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A demographically motivated index of within-population health inequality

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Motivation

- $e^{\dagger}$ - average life expectancy lost due to death.

$$e^{\dagger} = \int_0^{\infty} e(\alpha) \cdot d(\alpha) d\alpha$$

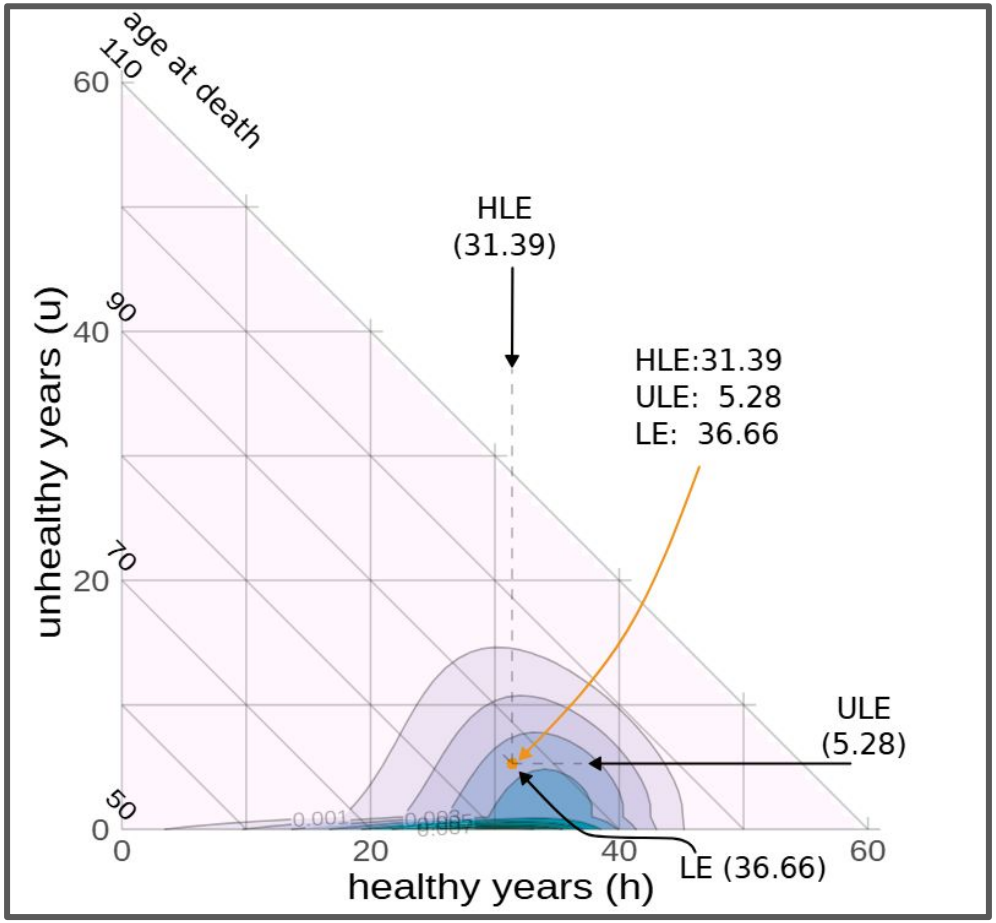
- Much is known about measuring healthy lifespan using averages.

  e.g. Sullivan DFLE:

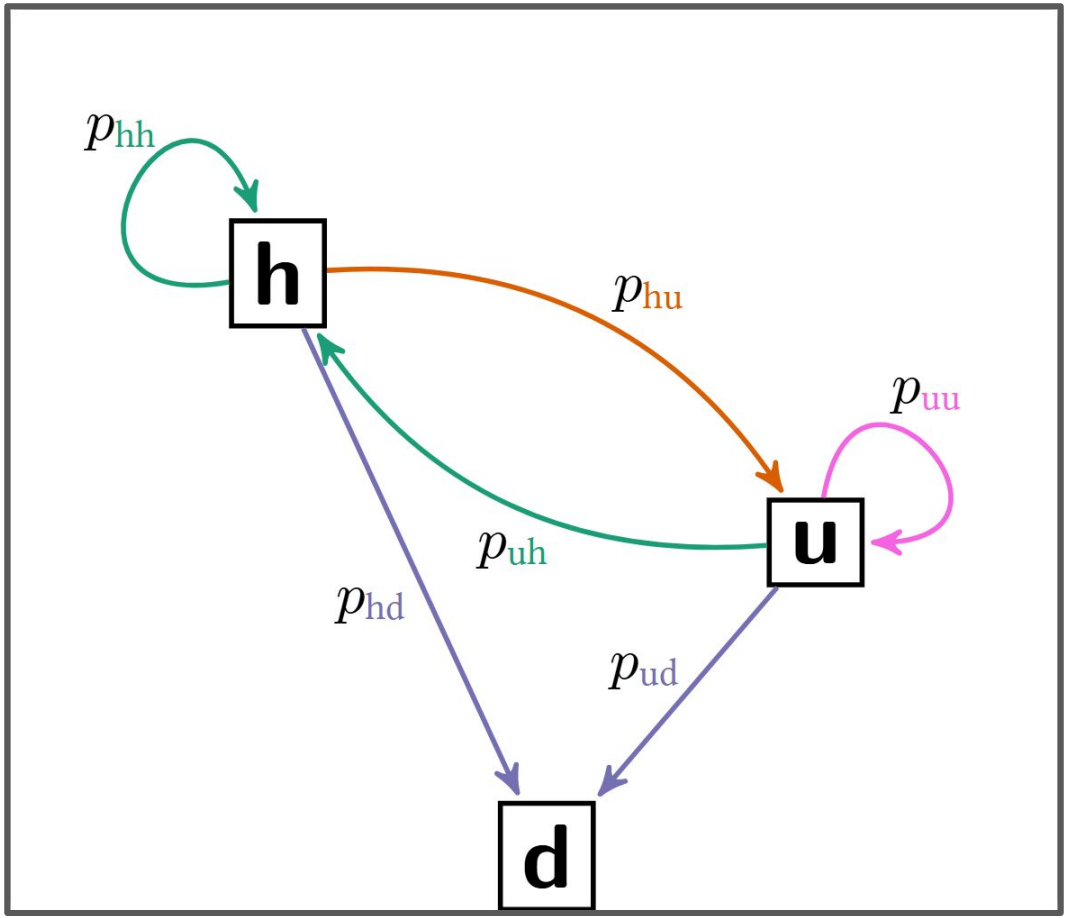
$$DFLE_x = \frac{1}{l_x} \sum_i L_\alpha \cdot (1 - \pi_\alpha)$$

- Less is known about within-population health inequality.

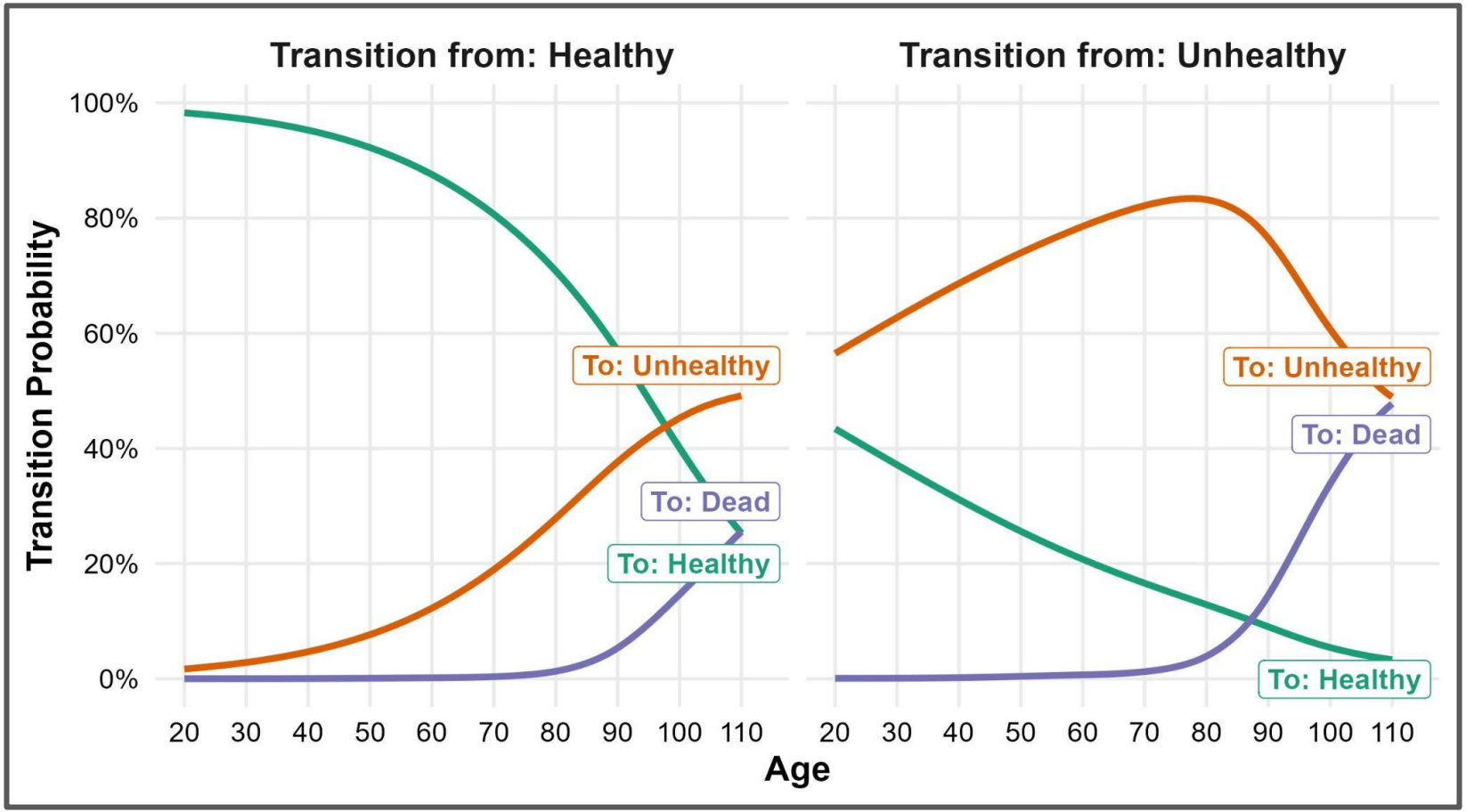
Ideal properties of a health inequality index?



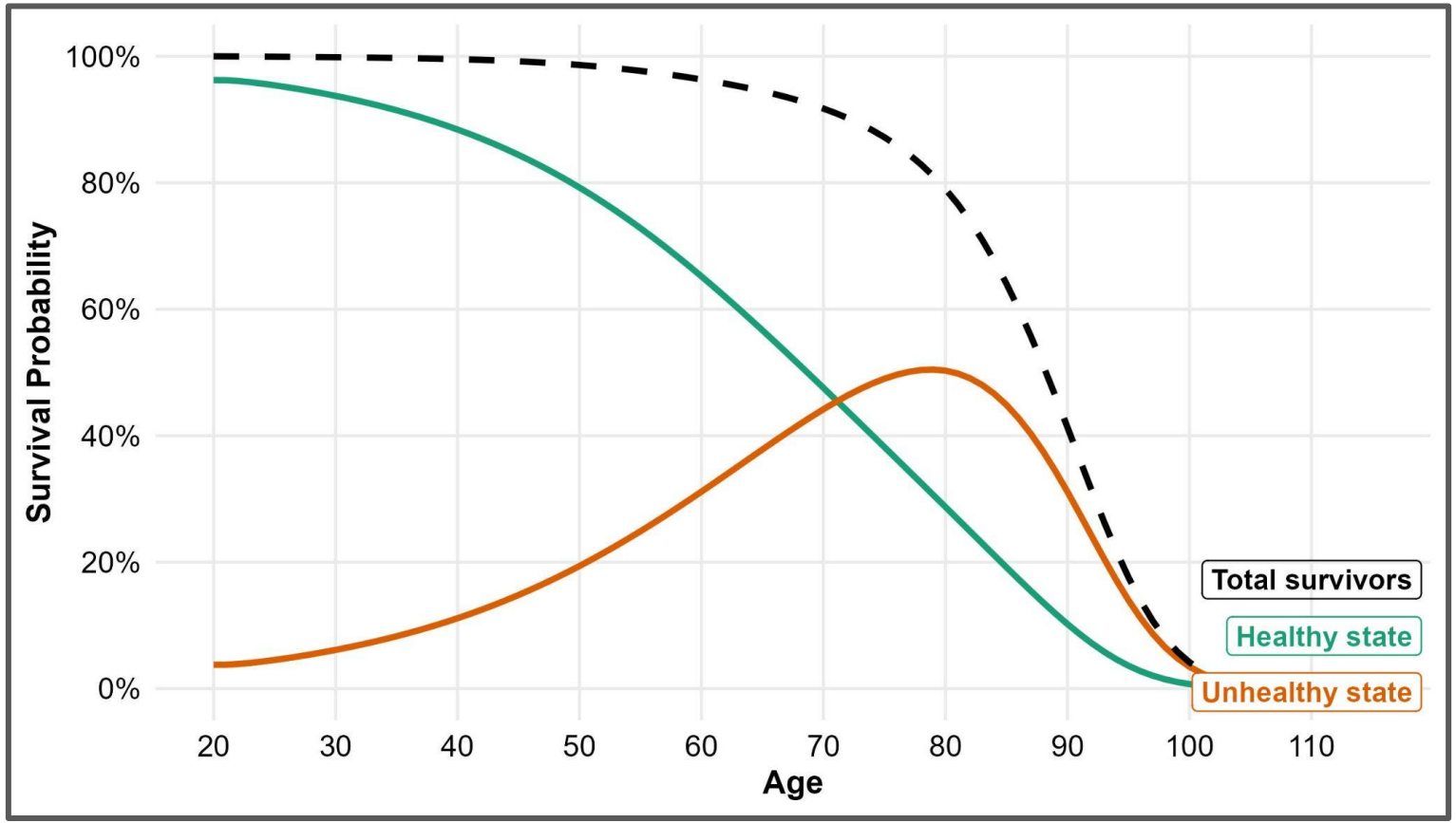
Multistate model with three states: Healthy, Unhealthy, and Dead



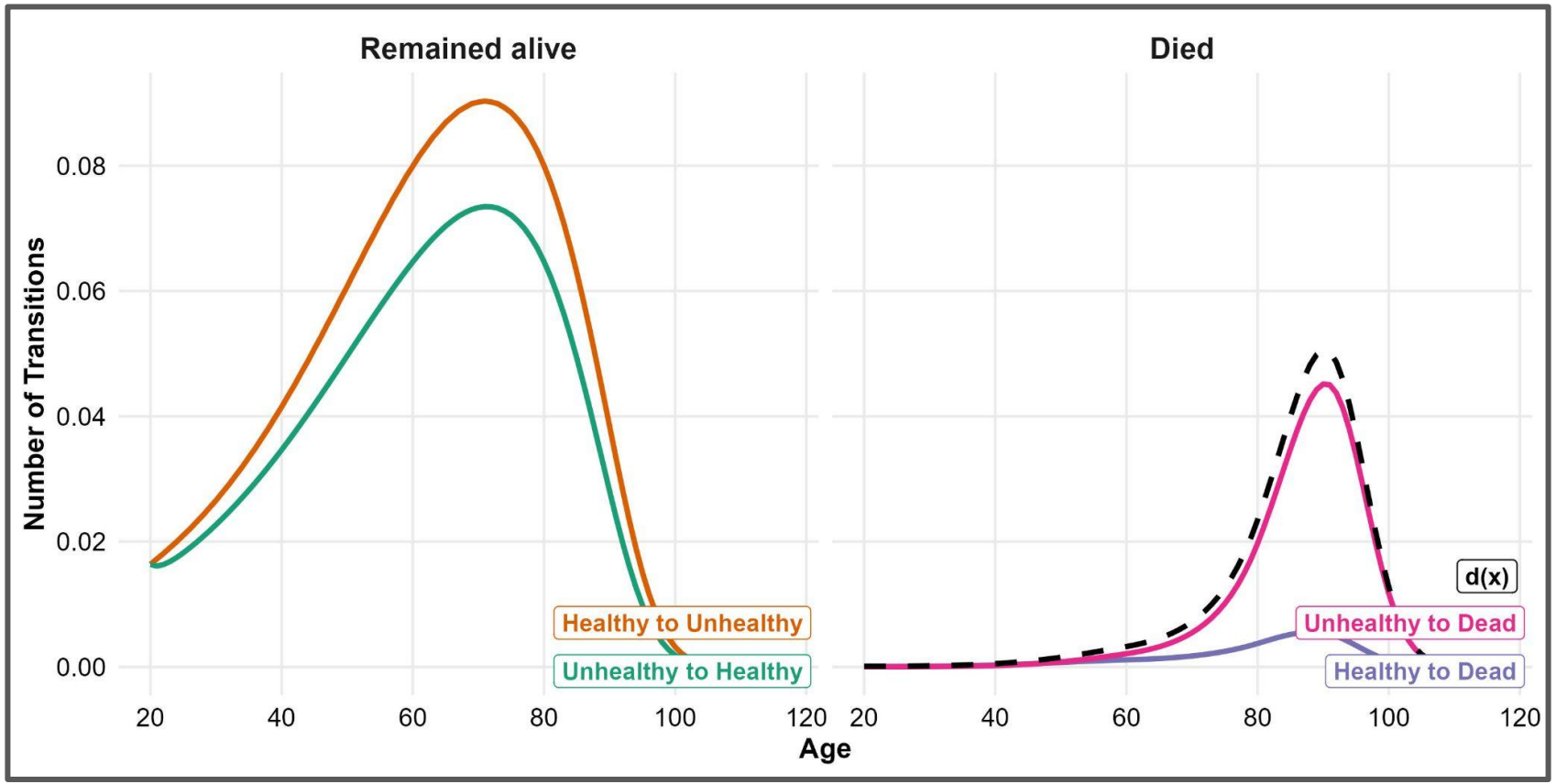
State-specific transition probabilities



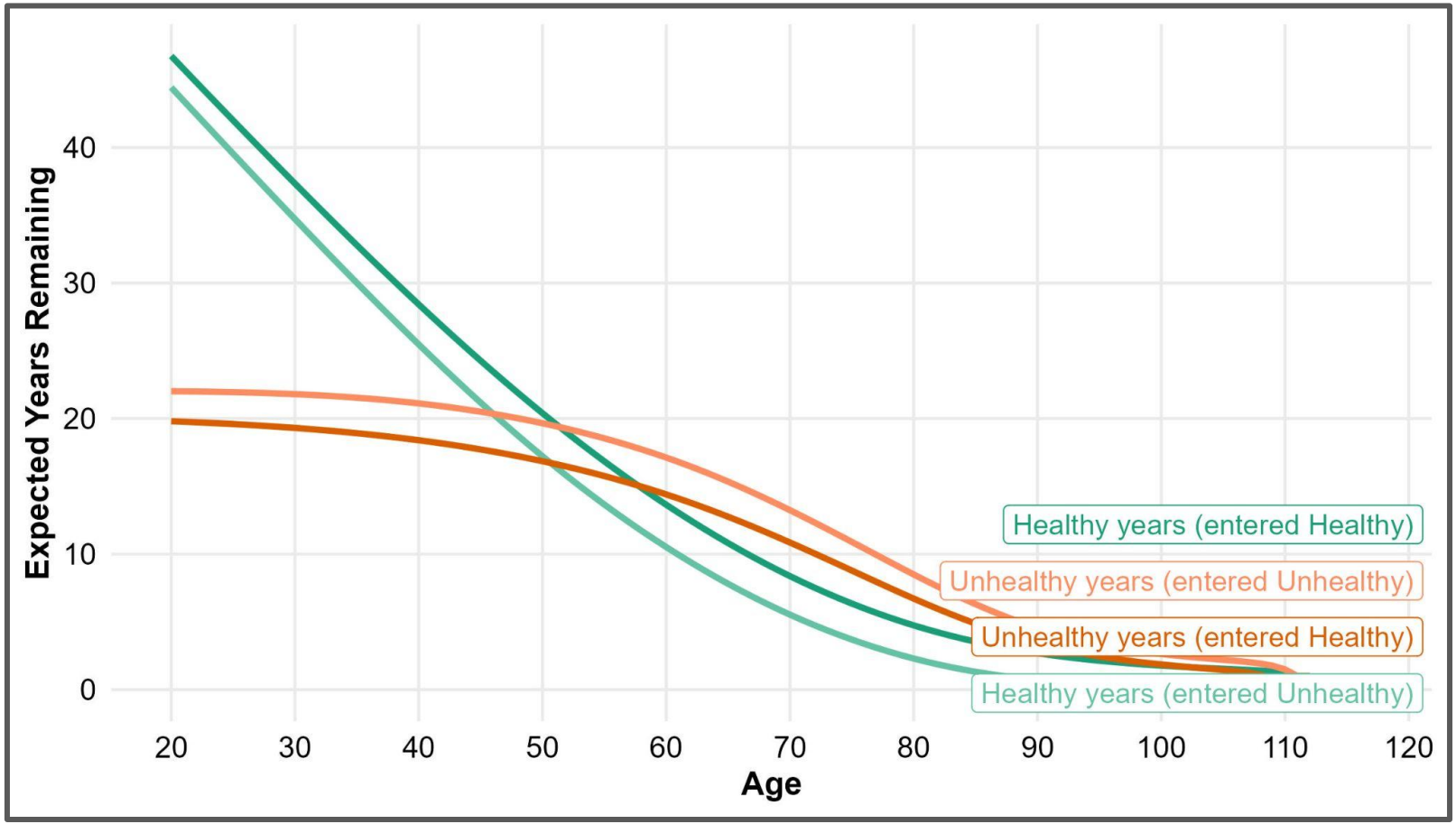
State-specific stocks from MSLT



Expected transfers from MSLT



Conditional Life Expectancies from MSLT by Entry Health State:



We can combine the previous steps to calculate the MSLT†.

$$HLE^{\dagger}_{hu}(x) = \sum_x \overbrace{p^{hu}(x) \cdot l^h(x)}^{\text{number loosing health}} \cdot \overbrace{(1 + HLE^h(x+1) - HLE^u(x+1))}^{\text{HLE loss due to transition}}$$

$$HLE^{\dagger}_{hd}(x) = \sum_x p^{hd}(x) \cdot \ell^h(x) \cdot HLE^h(x),$$

$$HLE^{\dagger}_{uh}(x) = \sum_x p^{uh}(x) \cdot \ell^u(x) \cdot (-1 + HLE^u(x+1) - HLE^h(x+1)),$$

$$HLE^{\dagger}_{ud}(x) = \sum_x p^{ud}(x) \cdot \ell^u(x) \cdot HLE^u(x).$$

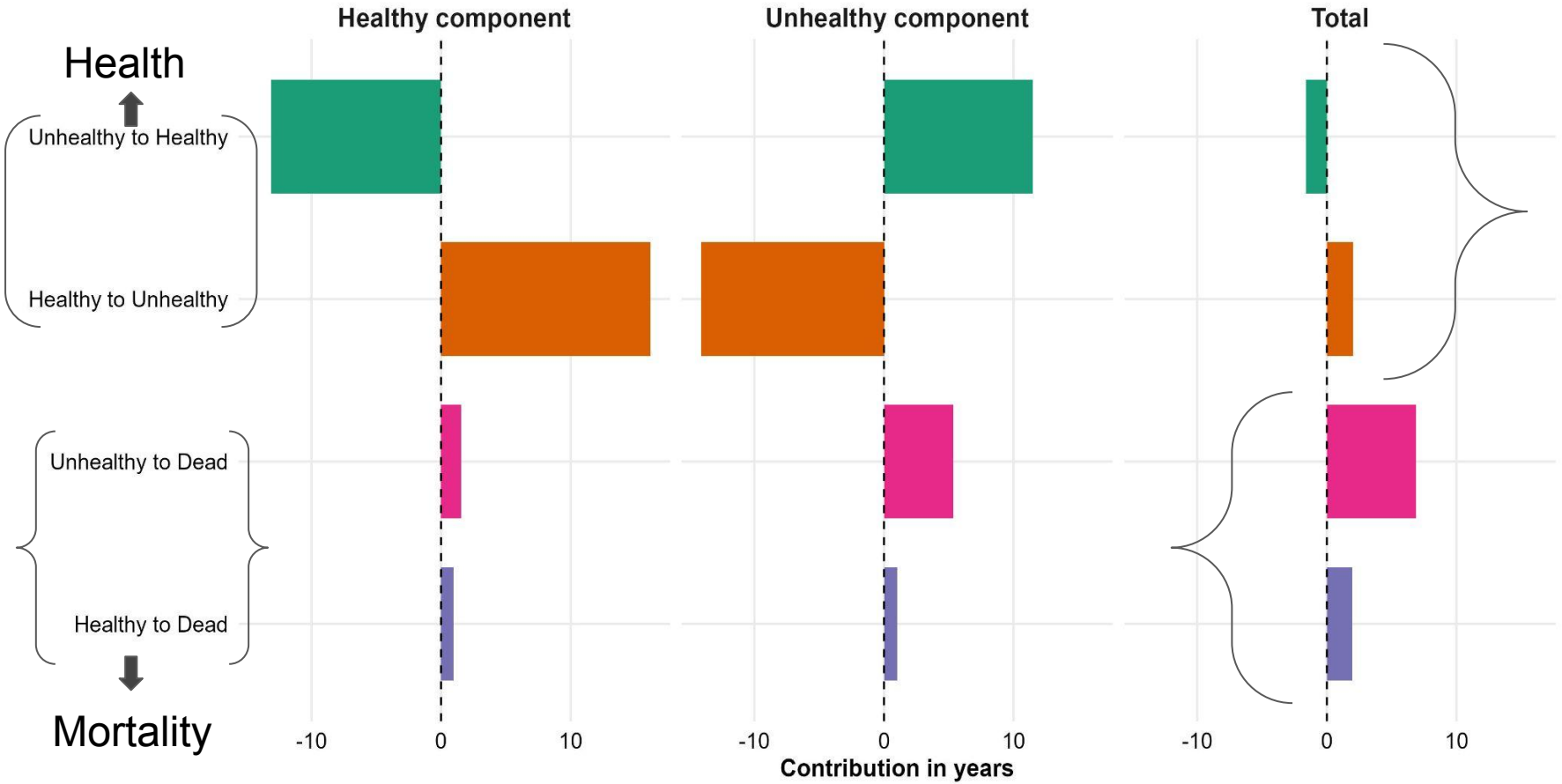
Health component

$$Health^{\dagger} = \begin{pmatrix} HLE^{\dagger}_{hu} + ULE^{\dagger}_{hu} + \\ ULE^{\dagger}_{uh} + HLE^{\dagger}_{uh} + \end{pmatrix} \begin{Bmatrix} ULE^{\dagger}_{ud} + HLE^{\dagger}_{ud} + \\ ULE^{\dagger}_{hd} + HLE^{\dagger}_{hd} \end{Bmatrix}$$

Mortality component

These quantities are additive

Components of MSLT1 (HLE1, ULE1, and Total):



How different from $e^\dagger$?

MSLT-dagger and $e^\dagger$ are not equal.

- $e^\dagger$ does not consider the path to death;
- $e^\dagger$ does not consider health gained or lost due to non-lethal transitions, which are important;
- $e^\dagger$ treats reversible and irreversible conditions equally;
- $e^\dagger$ implicitly assumes that life lost by healthy and unhealthy is the same (both states have equal mortality), this bias is small though.

MSLT† is thus is more informative than $e^\dagger$.

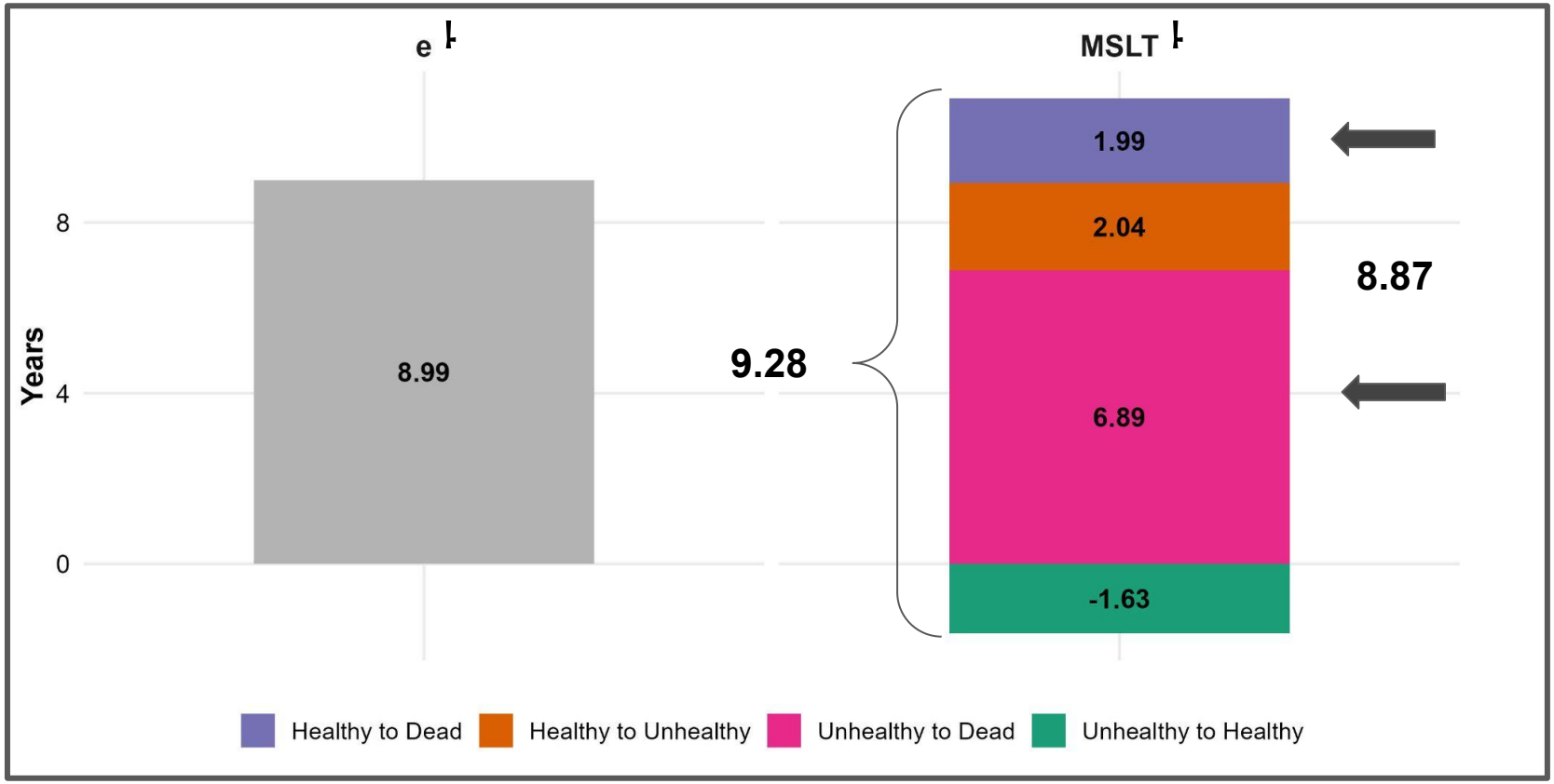
Summary:

- Transitions specific daggers can be either **+** or **-** ;
- HLE$\dagger$ + ULE$\dagger$ = MSLT$\dagger$, not equal to e$\dagger$.

Our index is:

- Demographically motivated, interpretable, and additive;
- It does not assume the independence of survival and health status;
- It distinguishes between reversible and irreversible conditions.

Thank you!


e
MSLT
Years
8
4
0
8.99
9.28
1.99
2.04
6.89
-1.63
8.87
Healthy to Dead
Healthy to Unhealthy
Unhealthy to Dead
Unhealthy to Healthy