is meant by value and how can it be measured?

Value is conceptual and measures a sense of worth or usefulness of something to individuals or to a society. Measuring the value of something, such as health, enables it to be included in assessments or analyses such as cost-benefit analyses to recognise its relative importance.

Value can be derived in many ways and a common approach is to use monetary terms, such as dollars. Valuing something using dollars is not the same as equating it with its price. Prices represent the amount at which something can be traded, prices therefore represent the amount of money for buying or selling something such as food, clothing or to pay bills. One way is to evaluate health in dollar terms is to use the Value of a Statistical Life and Value of a Statistical Life Year**[b]**.

b. What is the Value of a Statistical Life and Value of a Statistical Life Year?

The value of a **statistical life** is the estimated amount that a society is willing to trade to reduce the risk of death. The word 'Statistical' refers to the average value for life and therefore means the value of a statistical life doesn't relate to any specific individual. This value can change across risk factors and different societies who may value life differently. There are various ways of measuring the value of a statistical life with most approaches using revealed or stated preference approaches.[3] In Australia, the Office of Best Practice Regulation estimates a statistical life at $5.3M in 2022 dollar terms, and assumes that the life is of a young person with at least another 40 years to live.[5, 6]

Value of a Statistical Life Year

The value of a statistical life year is the estimated amount that a society is willing to trade to reduce the risk of death over **one year.** It can be derived from the value of a statistical life or measured directly using surveys or willingness to pay techniques.[5] The current value of a **statistical life year** is $227,000 in 2022 dollars based on current estimates from the Office of Best Practice Regulation.[6] The value of a statistical life year is useful for evaluating small increases in life years instead of evaluating full life expectancy. It is appropriate for valuing the Health Adjusted Life Years estimated from the scenarios and modelling presented in this tool. For the modelling and results presented here, the value of $227,000 was converted to 2019 dollars based on the Wage Price Index for Brisbane.

c. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

d. Application in advocacy and reporting

This section uses figures to show how the value of community health (estimated from HALYs and the value of statistical life year) can be used for reporting and advocacy purposes.

The simulation model uses **population-based estimates** for disease morbidity and mortality and is best applied to larger groups of people. It also assumes that the people of interest have similar characteristics and behaviours to the population data used in the simulation model and scenarios. The **example** below shows results from a scenario that replaces car trips with walking trips for distances of 0-2 km for All age groups.

Example:

The HALYs gained in this scenario have a statistical value of:

- **$10,859,605** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **$6,662,541** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **$4,533,392** per 1,000 members of the population, when calculated using a discount rate of 7%.

This **example** shows that the HALYs gained in this scenario have a statistical value of $10,859,605 per 1,000 members of the population using a discount of 3%.

This figure can be divided by 1,000 to give a per person figure. Once a per person figure is established, it can be multiplied by the number of people in any population size of interest for use in reports or as evidence to advocate for benefits associated with shifts to active transport modes.

$10,859,605 / 1,000 = $10,859.61 per person value

A good example of how this model can be applied links to previous research that investigated the impact of new more walkable development in Altona North on a population of 21,000 people [11]. If we assume that these people have similar characteristics to the underlying population based estimates and behaviours based on the travel survey data in the simulation model underlying this tool, then the value of community health according to the chosen scenario can be calculated as:

21,000 (people) x $10,859 (statistical value from HALYs gained) = $228 M.

Savings

An increase in physical activity due to the chosen scenario reduces chronic disease cases across a lifetime and reduces spending for each disease within the health care system resulting in overall health care cost savings**[a]**.

Table 3 provides estimated health care cost savings associated with the prevented cases of chronic diseases per 1,000 members of the population according to the selected scenario. These figures are based on applying average health care system costs per prevalent case of disease and using three alternative discount rates**[b]**:

Table 3. Total health care cost savings by disease per 1,000 members of the population.

Disease	3% discount rate	5% discount rate	7% discount rate
Alzheimer's disease and other dementias	$1,918	$1,416	$1,018
Breast cancer	$88,970	$53,868	$34,891
All cancers	$151,599	$95,525	$63,794
Colon cancer	$24,133	$16,618	$11,617
Chronic myeloid leukemia	$5,018	$3,073	$2,013
Diabetes type 2	$57,194	$33,194	$20,895
Depression	$271,655	$196,606	$147,485
Head and neck cancer	$1,101	$756	$544
Ischemic heart disease	$92,173	$53,847	$34,034
Liver cancer	$1,147	$798	$583
Multiple myeloma	$13,598	$8,833	$6,083
Stomach cancer	$5,861	$3,829	$2,652
Stroke	$11,067	$6,471	$4,085
Lung cancer	$7,805	$5,330	$3,828
Uterine cancer	$3,940	$2,425	$1,591

a. What do we mean by health care cost savings?

To calculate health care cost savings for each disease, the annual costs for each disease in each year is multiplied by the number of prevented cases of each disease for each scenario. This results in a total saving in spending for each disease by year. The savings in spending for future years are discounted**[b]** with annual savings aggregated to give a total amount saved for each disease. Total savings are presented as the amount saved per 1,000 members of the population to enable comparisons against populations of different sizes.

We use the term **health care cost saving** because it represents a reduction in health spending. However, the Australian Institute of Health and Welfare (AIHW) stress that the term cost is broad and not representative of the full cost experienced by individuals, families, or the health system, consequently AIHW use the term spending.[8]

These figures use AIHW estimates of the amounts spent through the health system in 2018-19 for each case of disease. This is extracted from Health system spending per case of disease and for certain risk factors, Table 1 – Estimates of health system spending per case, by burden of disease group, condition and sex, Australia 2018-2019.[9]. For head and neck cancers, supplementary figures were obtained from the Global Burden of Disease incidence data.[10]

b. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

References

1. Gold, M. R., Stevenson, D., & Fryback, D. G. (2002). *HALYS and QALYS and DALYS, Oh My: similarities and differences in summary measures of population Health.* Annual review of public health, 23(1), 115-134.
2. Attema, A.E., Brouwer, W.B. & Claxton, K. (2018). *Discounting in economic evaluations.* Pharmacoeconomics. 36: p. 745-758.
3. Ananthapavan, J., Moodie, M., Milat, A.J., & Carter, R. (2021). *Systematic review to update 'value of a statistical life' estimates for Australia.* International journal of environmental research and public health, 2021. 18(11): p. 6168.
4. Terrill, M. & Batrouney, H. (2018). *Unfreezing discount rates: Transport infrastructure for tomorrow.* Grattan Institute.
5. Abelson, P. (2008). *Establishing a monetary value for lives saved: issues and controversies.* Canberra: Office of Best Practice Regulation, Department of Finance and Deregulation.
6. Department of the Prime Minister and Cabinet. (2022). *Best practice regulation guidance note: Value of statistical life.* Australian Government.
7. Haacker, M., Hallett, T.B. & Atun, R. (2020). *On discount rates for economic evaluations in global health.* Health Policy and Planning, 2020. 35(1): p. 107-114.
8. Australian Institute of Health and Welfare (2023). Technical Notes: Estimating Spending per prevalent case of disease. Health system spending per case of disease and for certain risk factors, Estimating the spending per prevalent case of disease - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
9. Australian Institute of Health and Welfare (2023). Health system spending per case of disease and for certain risk factors. Health system spending per case of disease and for certain risk factors, Data - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
10. Global Burden of Disease (2019). Global Health Data Exchange. https://vizhub.healthdata.org/gbd-results. Accessed September 20, 2023.
11. Zapata-Diomedi, B., Boulangé, C., Giles-Corti, B., Phelan, K., Washington, S., Veerman, L.J., & Gunn, L. (2019). Physical activity-related health and economic benefits of building walkable neighbourhoods: A modelled comparison between brownfield and greenfield developments. International Journal of Behavioural Nutrition and Physical Activity.
12. Khorasani, E., Davari, M., Kebriaeezadeh, A., Fatemi, F., Akbari Sari, A., & Varahrami, V. (2022). A comprehensive review of official discount rates in guidelines of health economic evaluations over time: the trends and roots. The European Journal of Health Economics, 23(9), 1577-1590.

Scenario: replacing car trips under 2km with walking, and car trips between 2 and 5km with cycling for commuting trip purposes

This scenario shows the results of replacing car trips under 2km with walking and replacing car trips between 2km and 5km with cycling for work related or education purposes for all adults of all ages.

This implies that the selected scenario results in a mode shift in walking from 16.8% to 18.6%; cycling from 1.3% to 5.9%; and, from 74.7% to 68.2% for car trips taken as either a driver or passenger.

Increases in walking and cycling translate into a shift from 47.9% to 53.4% of the population accumulating the required minutes spent being moderately (150 – 300 mins) or vigorously physically active (75 – 150 mins) or an equivalent combination of both contributing to recommended levels as detailed in the Physical Activity Guidelines.

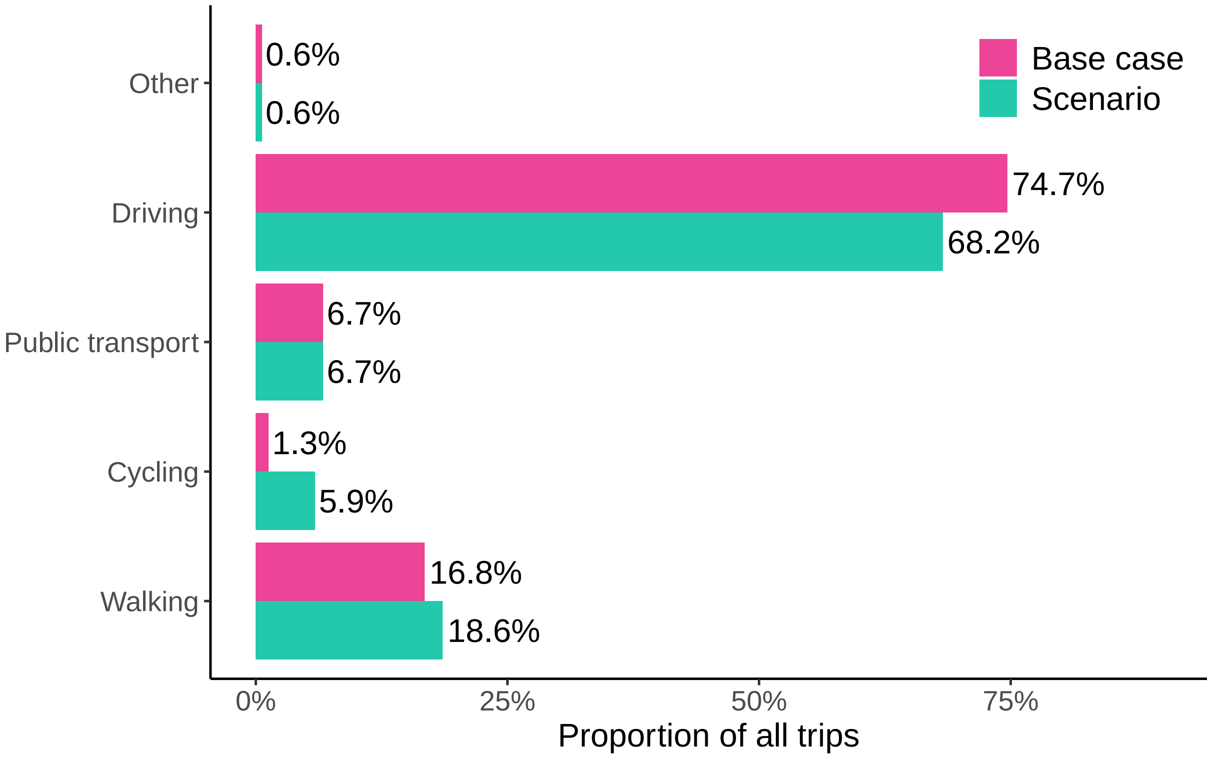

Figure 1: Distribution of base case and scenario trips.

Incidence

Incidence describes the rate of occurrence of new cases of a disease over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of disease prevented, due to increases in physical activity associated with the scenario. Figure 2 presents the change (%) in the disease incidence across the life course. Figure 3 presents how the difference in disease incidence changes over time, by year, using a snapshot of the population from 2019.

Table 1 shows how the scenario impacts the incidence of chronic diseases as both as a percentage and total number of prevented cases.

Table 1. Chronic disease incidence reduction and total number of prevented cases of disease measured across the years of the simulation

Disease*	Incidence of disease is reduced by	Total number of prevented cases of disease aggregated across the simulation
Alzheimer's disease and other dementias	-0.07%	-439
Breast cancer	0.18%	133
All cancers	0.12%	491
Colon cancer	0.02%	22
Chronic myeloid leukemia	0.09%	3
Diabetes type 2	1.02%	3,378
Depression	0.17%	2,762
Head and neck cancer	0.47%	21
Ischemic heart disease	0.27%	2,370
Liver cancer	0.28%	49
Multiple myeloma	0.21%	42
Stomach cancer	0.21%	50
Stroke	0.21%	553
Lung cancer	0.13%	150
Uterine cancer	0.26%	22

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

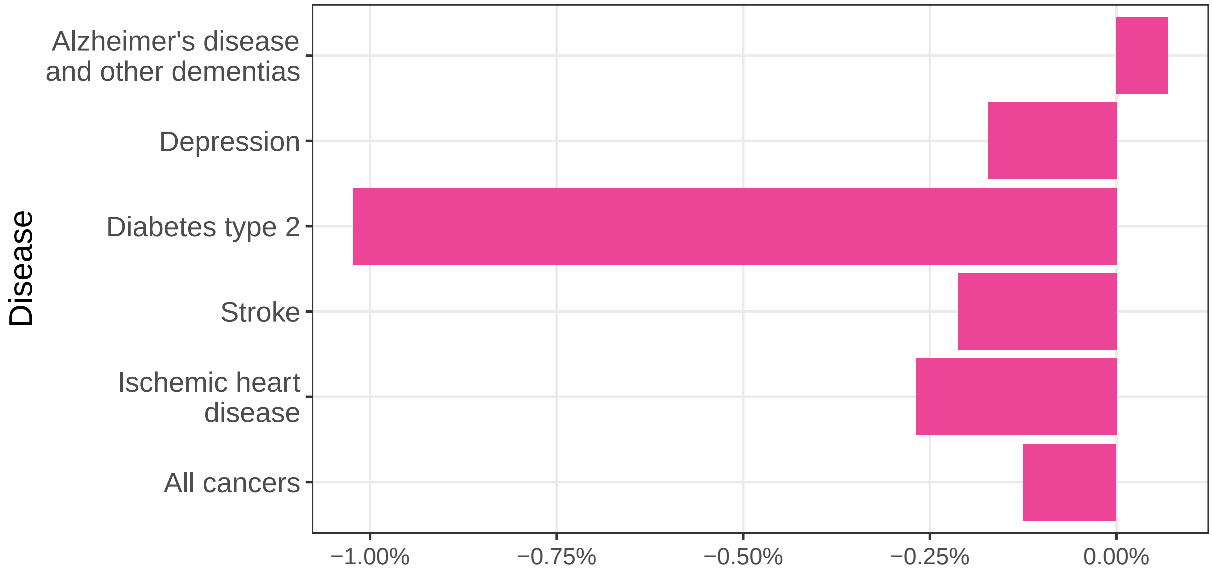

Figure 2.a: Percentage change in incidence by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

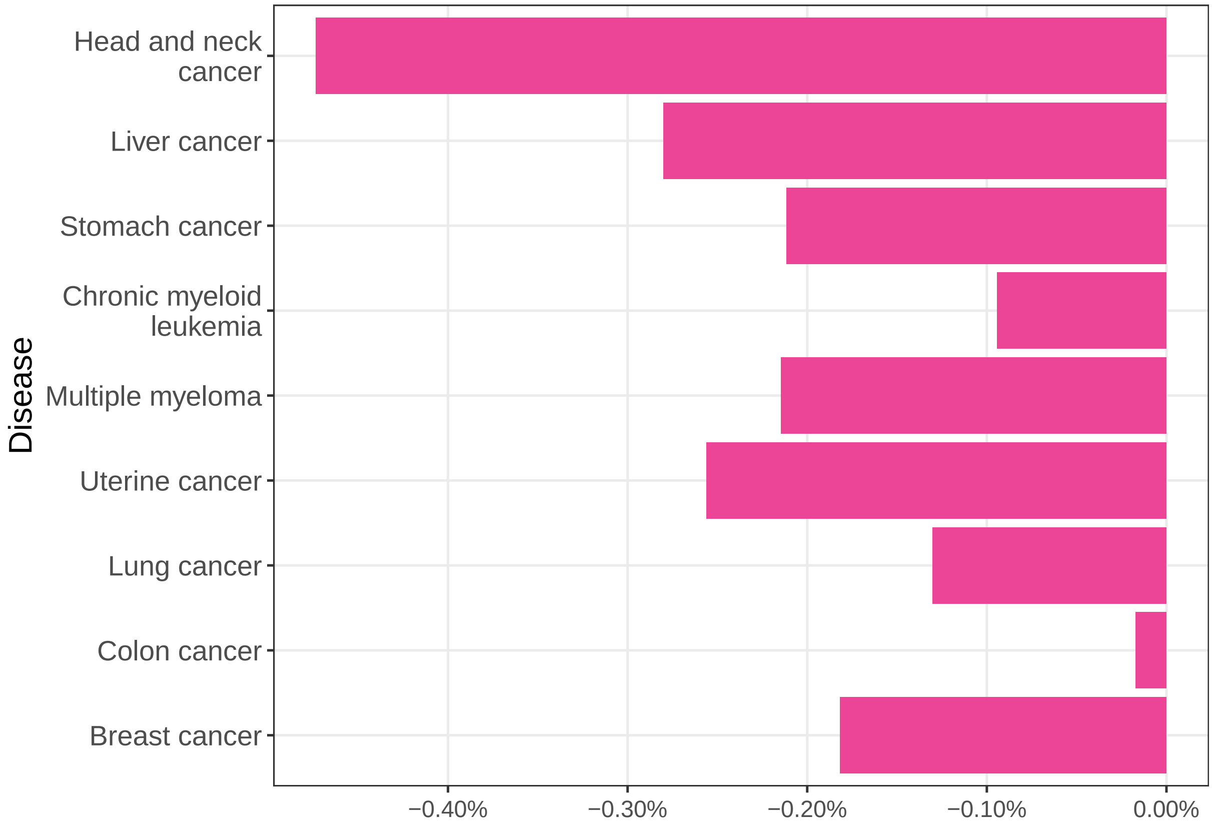

Figure 2.b: Percentage change in incidence for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

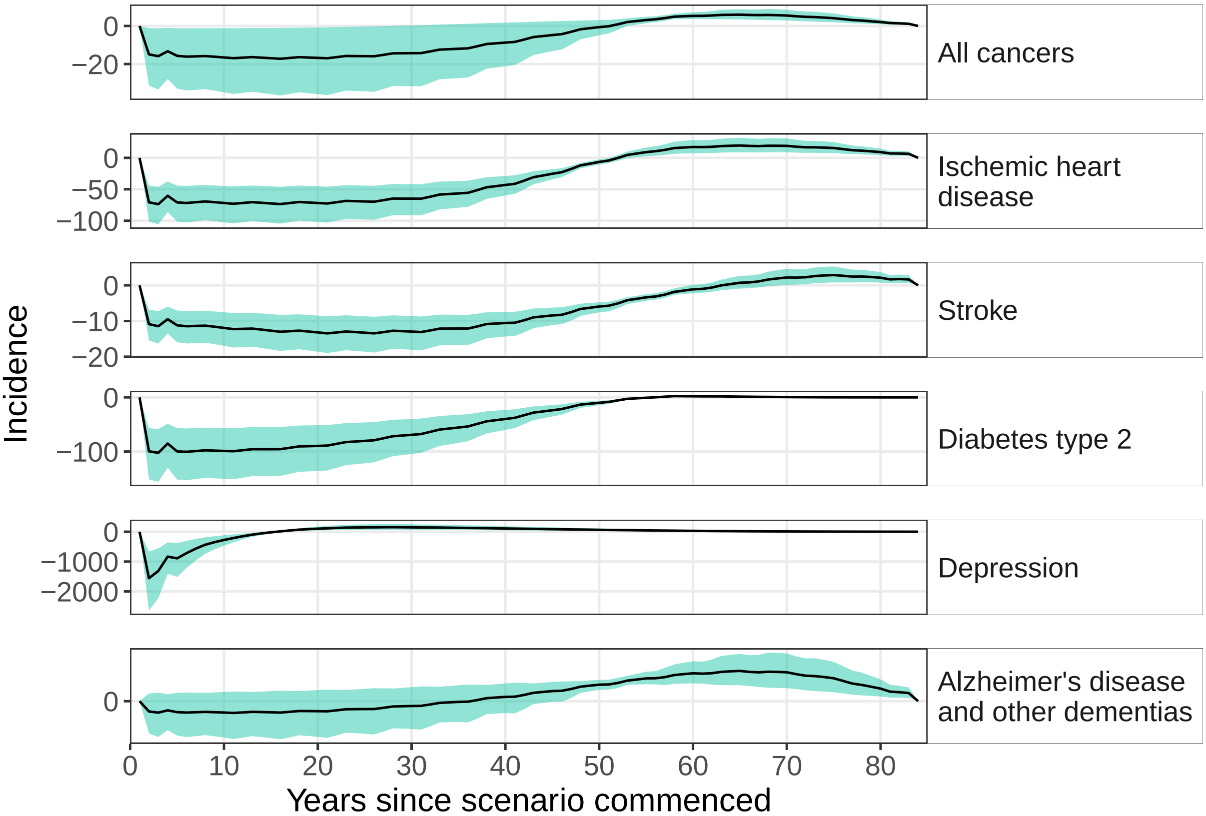

Figure 3.a: The change in incidence over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

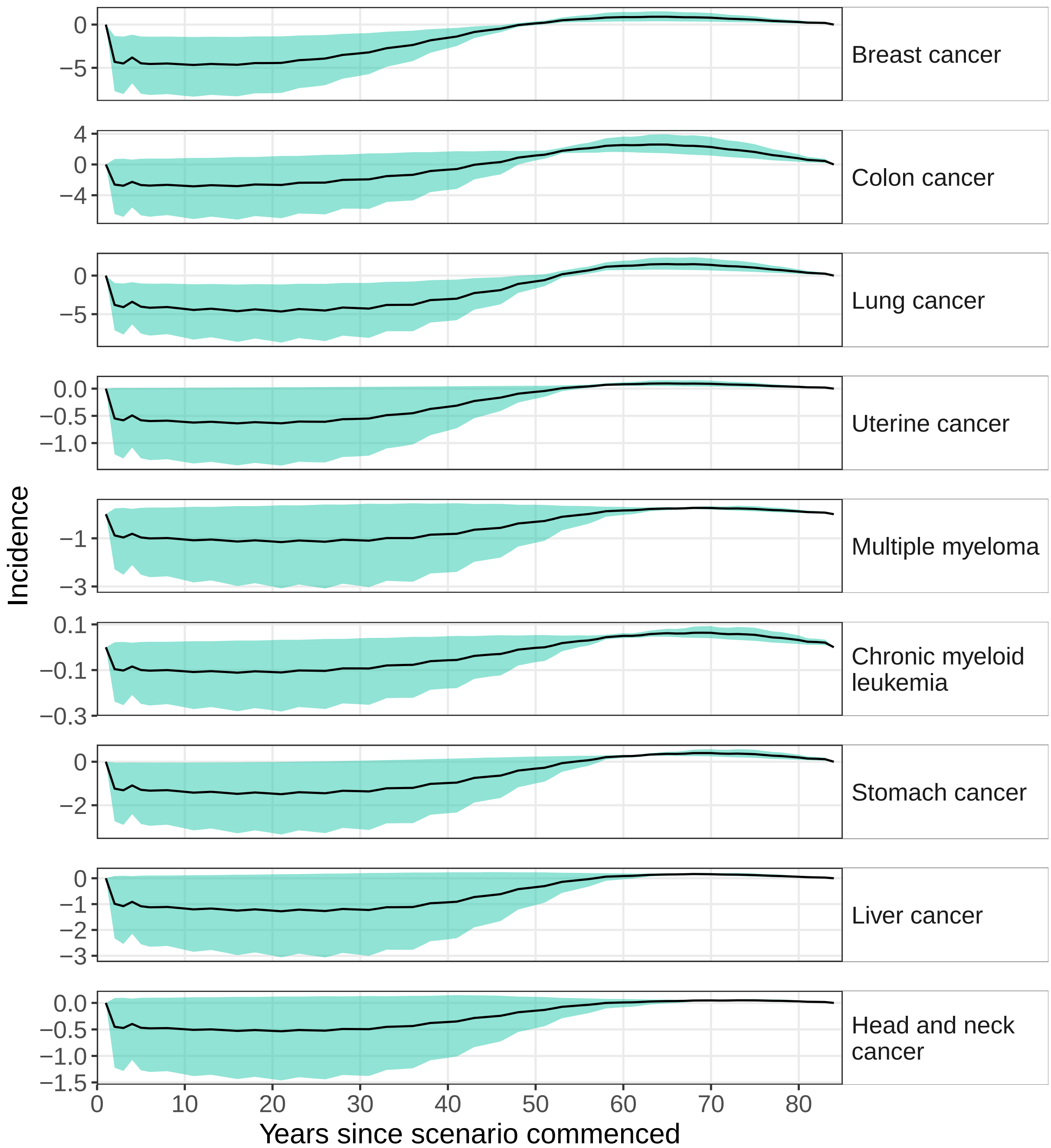

Figure 3.b: Percentage change in incidence for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Mortality

Mortality is the number of deaths due to a given disease over over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of prevented deaths due to increases in physical activity associated with the scenario. Figure 4 presents the total change in mortality over the life course. Figure 5 presents the difference in the number of deaths by year using a snapshot of the population from 2019.

Table 2 shows how the scenario impacts reductions in mortality presented as a percentage and total number of prevented deaths caused by chronic diseases.

Table 2. Percentage reduction in mortality and total number of prevented deaths by chronic disease measured across the years of the simulation.

Disease*	Mortality is reduced by	Total number of prevented deaths aggregated across the simulation
Alzheimer's disease and other dementias	-0.15%	-361
Breast cancer	0.19%	61
All cancers	0.15%	382
Colon cancer	0.03%	13
Chronic myeloid leukemia	0.06%	1
Diabetes type 2	0.93%	460
Depression	0.00%	0
Head and neck cancer	0.51%	20
Ischemic heart disease	0.27%	1,026
Liver cancer	0.28%	48
Multiple myeloma	0.21%	37
Stomach cancer	0.21%	44
Stroke	0.18%	319
Lung cancer	0.13%	141
Uterine cancer	0.22%	16

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

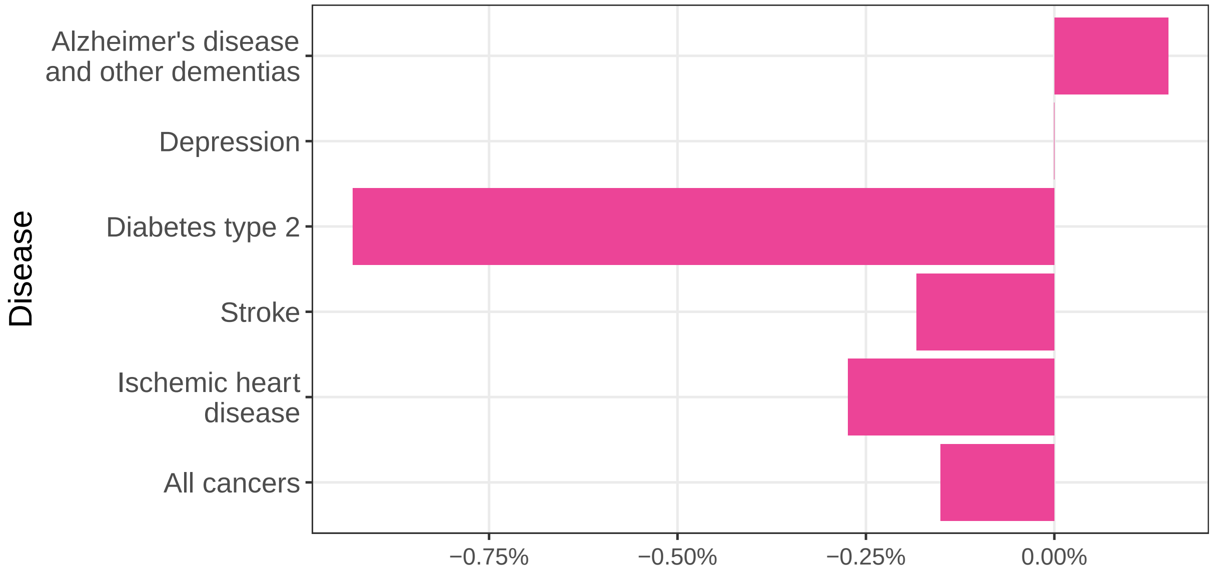

Figure 4.a: Percentage change in mortality by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

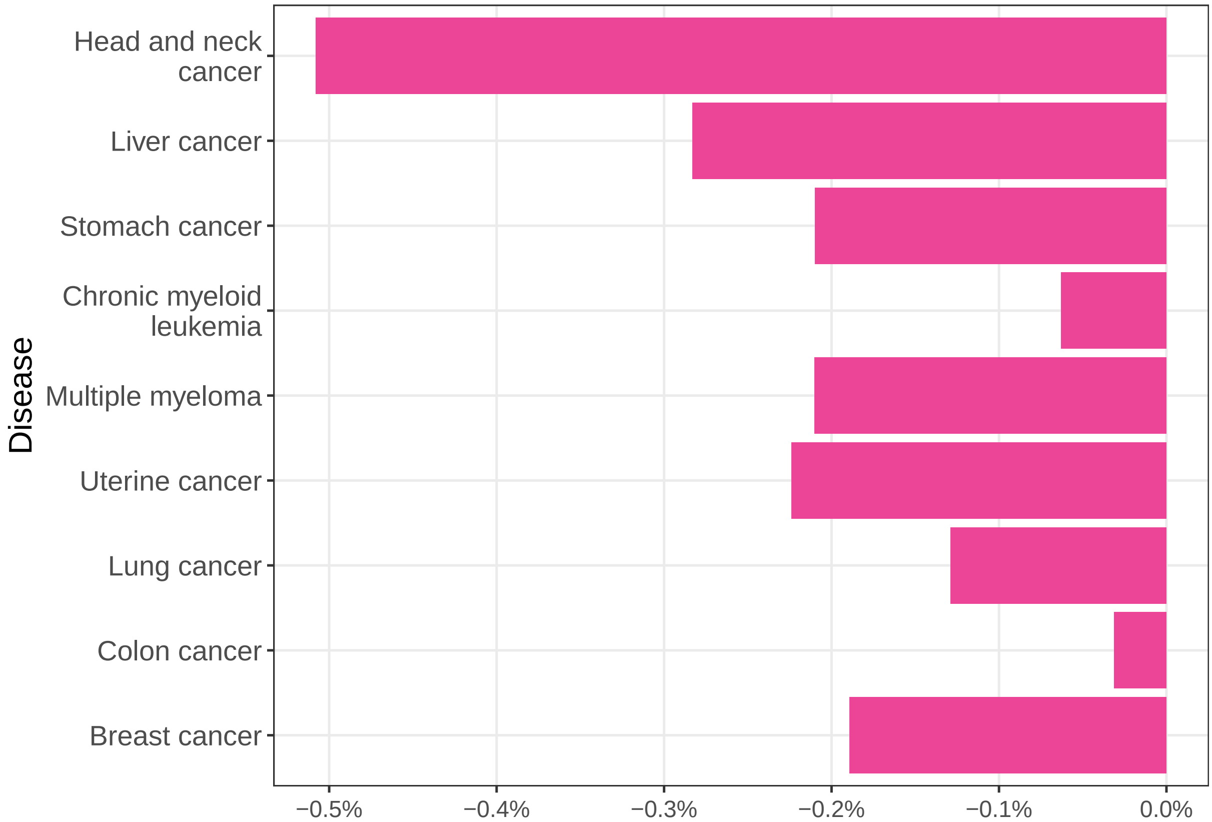

Figure 4.b: Percentage change in mortality for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

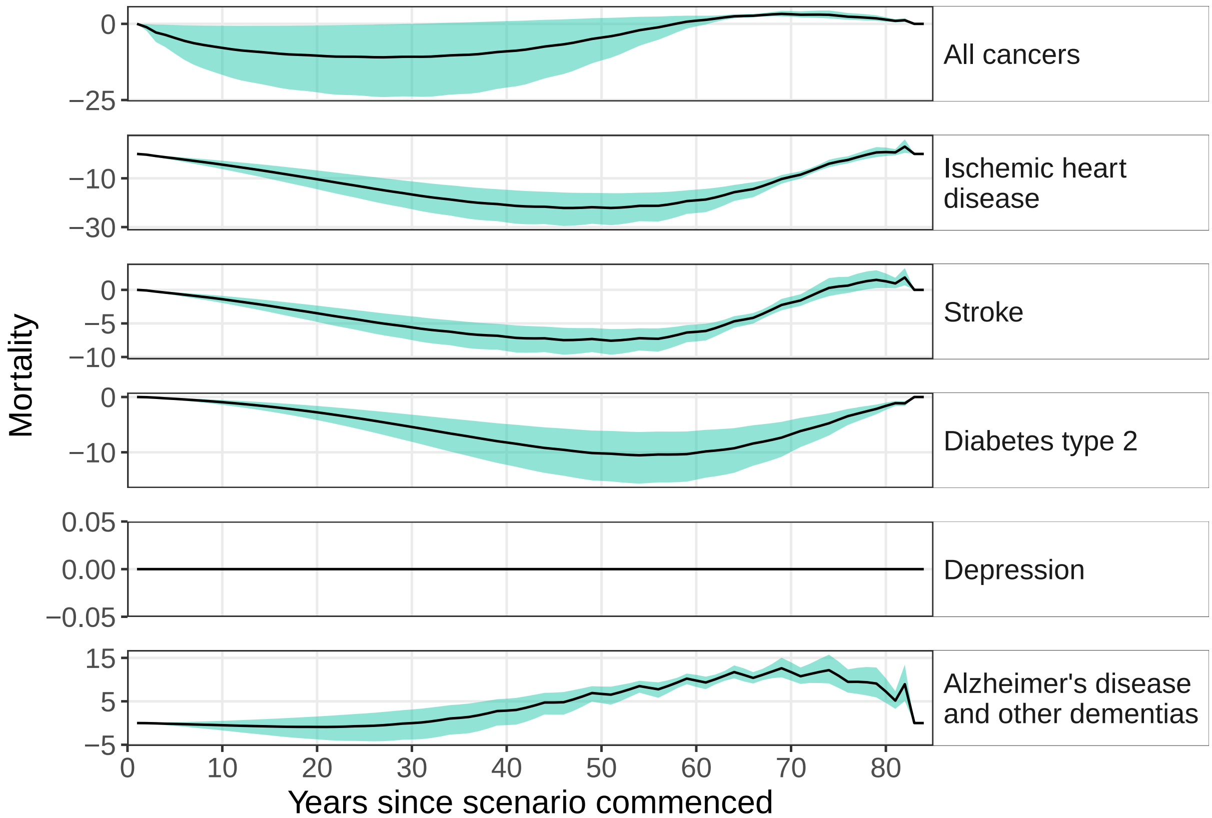

Figure 5.a: The change in mortality over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

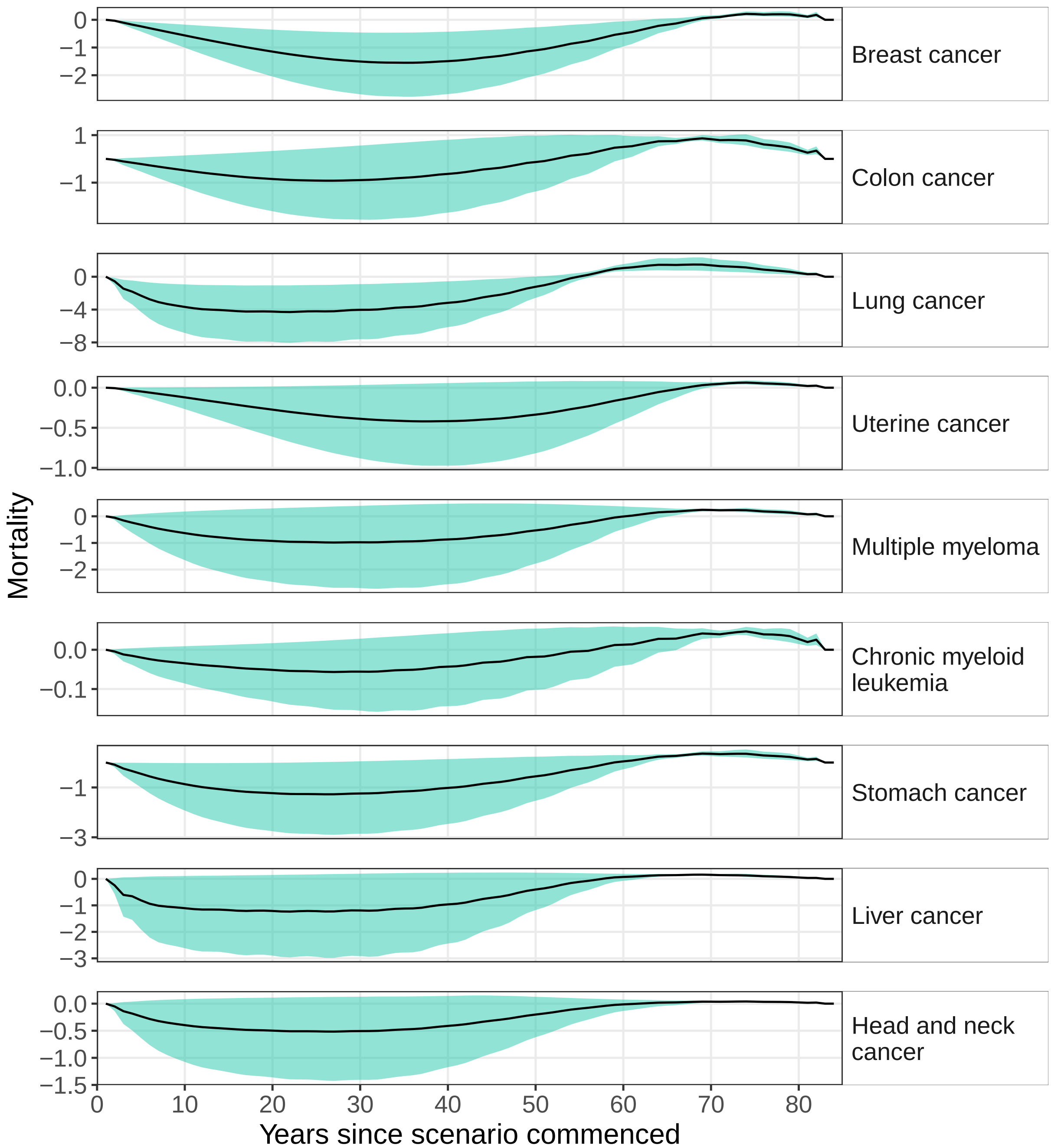

Figure 5.b: Percentage change in mortality for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Health

Figures 6 and 7 below show the change in Health Adjusted Life Years (HALYs)[1] and Life Years[2] for a snapshot of the population from 2019 for the scenario. Both figures show that the greatest gains from increasing physical activity occur midway through the life cycle with most of the gains occurring cumulatively in the long term. The decline from the mid-point onwards is due to individuals dying from natural causes within the model.

HALYS

The model estimates a total of **103,790** HALYs for the scenario population, which is **52** HALYs per 1,000 members of the population.

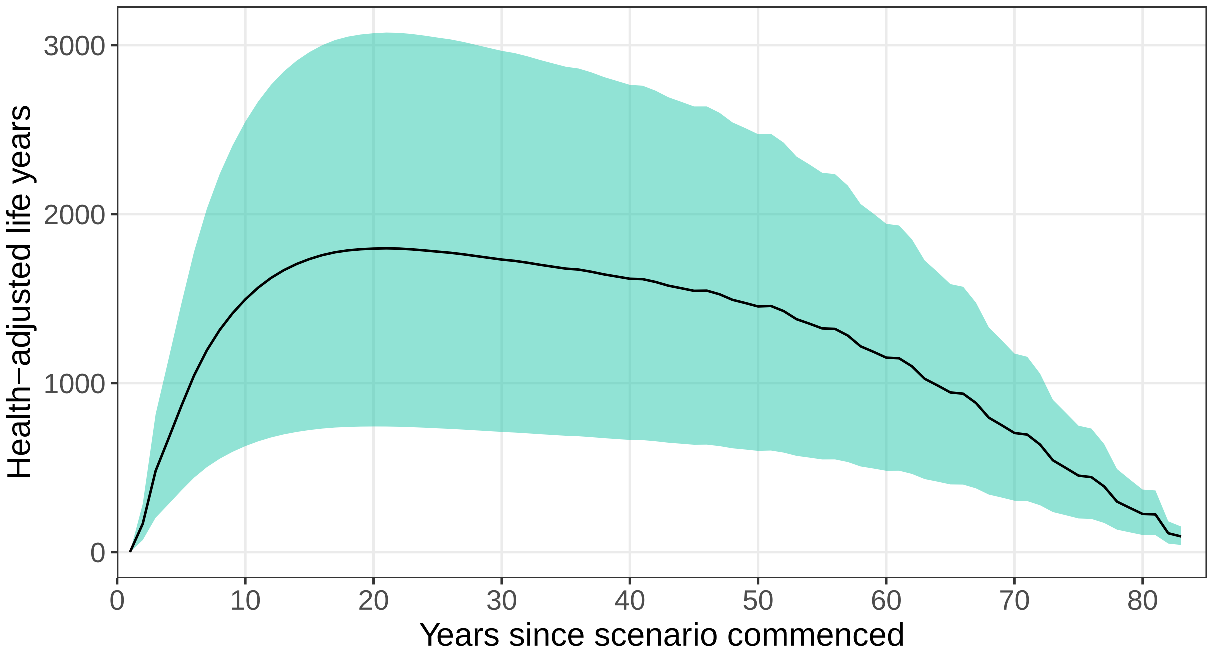

Figure 6. Total health-adjusted life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

[1]Health Adjusted Life Years are holistic measures of health that account for morbidity, mortality and quality of life.

[2]Life Years are similar to a HALYs however they exclude the quality of life component.

Life Years

The model estimates a total of **46,971** Life Years for the scenario population, which is **23** Life Years per 1,000 members of the population.

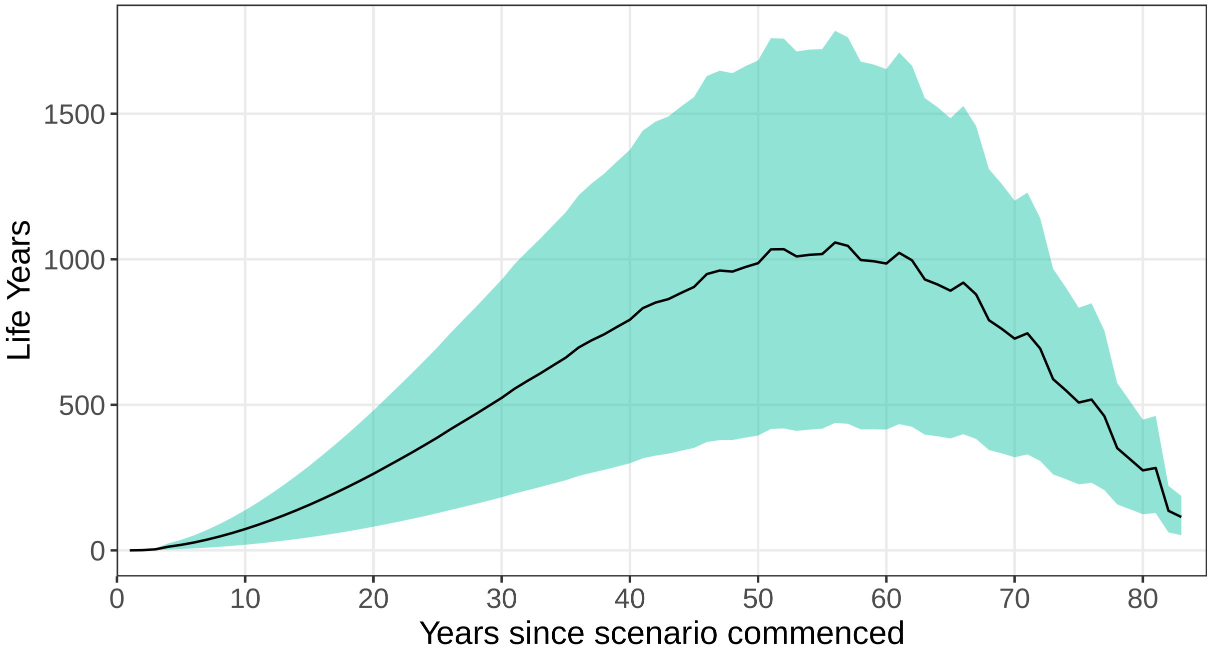

Figure 7. Total life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Value

The value of improvements to community health can be calculated**[a]** by translating the Health Adjusted Life Years (HALYs) from each scenario into dollar terms using the value of a statistical life year**[b]**. The value of a statistical life year is an estimate of the amount a society is willing to trade to reduce the risk of death for one year.

In the simulation model, HALYs are generated across time and are cumulative. Thus, to help us understand the value of HALYs across time in present day terms, it is necessary to use discounting**[c]** to reduce HALYs generated at the future point in time. Discounted HALYs from these future points can be added up to give the aggregate value of HALYs in today's terms as a measure of the value of improvements to community health arising from the chosen scenario.

The size of the discount rate can impact the aggregated value of HALYs and there is considerable debate on what discount rates should be used (with some arguing that health should not be discounted at all).[2] Hence, it is common to use a variety of discount rates to allow for differing risks, preferences and sensitivity when valuing health. The figures presented below were calculated using discount rates of 3%, 5% and 7% based on recent recommendations [3, 4] and represent the value of HALYs in present day terms resulting from an increase in physical activity from the chosen scenario.

The value of improvements to community health

The model estimates a total of **HALYs,** Health Adjusted Life Years (HALYs) gained for the scenario population, which is **52** HALYs per 1,000 members of the scenario population. The figures below represent the value of improvements to community health from the chosen scenario. These figures can be used in summary reports and for advocacy purposes**[d]**.

The HALYs gained in this scenario have a statistical value of:

- **4,367,947** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **2,749,415** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **1,886,696** per 1,000 members of the population, when calculated using a discount rate of 7%.

a. What is meant by value and how can it be measured?

Value is conceptual and measures a sense of worth or usefulness of something to individuals or to a society. Measuring the value of something, such as health, enables it to be included in assessments or analyses such as cost-benefit analyses to recognise its relative importance.

Value can be derived in many ways and a common approach is to use monetary terms, such as dollars. Valuing something using dollars is not the same as equating it with its price. Prices represent the amount at which something can be traded, prices therefore represent the amount of money for buying or selling something such as food, clothing or to pay bills. One way is to evaluate health in dollar terms is to use the Value of a Statistical Life and Value of a Statistical Life Year**[b]**.

b. What is the Value of a Statistical Life and Value of a Statistical Life Year?

The value of a **statistical life** is the estimated amount that a society is willing to trade to reduce the risk of death. The word 'Statistical' refers to the average value for life and therefore means the value of a statistical life doesn't relate to any specific individual. This value can change across risk factors and different societies who may value life differently. There are various ways of measuring the value of a statistical life with most approaches using revealed or stated preference approaches.[3] In Australia, the Office of Best Practice Regulation estimates a statistical life at $5.3M in 2022 dollar terms, and assumes that the life is of a young person with at least another 40 years to live.[5, 6]

Value of a Statistical Life Year

The value of a statistical life year is the estimated amount that a society is willing to trade to reduce the risk of death over **one year.** It can be derived from the value of a statistical life or measured directly using surveys or willingness to pay techniques.[5] The current value of a **statistical life year** is $227,000 in 2022 dollars based on current estimates from the Office of Best Practice Regulation.[6] The value of a statistical life year is useful for evaluating small increases in life years instead of evaluating full life expectancy. It is appropriate for valuing the Health Adjusted Life Years estimated from the scenarios and modelling presented in this tool. For the modelling and results presented here, the value of $227,000 was converted to 2019 dollars based on the Wage Price Index for Brisbane.

c. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

d. Application in advocacy and reporting

This section uses figures to show how the value of community health (estimated from HALYs and the value of statistical life year) can be used for reporting and advocacy purposes.

The simulation model uses **population-based estimates** for disease morbidity and mortality and is best applied to larger groups of people. It also assumes that the people of interest have similar characteristics and behaviours to the population data used in the simulation model and scenarios. The **example** below shows results from a scenario that replaces car trips with walking trips for distances of 0-2 km for All age groups.

Example:

The HALYs gained in this scenario have a statistical value of:

- **$10,859,605** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **$6,662,541** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **$4,533,392** per 1,000 members of the population, when calculated using a discount rate of 7%.

This **example** shows that the HALYs gained in this scenario have a statistical value of $10,859,605 per 1,000 members of the population using a discount of 3%.

This figure can be divided by 1,000 to give a per person figure. Once a per person figure is established, it can be multiplied by the number of people in any population size of interest for use in reports or as evidence to advocate for benefits associated with shifts to active transport modes.

$10,859,605 / 1,000 = $10,859.61 per person value

A good example of how this model can be applied links to previous research that investigated the impact of new more walkable development in Altona North on a population of 21,000 people [11]. If we assume that these people have similar characteristics to the underlying population based estimates and behaviours based on the travel survey data in the simulation model underlying this tool, then the value of community health according to the chosen scenario can be calculated as:

21,000 (people) x $10,859 (statistical value from HALYs gained) = $228 M.

Savings

An increase in physical activity due to the chosen scenario reduces chronic disease cases across a lifetime and reduces spending for each disease within the health care system resulting in overall health care cost savings**[a]**.

Table 3 provides estimated health care cost savings associated with the prevented cases of chronic diseases per 1,000 members of the population according to the selected scenario. These figures are based on applying average health care system costs per prevalent case of disease and using three alternative discount rates**[b]**:

Table 3. Total health care cost savings by disease per 1,000 members of the population.

Disease	3% discount rate	5% discount rate	7% discount rate
Alzheimer's disease and other dementias	$1,059	$764	$543
Breast cancer	$41,722	$25,396	$16,515
All cancers	$73,944	$46,748	$31,303
Colon cancer	$12,086	$8,308	$5,805
Chronic myeloid leukemia	$2,801	$1,706	$1,114
Diabetes type 2	$27,876	$16,181	$10,190
Depression	$141,294	$102,734	$77,378
Head and neck cancer	$557	$381	$274
Ischemic heart disease	$44,907	$26,214	$16,568
Liver cancer	$549	$381	$278
Multiple myeloma	$7,229	$4,678	$3,215
Stomach cancer	$2,959	$1,928	$1,333
Stroke	$5,723	$3,346	$2,114
Lung cancer	$4,042	$2,748	$1,969
Uterine cancer	$1,990	$1,225	$805

a. What do we mean by health care cost savings?

To calculate health care cost savings for each disease, the annual costs for each disease in each year is multiplied by the number of prevented cases of each disease for each scenario. This results in a total saving in spending for each disease by year. The savings in spending for future years are discounted**[b]** with annual savings aggregated to give a total amount saved for each disease. Total savings are presented as the amount saved per 1,000 members of the population to enable comparisons against populations of different sizes.

We use the term **health care cost saving** because it represents a reduction in health spending. However, the Australian Institute of Health and Welfare (AIHW) stress that the term cost is broad and not representative of the full cost experienced by individuals, families, or the health system, consequently AIHW use the term spending.[8]

These figures use AIHW estimates of the amounts spent through the health system in 2018-19 for each case of disease. This is extracted from Health system spending per case of disease and for certain risk factors, Table 1 – Estimates of health system spending per case, by burden of disease group, condition and sex, Australia 2018-2019.[9]. For head and neck cancers, supplementary figures were obtained from the Global Burden of Disease incidence data.[10]

b. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

References

1. Gold, M. R., Stevenson, D., & Fryback, D. G. (2002). *HALYS and QALYS and DALYS, Oh My: similarities and differences in summary measures of population Health.* Annual review of public health, 23(1), 115-134.
2. Attema, A.E., Brouwer, W.B. & Claxton, K. (2018). *Discounting in economic evaluations.* Pharmacoeconomics. 36: p. 745-758.
3. Ananthapavan, J., Moodie, M., Milat, A.J., & Carter, R. (2021). *Systematic review to update 'value of a statistical life' estimates for Australia.* International journal of environmental research and public health, 2021. 18(11): p. 6168.
4. Terrill, M. & Batrouney, H. (2018). *Unfreezing discount rates: Transport infrastructure for tomorrow.* Grattan Institute.
5. Abelson, P. (2008). *Establishing a monetary value for lives saved: issues and controversies.* Canberra: Office of Best Practice Regulation, Department of Finance and Deregulation.
6. Department of the Prime Minister and Cabinet. (2022). *Best practice regulation guidance note: Value of statistical life.* Australian Government.
7. Haacker, M., Hallett, T.B. & Atun, R. (2020). *On discount rates for economic evaluations in global health.* Health Policy and Planning, 2020. 35(1): p. 107-114.
8. Australian Institute of Health and Welfare (2023). Technical Notes: Estimating Spending per prevalent case of disease. Health system spending per case of disease and for certain risk factors, Estimating the spending per prevalent case of disease - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
9. Australian Institute of Health and Welfare (2023). Health system spending per case of disease and for certain risk factors. Health system spending per case of disease and for certain risk factors, Data - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
10. Global Burden of Disease (2019). Global Health Data Exchange. https://vizhub.healthdata.org/gbd-results. Accessed September 20, 2023.
11. Zapata-Diomedi, B., Boulangé, C., Giles-Corti, B., Phelan, K., Washington, S., Veerman, L.J., & Gunn, L. (2019). Physical activity-related health and economic benefits of building walkable neighbourhoods: A modelled comparison between brownfield and greenfield developments. International Journal of Behavioural Nutrition and Physical Activity.
12. Khorasani, E., Davari, M., Kebriaeezadeh, A., Fatemi, F., Akbari Sari, A., & Varahrami, V. (2022). A comprehensive review of official discount rates in guidelines of health economic evaluations over time: the trends and roots. The European Journal of Health Economics, 23(9), 1577-1590.

Scenario: replacing car trips under 2km with walking, and car trips between 2 and 10km with cycling for commuting trip purposes

This scenario shows the results of replacing car trips under 2km with walking and replacing car trips between 2km and 10km with cycling for work related or education purposes for all adults of all ages.

This implies that the selected scenario results in a mode shift in walking from 16.8% to 18.6%; cycling from 1.3% to 12.0%; and, from 74.7% to 62.2% for car trips taken as either a driver or passenger.

Increases in walking and cycling translate into a shift from 47.9% to 58.2% of the population accumulating the required minutes spent being moderately (150 – 300 mins) or vigorously physically active (75 – 150 mins) or an equivalent combination of both contributing to recommended levels as detailed in the Physical Activity Guidelines.

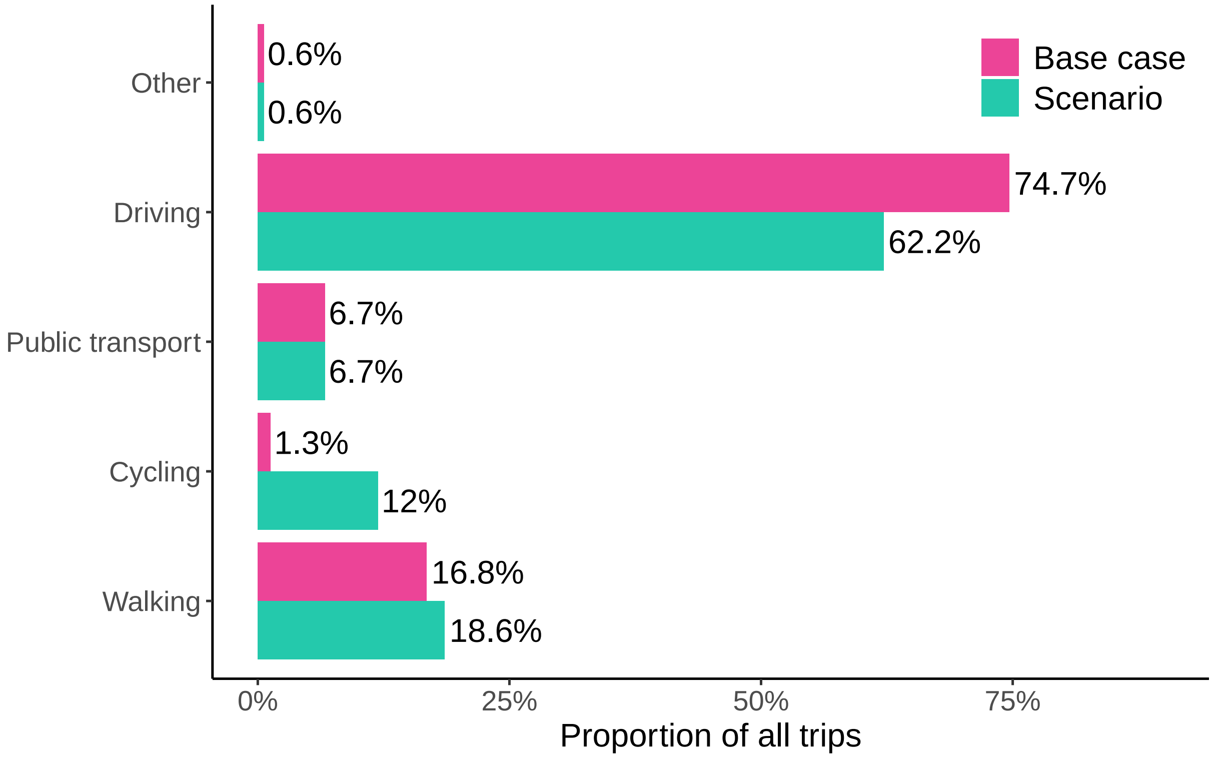

Figure 1: Distribution of base case and scenario trips.

Incidence

Incidence describes the rate of occurrence of new cases of a disease over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of disease prevented, due to increases in physical activity associated with the scenario. Figure 2 presents the change (%) in the disease incidence across the life course. Figure 3 presents how the difference in disease incidence changes over time, by year, using a snapshot of the population from 2019.

Table 1 shows how the scenario impacts the incidence of chronic diseases as both as a percentage and total number of prevented cases.

Table 1. Chronic disease incidence reduction and total number of prevented cases of disease measured across the years of the simulation

Disease*	Incidence of disease is reduced by	Total number of prevented cases of disease aggregated across the simulation
Alzheimer's disease and other dementias	-0.15%	-962
Breast cancer	0.39%	286
All cancers	0.24%	950
Colon cancer	0.03%	38
Chronic myeloid leukemia	0.14%	4
Diabetes type 2	2.07%	6,844
Depression	0.34%	5,491
Head and neck cancer	0.92%	40
Ischemic heart disease	0.53%	4,706
Liver cancer	0.57%	100
Multiple myeloma	0.38%	73
Stomach cancer	0.40%	96
Stroke	0.40%	1,047
Lung cancer	0.24%	272
Uterine cancer	0.50%	42

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

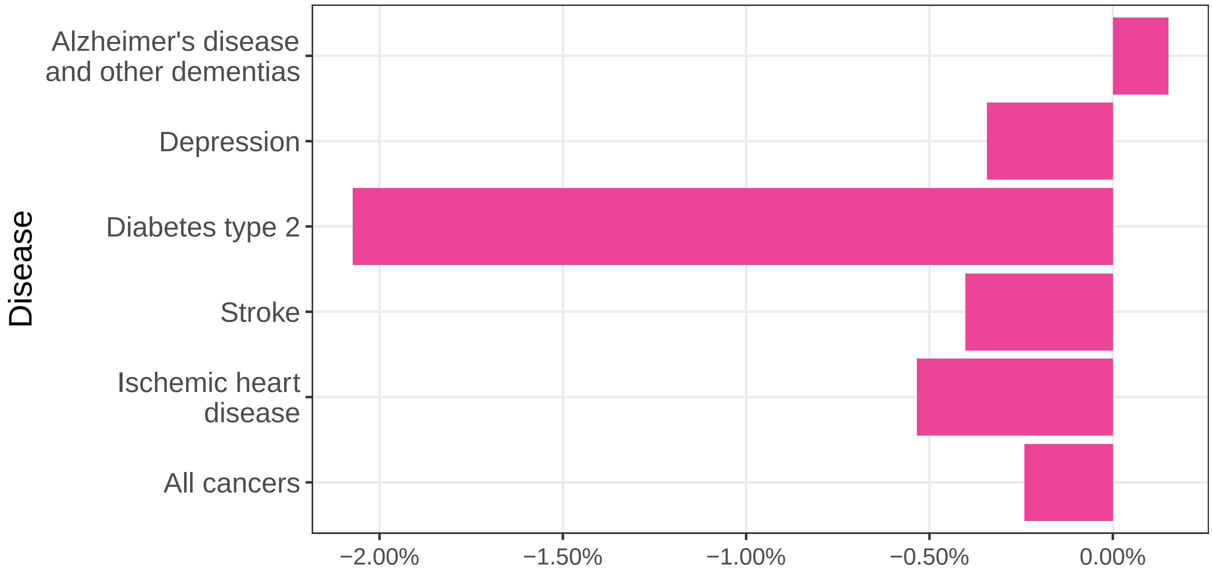

Figure 2.a: Percentage change in incidence by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

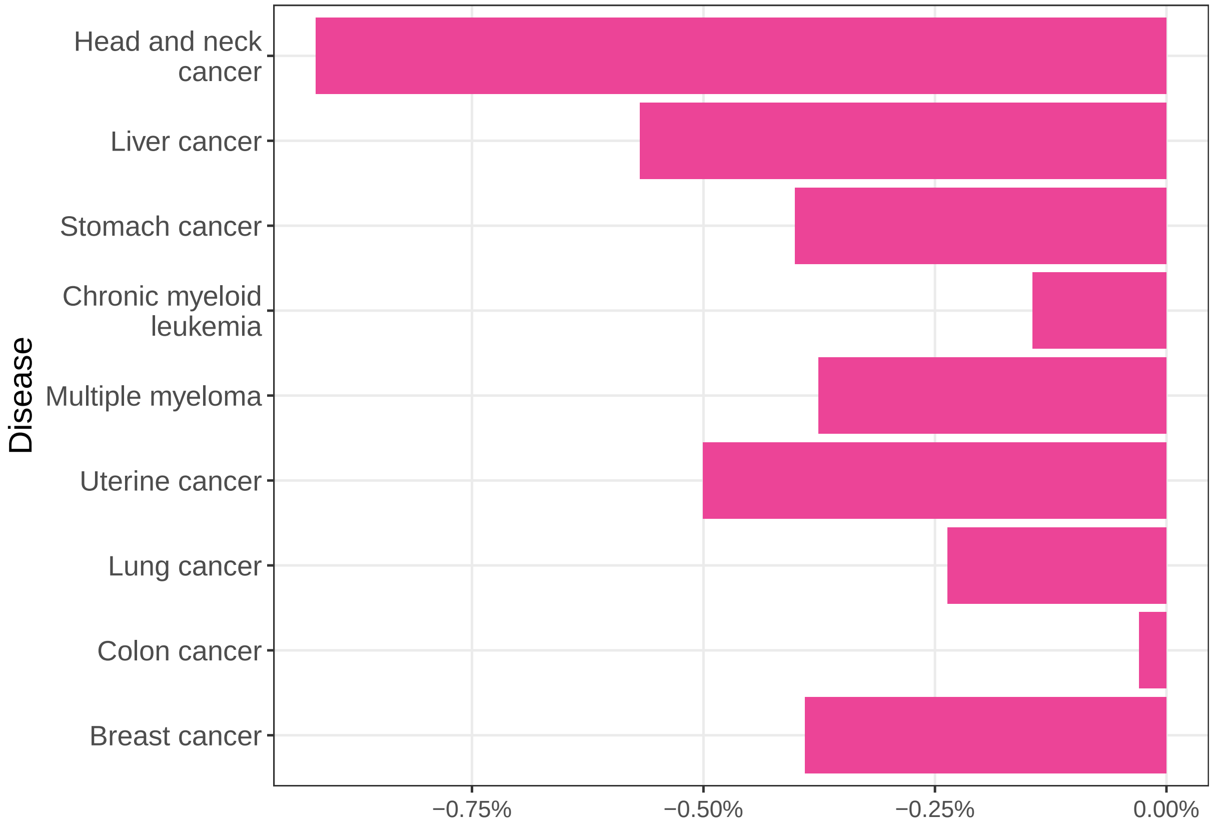

Figure 2.b: Percentage change in incidence for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

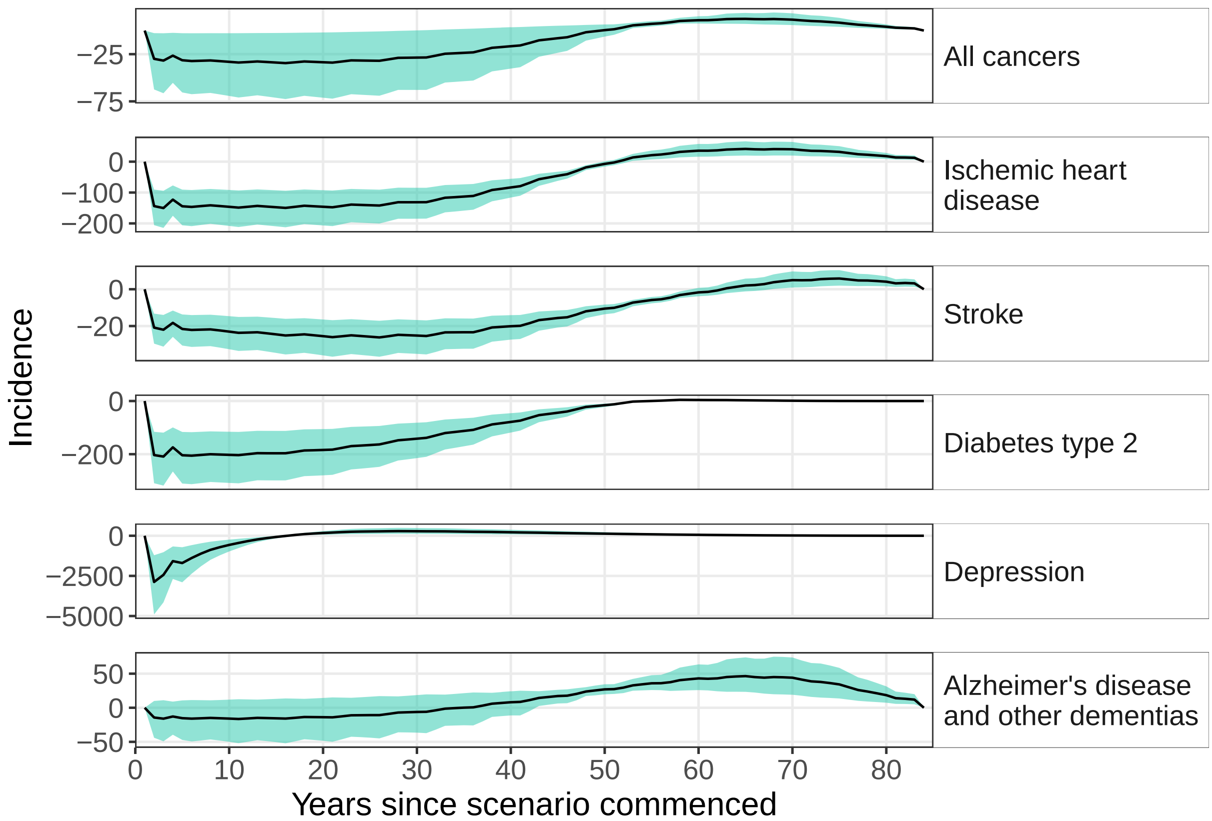

Figure 3.a: The change in incidence over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

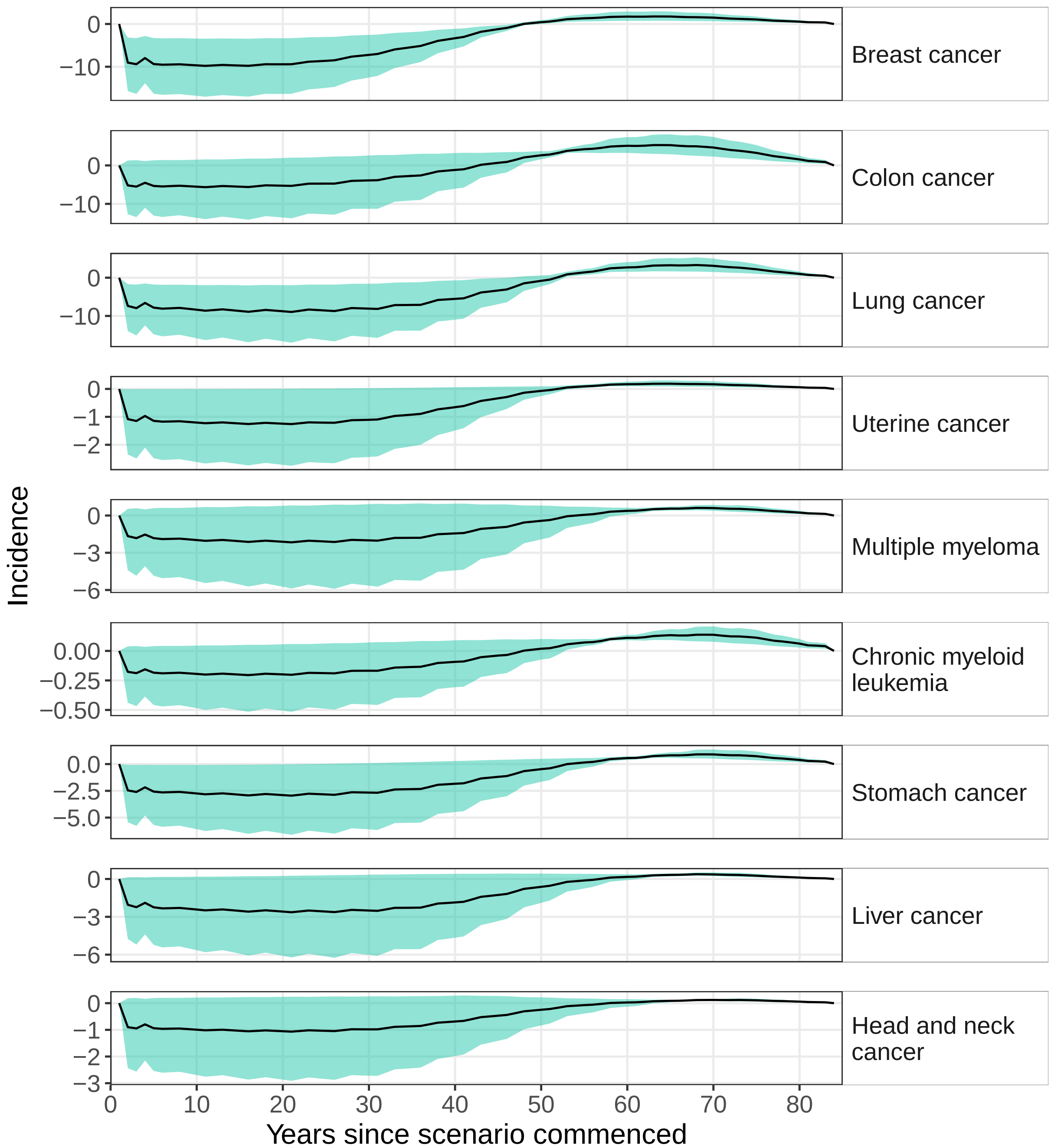

Figure 3.b: Percentage change in incidence for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in incidence returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Mortality

Mortality is the number of deaths due to a given disease over over a time period. In this example, results for females/males of all ages (n= 2,013,587) are presented as cases of prevented deaths due to increases in physical activity associated with the scenario. Figure 4 presents the total change in mortality over the life course. Figure 5 presents the difference in the number of deaths by year using a snapshot of the population from 2019.

Table 2 shows how the scenario impacts reductions in mortality presented as a percentage and total number of prevented deaths caused by chronic diseases.

Table 2. Percentage reduction in mortality and total number of prevented deaths by chronic disease measured across the years of the simulation.

Disease*	Mortality is reduced by	Total number of prevented deaths aggregated across the simulation
Alzheimer's disease and other dementias	-0.31%	-752
Breast cancer	0.43%	137
All cancers	0.29%	737
Colon cancer	0.06%	26
Chronic myeloid leukemia	0.09%	2
Diabetes type 2	1.90%	941
Depression	0.00%	0
Head and neck cancer	0.99%	39
Ischemic heart disease	0.54%	2,035
Liver cancer	0.57%	98
Multiple myeloma	0.37%	64
Stomach cancer	0.40%	84
Stroke	0.34%	603
Lung cancer	0.23%	254
Uterine cancer	0.44%	32

* Negative figures indicate an increase in disease. This can occur because the scenarios increase physical activity improving population and physical health allowing the population to live longer but making them susceptible to other degenerative and age related diseases such as Alzheimer's and other dementias. Some scenarios result in minor shifts in chronic disease reduction as shown by zeros for incidence and disease. This is more common for scenarios involving older age groups who undertake less commuting trips.

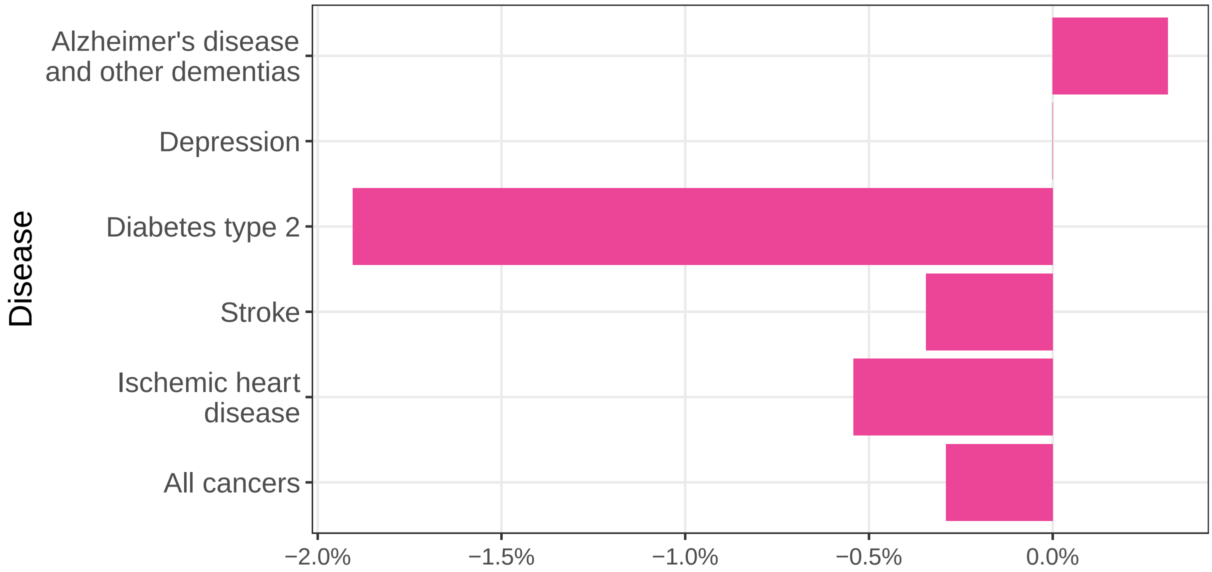

Figure 4.a: Percentage change in mortality by disease. Notes: In this model, breast and uterine cancers only apply to populations including females.

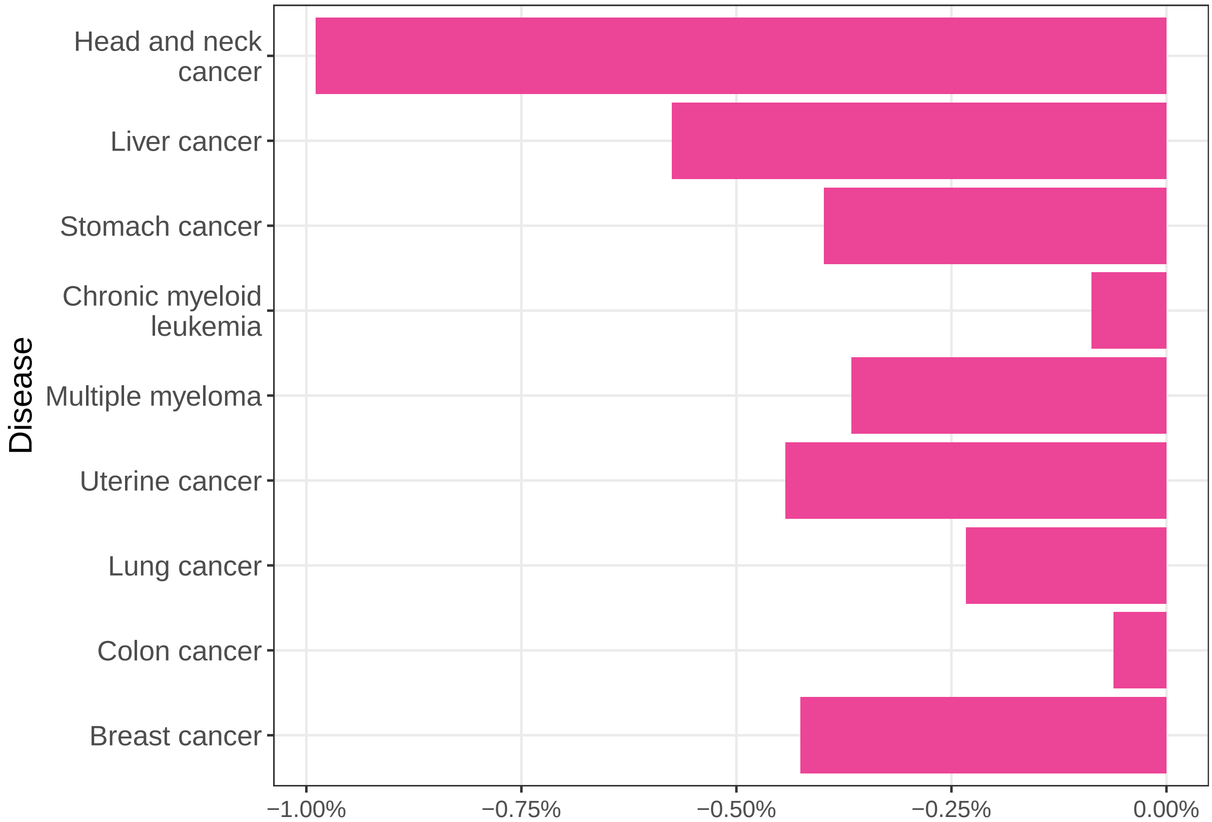

Figure 4.b: Percentage change in mortality for specific cancers. Notes: In this model, breast and uterine cancers only apply to populations including females.

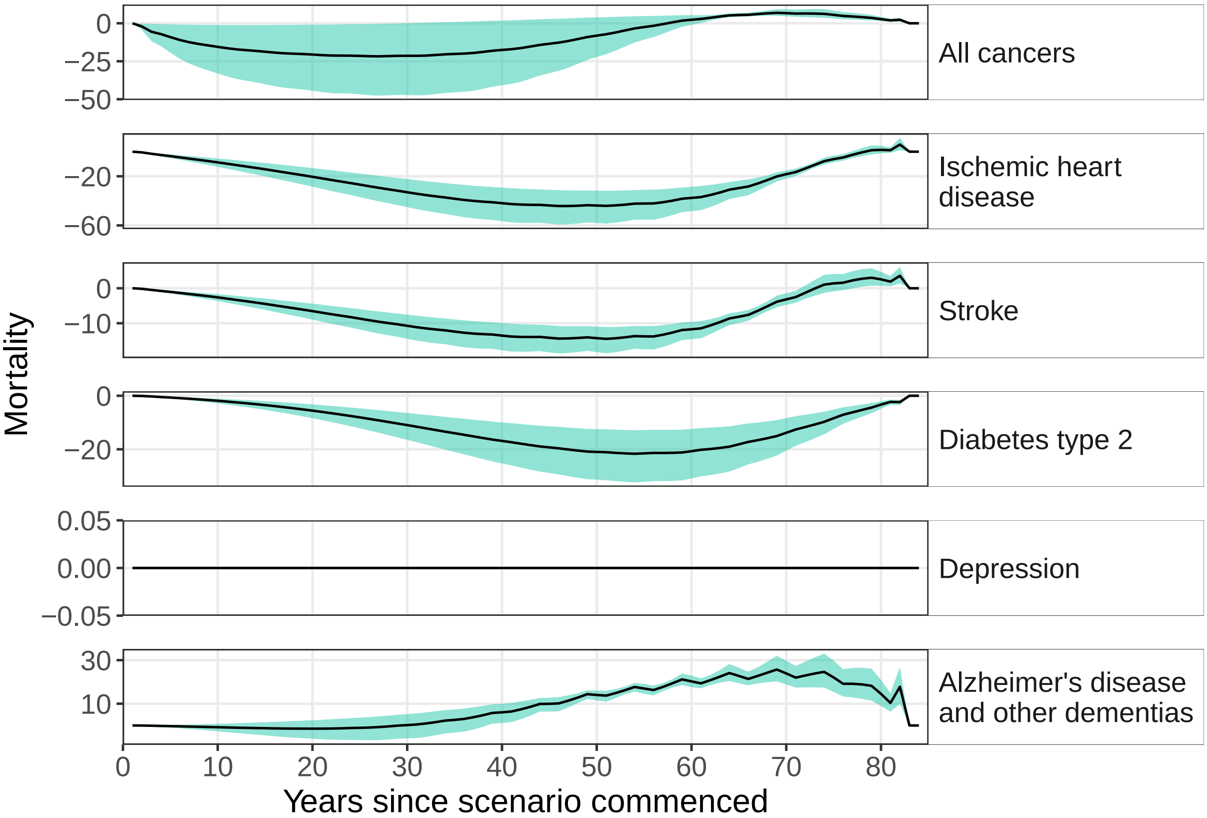

Figure 5.a: The change in mortality over time by disease.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

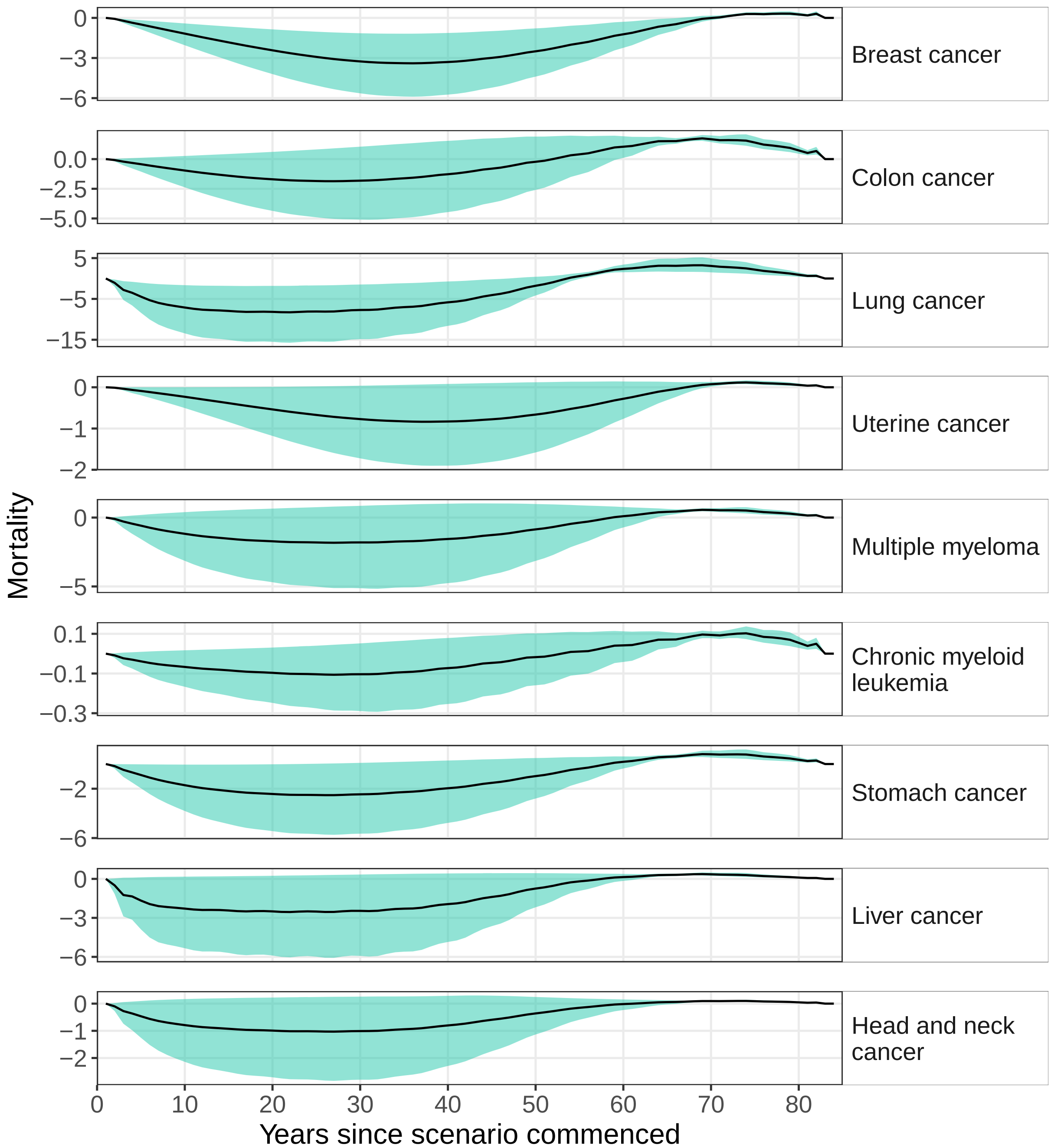

Figure 5.b: Percentage change in mortality for specific cancers.

Notes: In this model, breast and uterine cancer only apply to populations including females. Time=0 at baseline year 2019. In the above figure, the change in mortality returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. For example, older age groups included in the original simulated model will not reach the maximum simulation range of 80 years because the time period extends beyond a lifetime. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Health

Figures 6 and 7 below show the change in Health Adjusted Life Years (HALYs)[1] and Life Years[2] for a snapshot of the population from 2019 for the scenario. Both figures show that the greatest gains from increasing physical activity occur midway through the life cycle with most of the gains occurring cumulatively in the long term. The decline from the mid-point onwards is due to individuals dying from natural causes within the model.

HALYS

The model estimates a total of **205,707** HALYs for the scenario population, which is **102** HALYs per 1,000 members of the population.

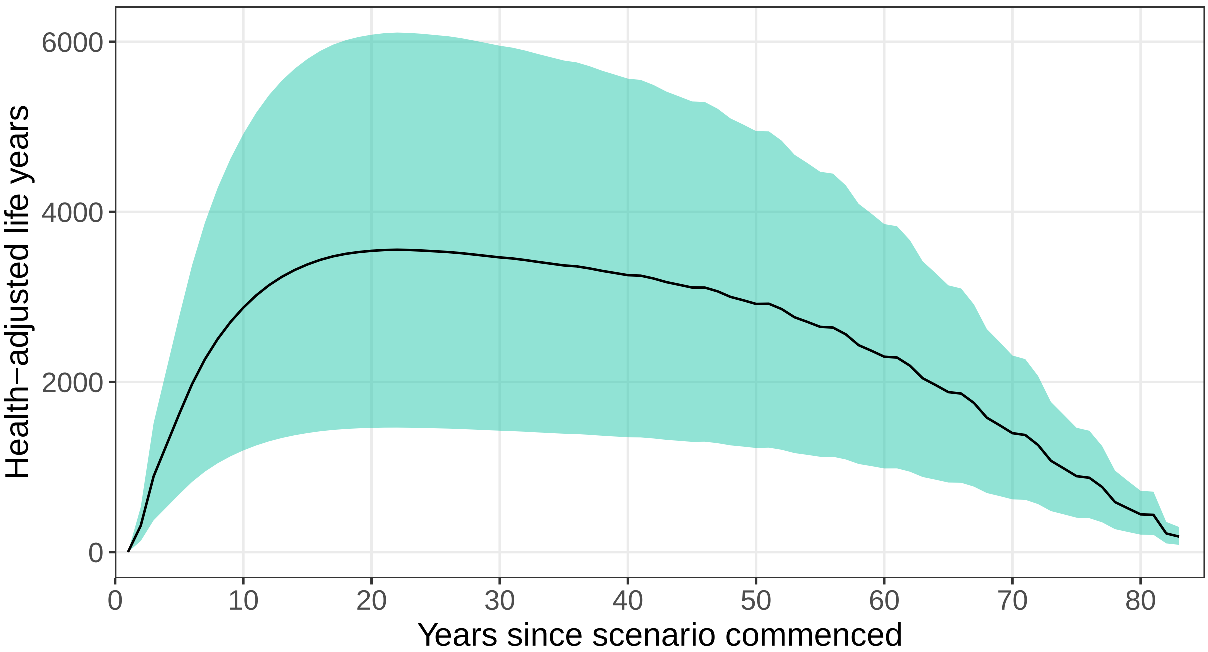

Figure 6. Total health-adjusted life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

[1]Health Adjusted Life Years are holistic measures of health that account for morbidity, mortality and quality of life.

[2]Life Years are similar to a HALYs however they exclude the quality of life component.

Life Years

The model estimates a total of **93,322** Life Years for the scenario population, which is **46** Life Years per 1,000 members of the population.

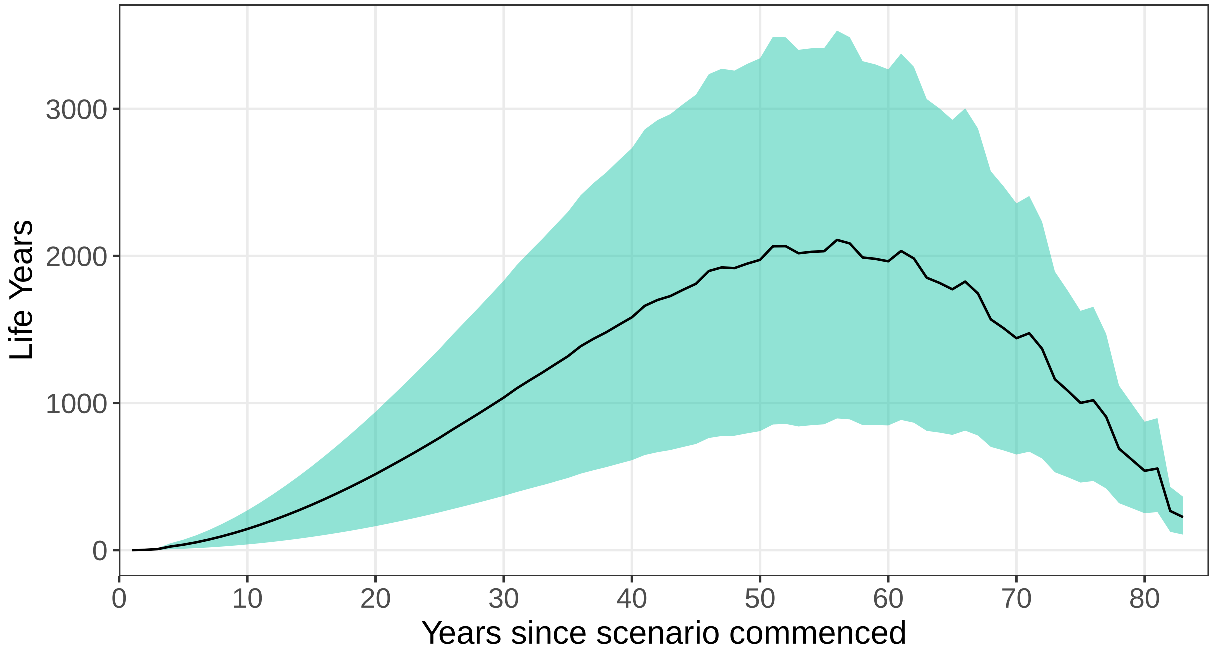

Figure 7. Total life years gained due to the scenario. Notes: Time = 0 at baseline year 2019. In the above figure, the change in Life Years returns towards zero across time as the modelled population is fixed and no new people are allowed into the simulation model. The aqua shading represents uncertainty in the results as modelling can only represent indicative values. Please refer to the technical documentation for more detail.

Value

The value of improvements to community health can be calculated**[a]** by translating the Health Adjusted Life Years (HALYs) from each scenario into dollar terms using the value of a statistical life year**[b]**. The value of a statistical life year is an estimate of the amount a society is willing to trade to reduce the risk of death for one year.

In the simulation model, HALYs are generated across time and are cumulative. Thus, to help us understand the value of HALYs across time in present day terms, it is necessary to use discounting**[c]** to reduce HALYs generated at the future point in time. Discounted HALYs from these future points can be added up to give the aggregate value of HALYs in today's terms as a measure of the value of improvements to community health arising from the chosen scenario.

The size of the discount rate can impact the aggregated value of HALYs and there is considerable debate on what discount rates should be used (with some arguing that health should not be discounted at all).[2] Hence, it is common to use a variety of discount rates to allow for differing risks, preferences and sensitivity when valuing health. The figures presented below were calculated using discount rates of 3%, 5% and 7% based on recent recommendations [3, 4] and represent the value of HALYs in present day terms resulting from an increase in physical activity from the chosen scenario.

The value of improvements to community health

The model estimates a total of **HALYs,** Health Adjusted Life Years (HALYs) gained for the scenario population, which is **102** HALYs per 1,000 members of the scenario population. The figures below represent the value of improvements to community health from the chosen scenario. These figures can be used in summary reports and for advocacy purposes**[d]**.

The HALYs gained in this scenario have a statistical value of:

- **8,593,572** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **5,380,176** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **3,673,341** per 1,000 members of the population, when calculated using a discount rate of 7%.

a. What is meant by value and how can it be measured?

Value is conceptual and measures a sense of worth or usefulness of something to individuals or to a society. Measuring the value of something, such as health, enables it to be included in assessments or analyses such as cost-benefit analyses to recognise its relative importance.

Value can be derived in many ways and a common approach is to use monetary terms, such as dollars. Valuing something using dollars is not the same as equating it with its price. Prices represent the amount at which something can be traded, prices therefore represent the amount of money for buying or selling something such as food, clothing or to pay bills. One way is to evaluate health in dollar terms is to use the Value of a Statistical Life and Value of a Statistical Life Year**[b]**.

b. What is the Value of a Statistical Life and Value of a Statistical Life Year?

The value of a **statistical life** is the estimated amount that a society is willing to trade to reduce the risk of death. The word 'Statistical' refers to the average value for life and therefore means the value of a statistical life doesn't relate to any specific individual. This value can change across risk factors and different societies who may value life differently. There are various ways of measuring the value of a statistical life with most approaches using revealed or stated preference approaches.[3] In Australia, the Office of Best Practice Regulation estimates a statistical life at $5.3M in 2022 dollar terms, and assumes that the life is of a young person with at least another 40 years to live.[5, 6]

Value of a Statistical Life Year

The value of a statistical life year is the estimated amount that a society is willing to trade to reduce the risk of death over **one year.** It can be derived from the value of a statistical life or measured directly using surveys or willingness to pay techniques.[5] The current value of a **statistical life year** is $227,000 in 2022 dollars based on current estimates from the Office of Best Practice Regulation.[6] The value of a statistical life year is useful for evaluating small increases in life years instead of evaluating full life expectancy. It is appropriate for valuing the Health Adjusted Life Years estimated from the scenarios and modelling presented in this tool. For the modelling and results presented here, the value of $227,000 was converted to 2019 dollars based on the Wage Price Index for Brisbane.

c. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

d. Application in advocacy and reporting

This section uses figures to show how the value of community health (estimated from HALYs and the value of statistical life year) can be used for reporting and advocacy purposes.

The simulation model uses **population-based estimates** for disease morbidity and mortality and is best applied to larger groups of people. It also assumes that the people of interest have similar characteristics and behaviours to the population data used in the simulation model and scenarios. The **example** below shows results from a scenario that replaces car trips with walking trips for distances of 0-2 km for All age groups.

Example:

The HALYs gained in this scenario have a statistical value of:

- **$10,859,605** per 1,000 members of the population, when calculated using a discount rate of 3%,
- **$6,662,541** per 1,000 members of the population, when calculated using a discount rate of 5%,
- **$4,533,392** per 1,000 members of the population, when calculated using a discount rate of 7%.

This **example** shows that the HALYs gained in this scenario have a statistical value of $10,859,605 per 1,000 members of the population using a discount of 3%.

This figure can be divided by 1,000 to give a per person figure. Once a per person figure is established, it can be multiplied by the number of people in any population size of interest for use in reports or as evidence to advocate for benefits associated with shifts to active transport modes.

$10,859,605 / 1,000 = $10,859.61 per person value

A good example of how this model can be applied links to previous research that investigated the impact of new more walkable development in Altona North on a population of 21,000 people [11]. If we assume that these people have similar characteristics to the underlying population based estimates and behaviours based on the travel survey data in the simulation model underlying this tool, then the value of community health according to the chosen scenario can be calculated as:

21,000 (people) x $10,859 (statistical value from HALYs gained) = $228 M.

Savings

An increase in physical activity due to the chosen scenario reduces chronic disease cases across a lifetime and reduces spending for each disease within the health care system resulting in overall health care cost savings**[a]**.

Table 3 provides estimated health care cost savings associated with the prevented cases of chronic diseases per 1,000 members of the population according to the selected scenario. These figures are based on applying average health care system costs per prevalent case of disease and using three alternative discount rates**[b]**:

Table 3. Total health care cost savings by disease per 1,000 members of the population.

Disease	3% discount rate	5% discount rate	7% discount rate
Alzheimer's disease and other dementias	$1,932	$1,425	$1,024
Breast cancer	$89,612	$54,253	$35,139
All cancers	$152,478	$96,064	$64,146
Colon cancer	$24,274	$16,709	$11,679
Chronic myeloid leukemia	$5,023	$3,076	$2,016
Diabetes type 2	$57,479	$33,359	$20,999
Depression	$272,358	$197,126	$147,880
Head and neck cancer	$1,103	$757	$545
Ischemic heart disease	$92,501	$54,037	$34,153
Liver cancer	$1,153	$802	$586
Multiple myeloma	$13,619	$8,847	$6,093
Stomach cancer	$5,884	$3,844	$2,663
Stroke	$11,105	$6,493	$4,099
Lung cancer	$7,822	$5,342	$3,836
Uterine cancer	$3,962	$2,438	$1,600

a. What do we mean by health care cost savings?

To calculate health care cost savings for each disease, the annual costs for each disease in each year is multiplied by the number of prevented cases of each disease for each scenario. This results in a total saving in spending for each disease by year. The savings in spending for future years are discounted**[b]** with annual savings aggregated to give a total amount saved for each disease. Total savings are presented as the amount saved per 1,000 members of the population to enable comparisons against populations of different sizes.

We use the term **health care cost saving** because it represents a reduction in health spending. However, the Australian Institute of Health and Welfare (AIHW) stress that the term cost is broad and not representative of the full cost experienced by individuals, families, or the health system, consequently AIHW use the term spending.[8]

These figures use AIHW estimates of the amounts spent through the health system in 2018-19 for each case of disease. This is extracted from Health system spending per case of disease and for certain risk factors, Table 1 – Estimates of health system spending per case, by burden of disease group, condition and sex, Australia 2018-2019.[9]. For head and neck cancers, supplementary figures were obtained from the Global Burden of Disease incidence data.[10]

b. What are discount rates and how are they relevant here?

Discount rates are used to translate future amounts into an equivalent amount in today's terms or present value. This process is also known as a Net Present Value calculation (NPV). NPV calculations are useful for evaluating competing projects which may have different monetary costs or benefits that occur at different times in the future. Discount rates also represent risk, the time value of money and opportunity costs.[2]

In practice, a variety of discount rates are often used for estimating the value of costs and benefits in projects. For health, there remains considerable debate on which discount rates should be applied. Many argue that the value of health should not be discounted. Considering current discourse and following best practice approaches, three discount rates were used for discounting future Health Adjusted Life Years arising from the scenarios modelled within this tool. Discount rates of 3%, 5% and 7% were used. [3, 4, 7]

References

1. Gold, M. R., Stevenson, D., & Fryback, D. G. (2002). *HALYS and QALYS and DALYS, Oh My: similarities and differences in summary measures of population Health.* Annual review of public health, 23(1), 115-134.
2. Attema, A.E., Brouwer, W.B. & Claxton, K. (2018). *Discounting in economic evaluations.* Pharmacoeconomics. 36: p. 745-758.
3. Ananthapavan, J., Moodie, M., Milat, A.J., & Carter, R. (2021). *Systematic review to update 'value of a statistical life' estimates for Australia.* International journal of environmental research and public health, 2021. 18(11): p. 6168.
4. Terrill, M. & Batrouney, H. (2018). *Unfreezing discount rates: Transport infrastructure for tomorrow.* Grattan Institute.
5. Abelson, P. (2008). *Establishing a monetary value for lives saved: issues and controversies.* Canberra: Office of Best Practice Regulation, Department of Finance and Deregulation.
6. Department of the Prime Minister and Cabinet. (2022). *Best practice regulation guidance note: Value of statistical life.* Australian Government.
7. Haacker, M., Hallett, T.B. & Atun, R. (2020). *On discount rates for economic evaluations in global health.* Health Policy and Planning, 2020. 35(1): p. 107-114.
8. Australian Institute of Health and Welfare (2023). Technical Notes: Estimating Spending per prevalent case of disease. Health system spending per case of disease and for certain risk factors, Estimating the spending per prevalent case of disease - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
9. Australian Institute of Health and Welfare (2023). Health system spending per case of disease and for certain risk factors. Health system spending per case of disease and for certain risk factors, Data - Australian Institute of Health and Welfare (aihw.gov.au). Accessed September 20, 2023.
10. Global Burden of Disease (2019). Global Health Data Exchange. https://vizhub.healthdata.org/gbd-results. Accessed September 20, 2023.
11. Zapata-Diomedi, B., Boulangé, C., Giles-Corti, B., Phelan, K., Washington, S., Veerman, L.J., & Gunn, L. (2019). Physical activity-related health and economic benefits of building walkable neighbourhoods: A modelled comparison between brownfield and greenfield developments. International Journal of Behavioural Nutrition and Physical Activity.
12. Khorasani, E., Davari, M., Kebriaeezadeh, A., Fatemi, F., Akbari Sari, A., & Varahrami, V. (2022). A comprehensive review of official discount rates in guidelines of health economic evaluations over time: the trends and roots. The European Journal of Health Economics, 23(9), 1577-1590.


ADELAIDE ST

Centre for
Urban Research

Building 8, Level 11
RMIT University City campus
124 La Trobe Street
Melbourne VIC, 3000
Australia

T: +61 3 9925 0917
E: cur@rmit.edu.au

cur.org.au

RMIT UNIVERSITY | Centre for Urban Research

Australian Urban Observatory

Your pathway to liveable cities
auo.org.au