How does a diagnosis of cancer affect life expectancy? Making use of the loss in expectation of life.

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Background

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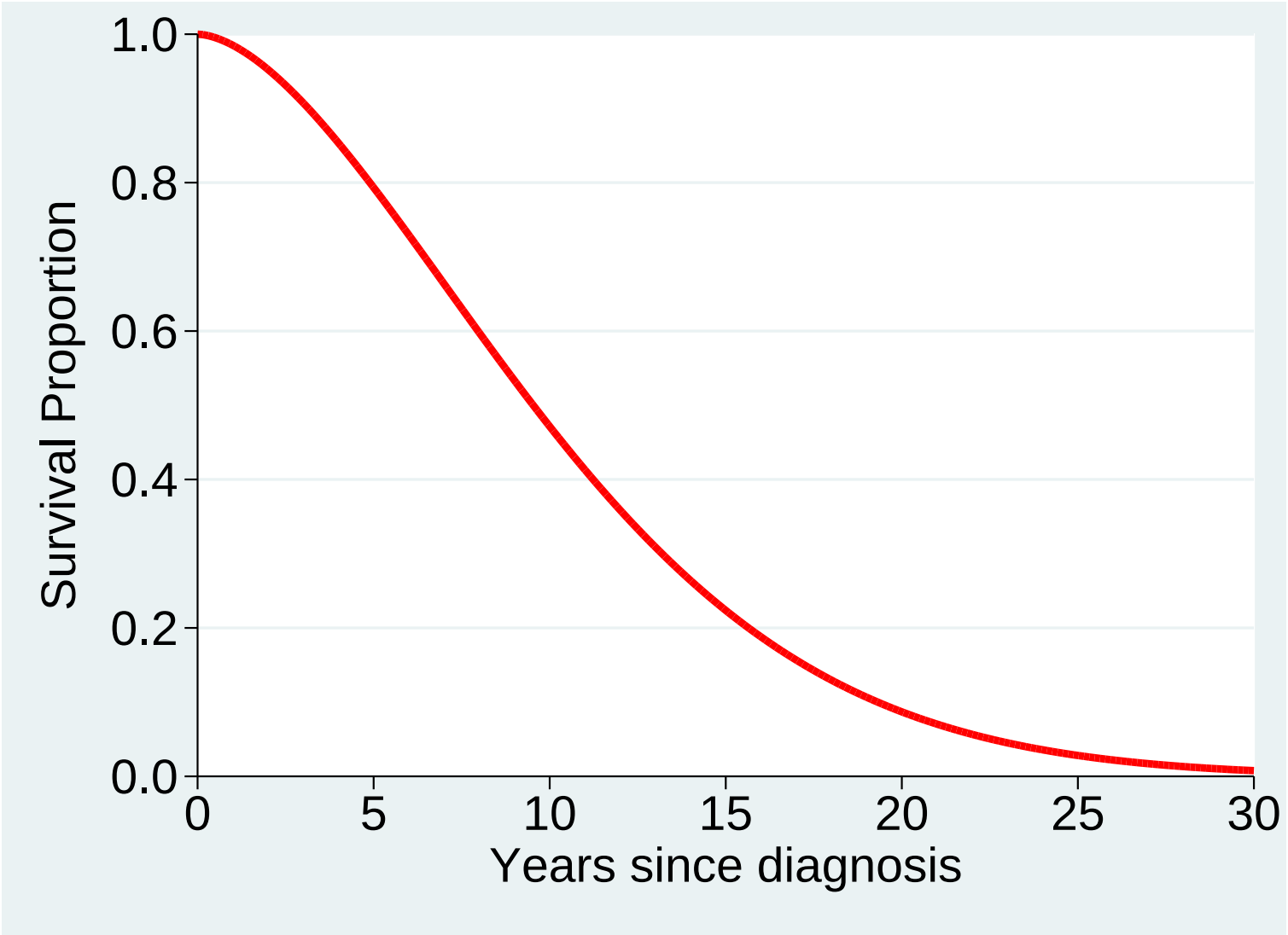
Expectation of life



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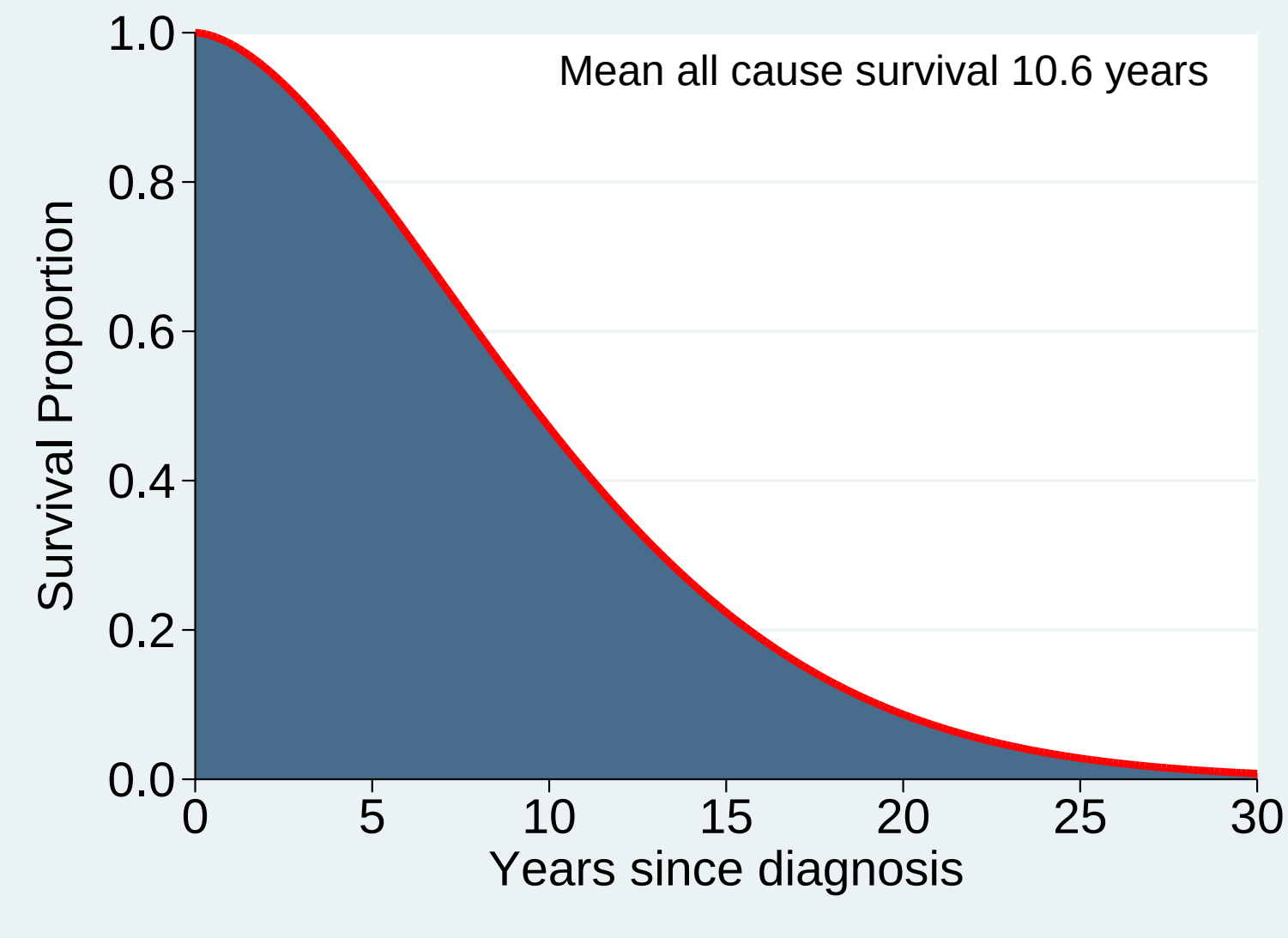
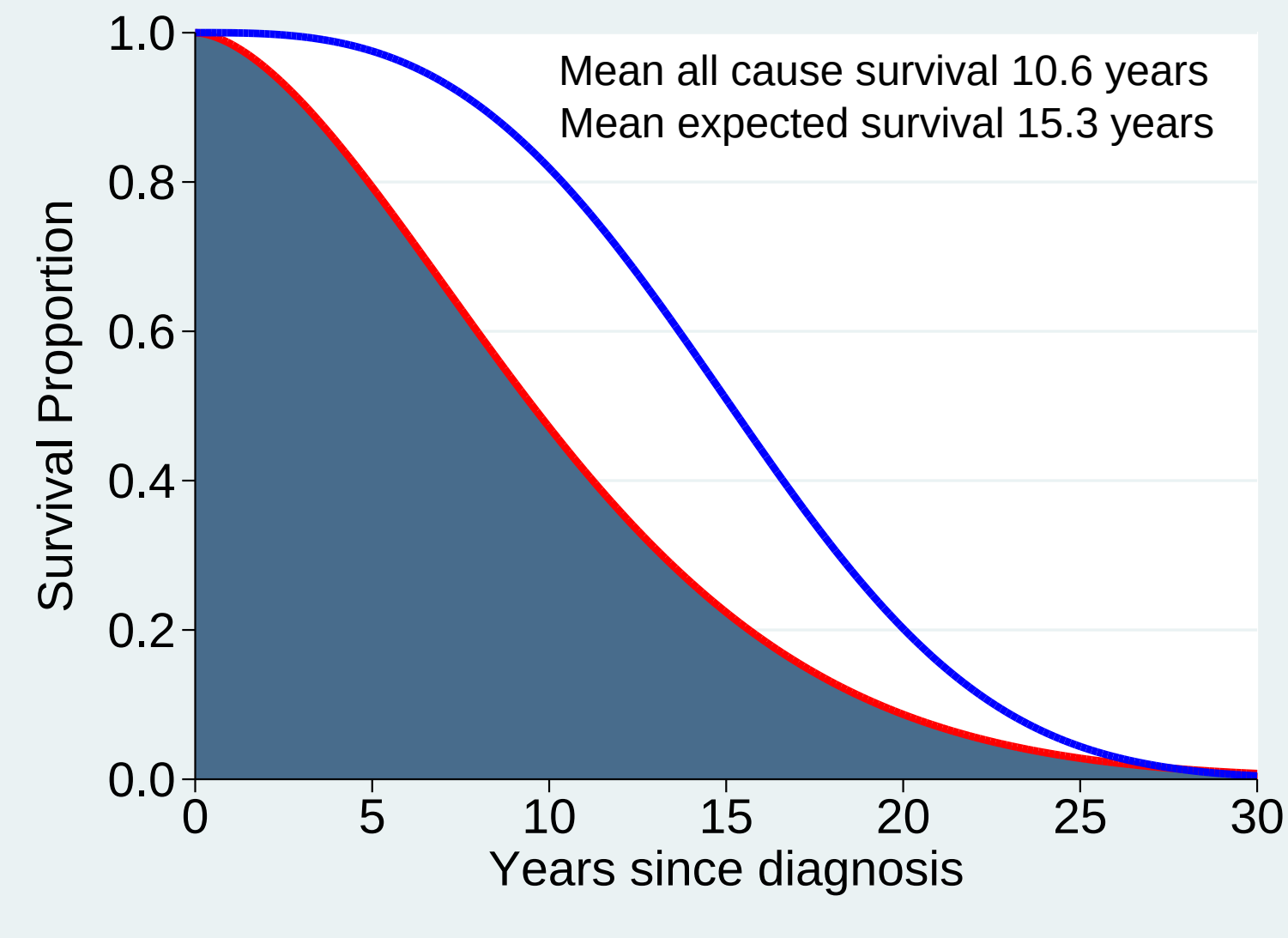


Loss in expectation of life



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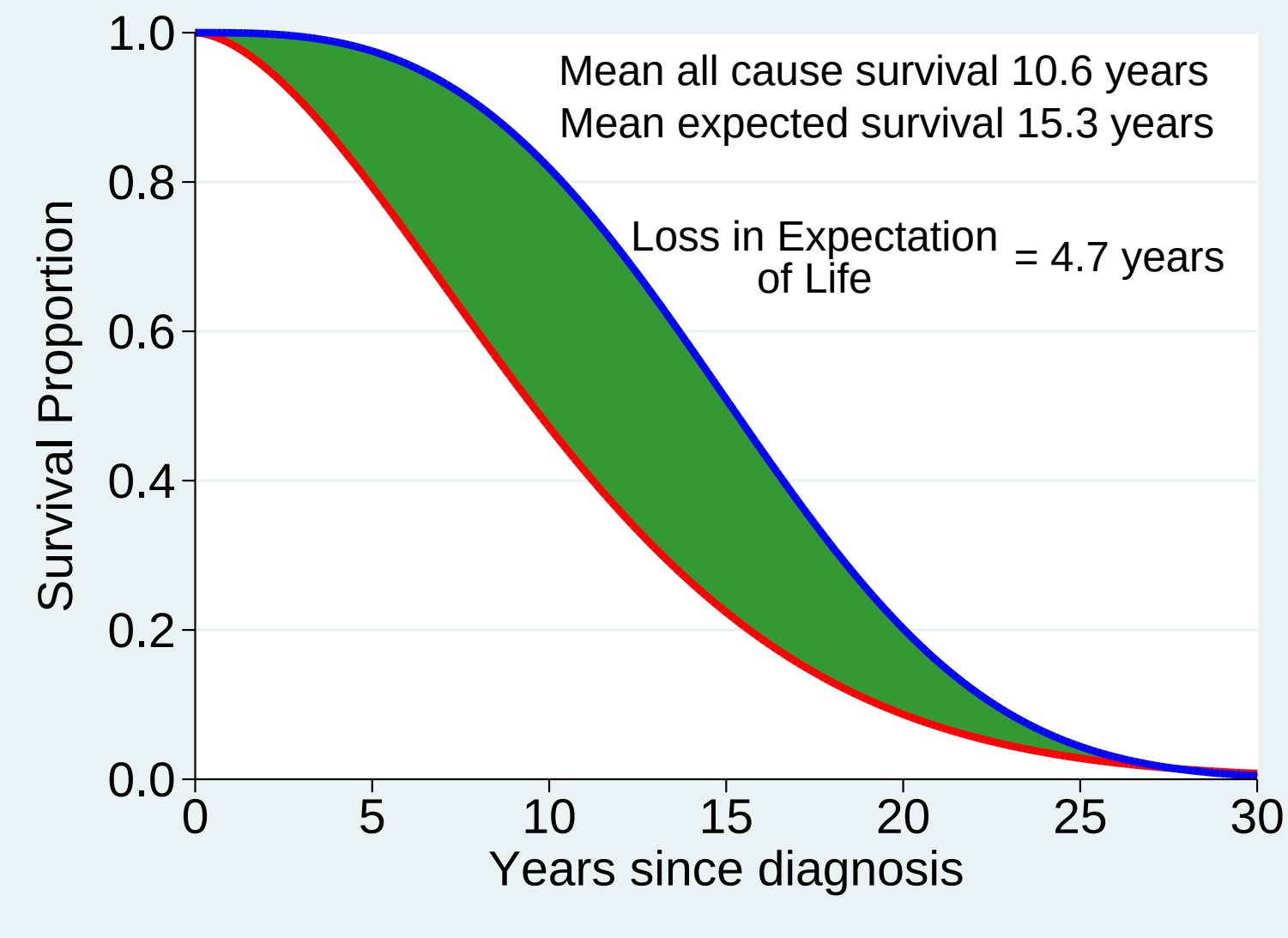

Loss in expectation of life, why?

Quantify disease burden on society

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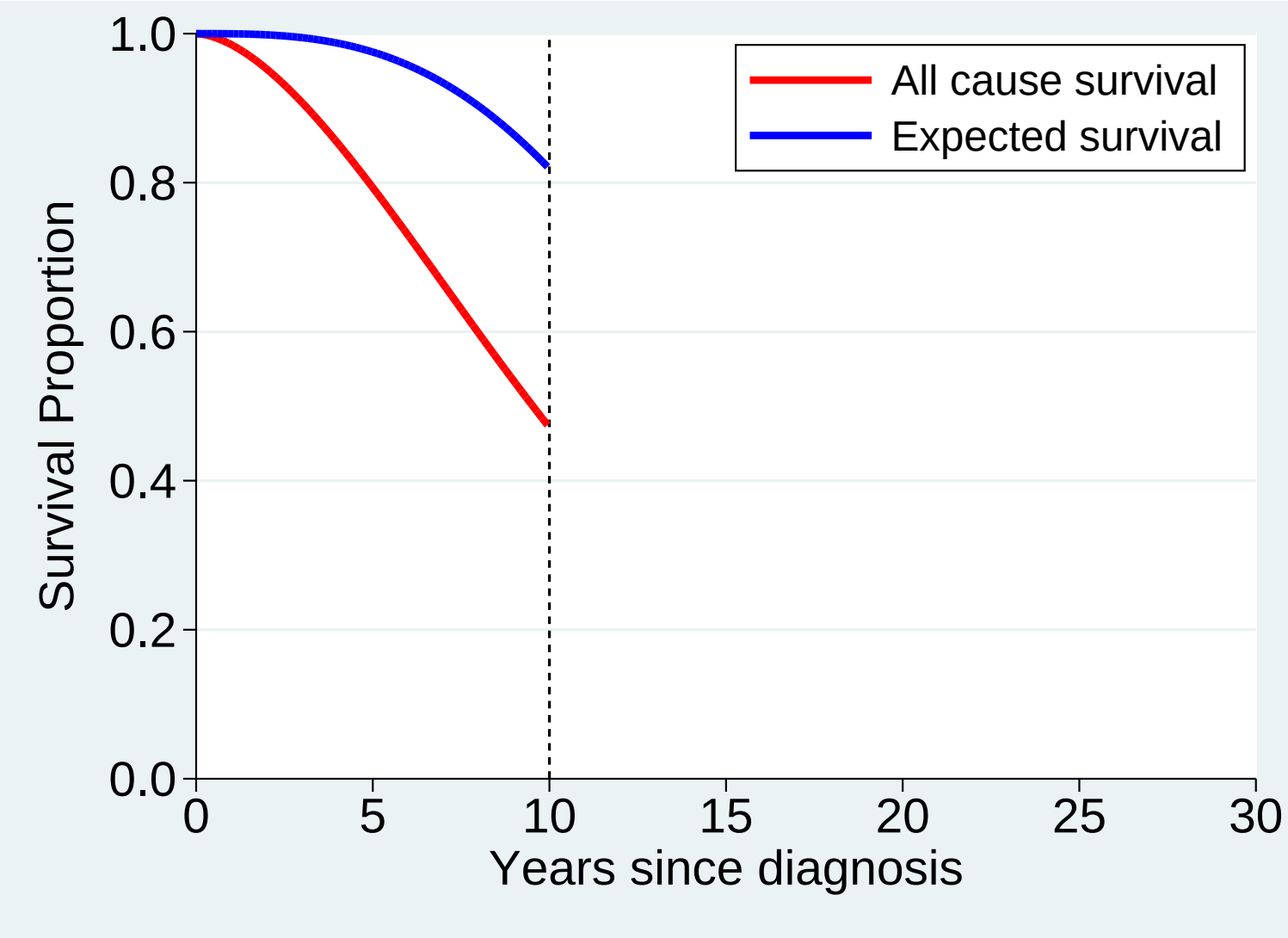
- Gives more weight to young patients because they have more years to lose.

Limited follow-up



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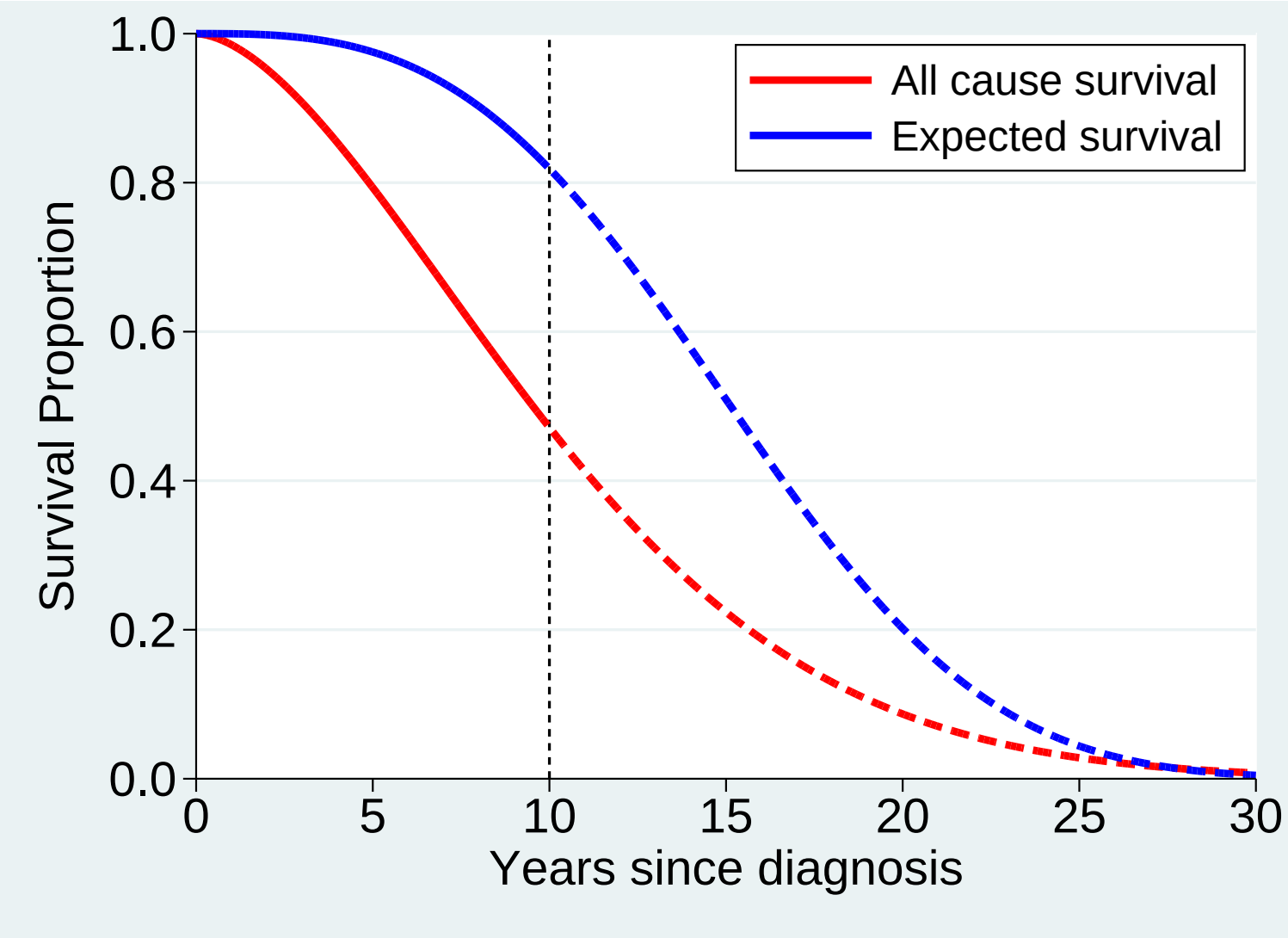

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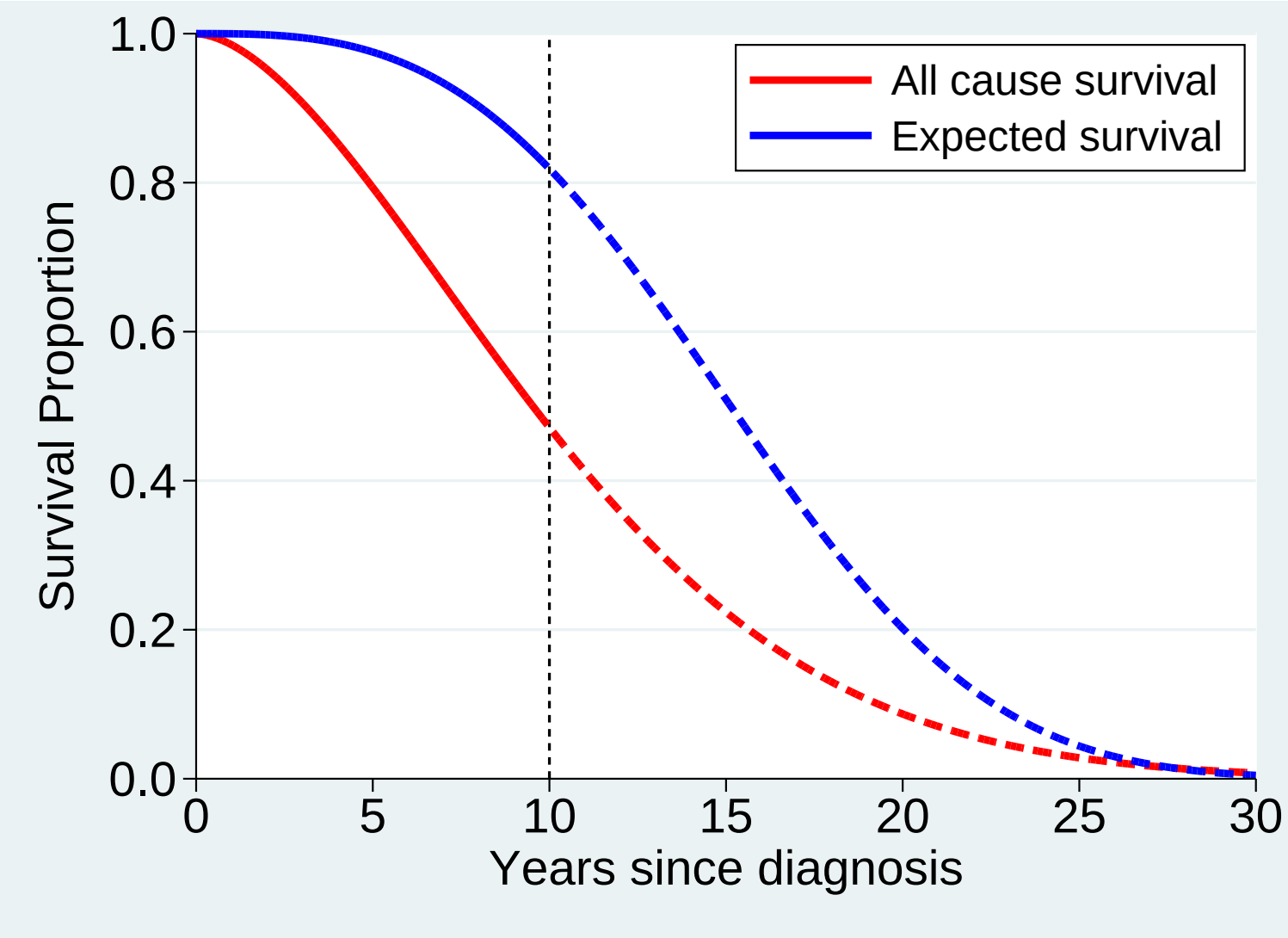

How do we extrapolate observed survival?

Estimating Loss in Expectation of Life

- Main problem is how to extrapolate to long term.
- We build on ideas of Hakama and Hakulinen[3] and use relative survival / excess mortality framework.

$$\begin{array}{c}\text{Observed}\\ \text{Mortality Rate}\end{array} = \begin{array}{c}\text{Expected}\\ \text{Mortality Rate}\end{array} + \begin{array}{c}\textit{Excess}\\ \textit{Mortality Rate}\end{array}$$

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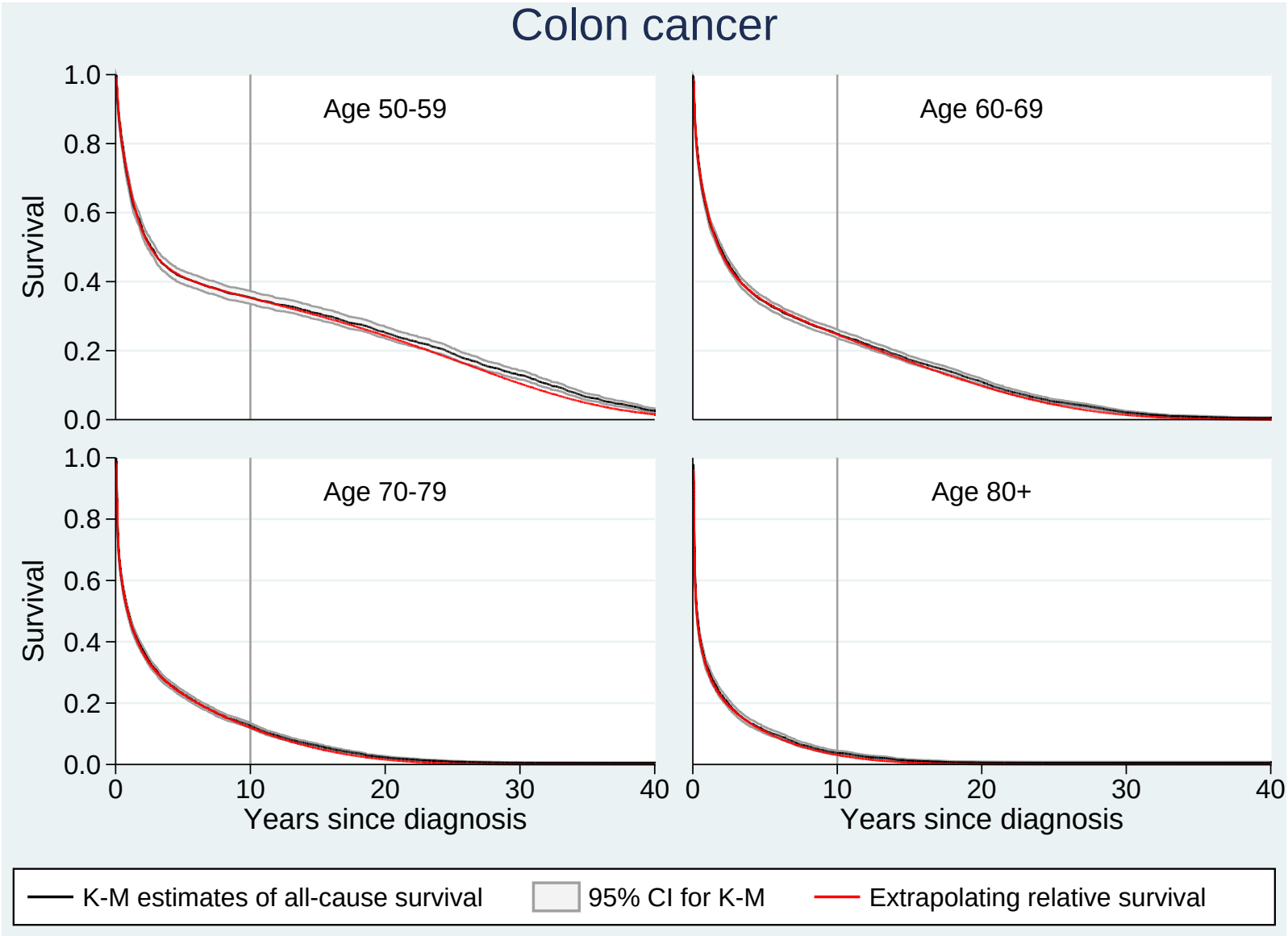
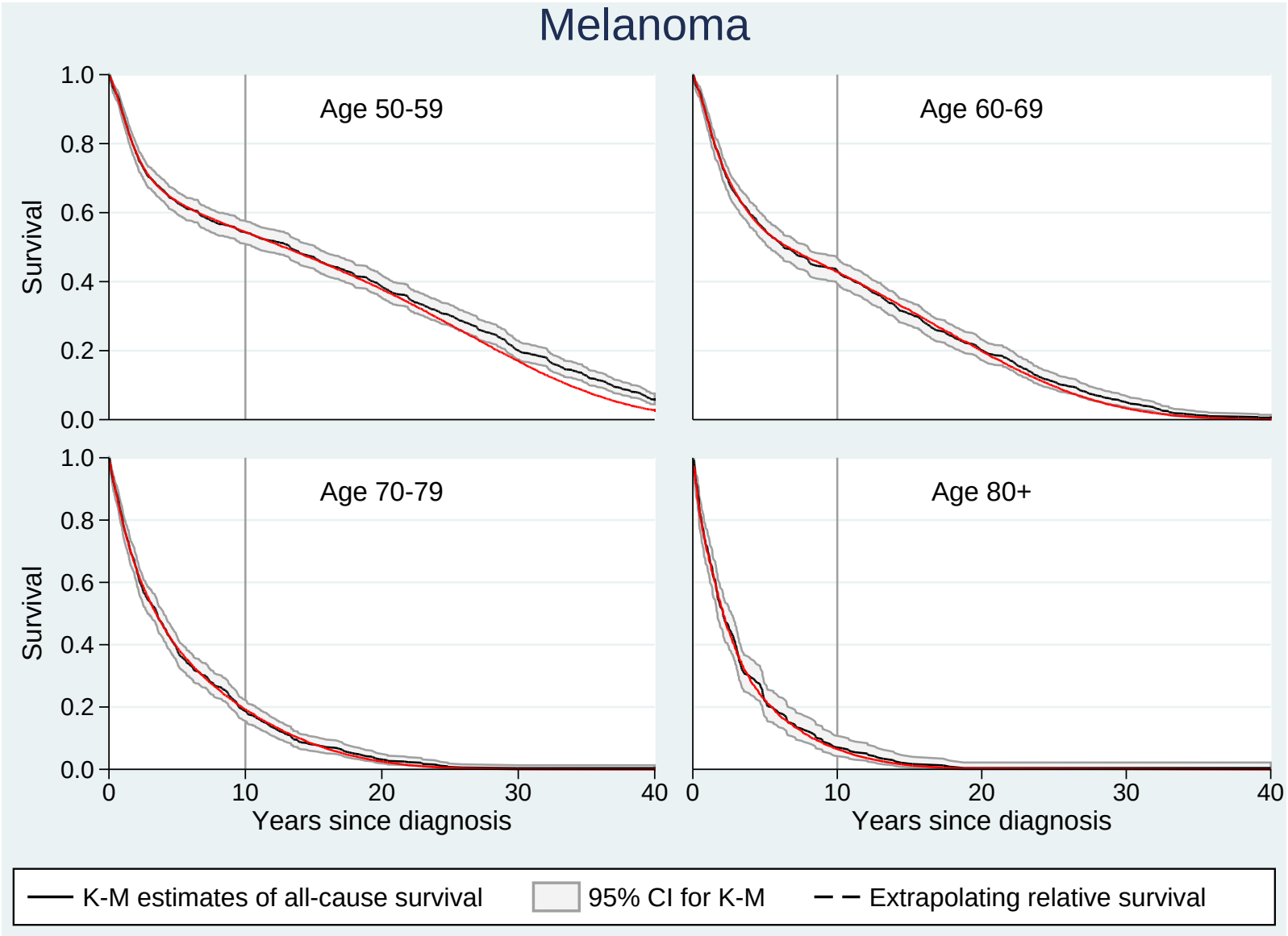
- As time since diagnosis increases the expected mortality rate dominates.
- Simple assumptions about excess mortality (relative survival) can be made when extrapolating.

1. Cure: no excess mortality after a certain point in time[4]
2. Constant excess mortality after a certain point in time
3. Excess mortality estimated from the model

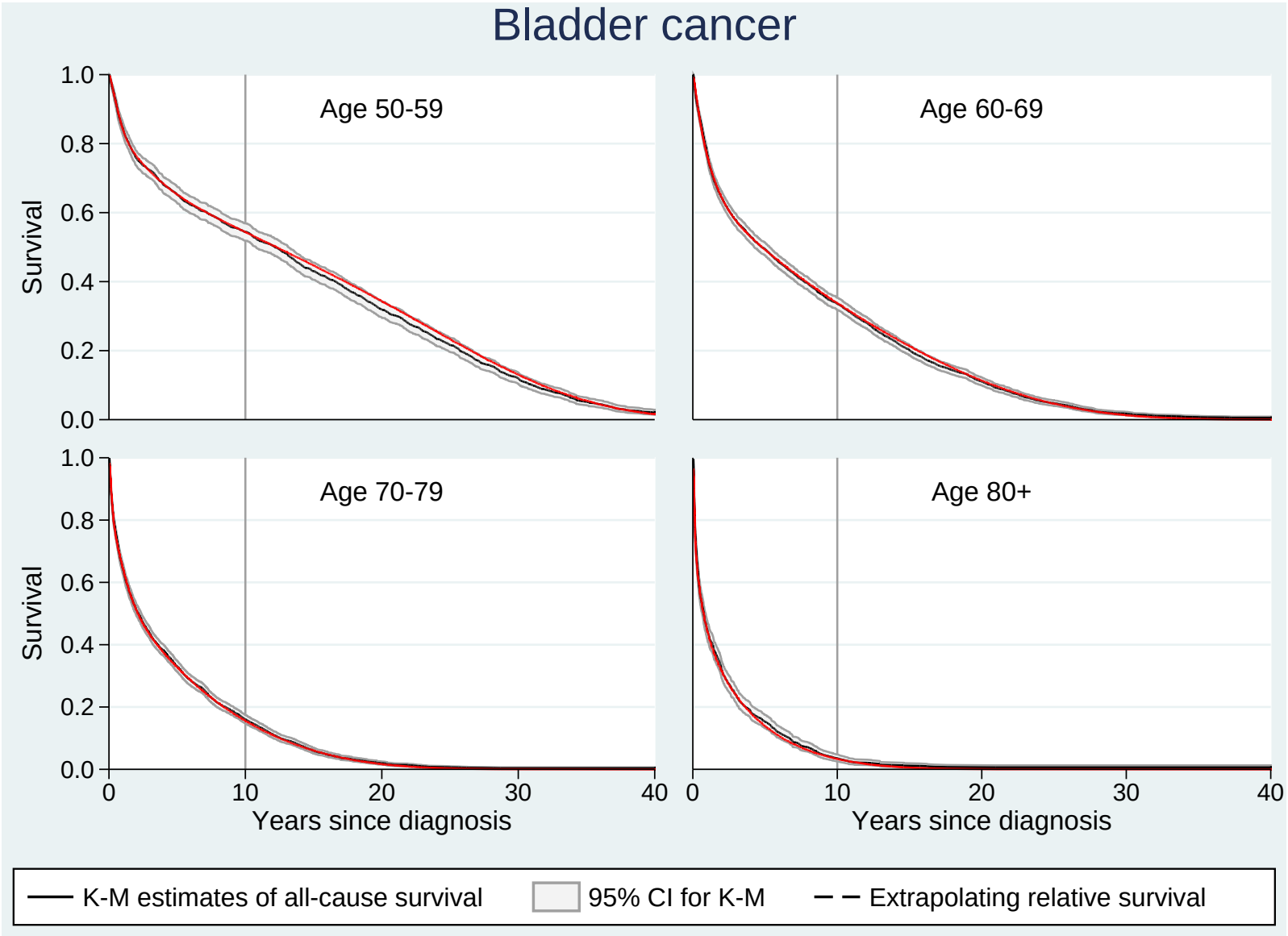
Evaluation of Extrapolation: Colon (Sweden)



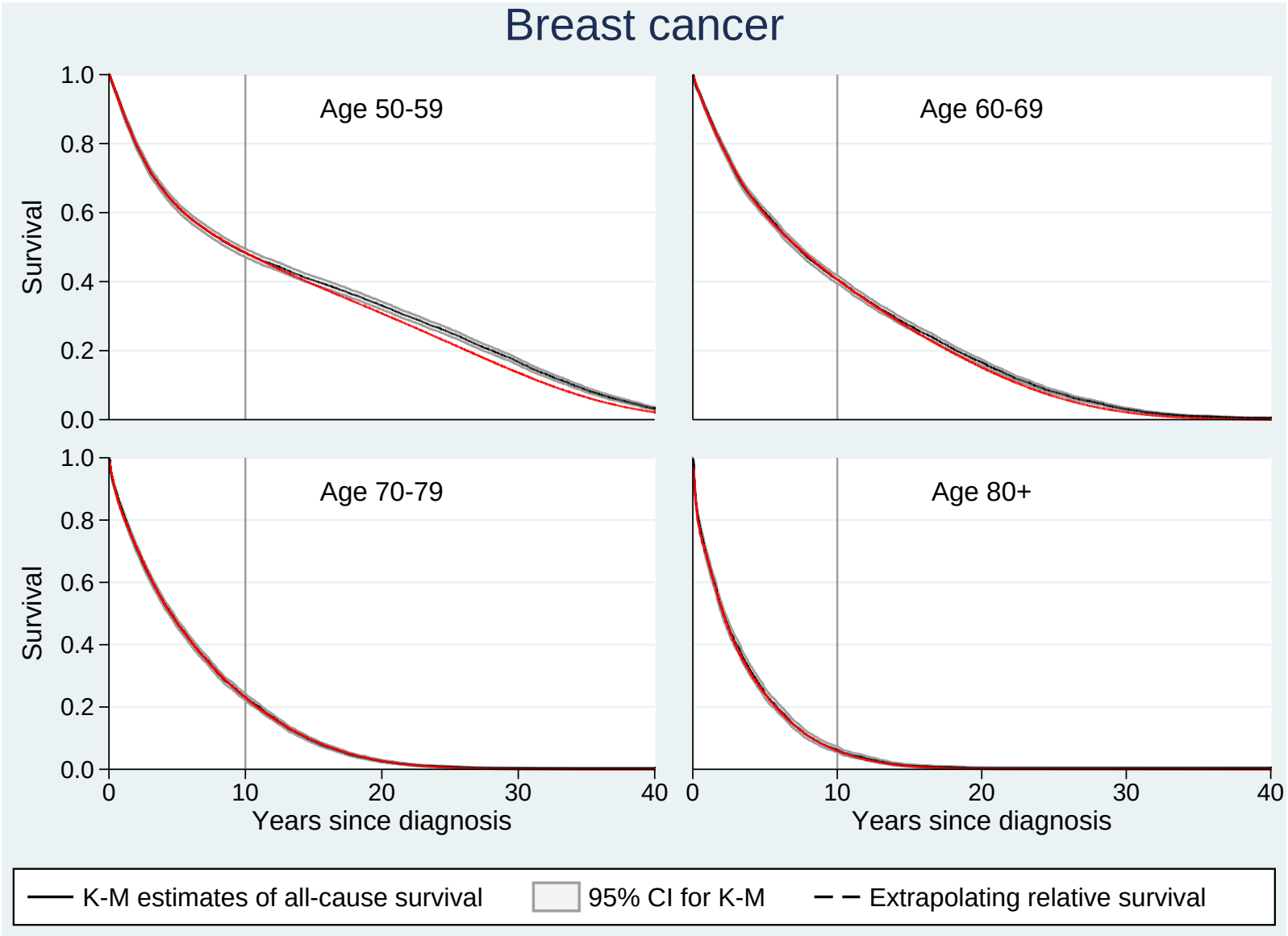
Evaluation of Extrapolation: Melanoma (Sweden)



Bladder Cancer (Sweden)



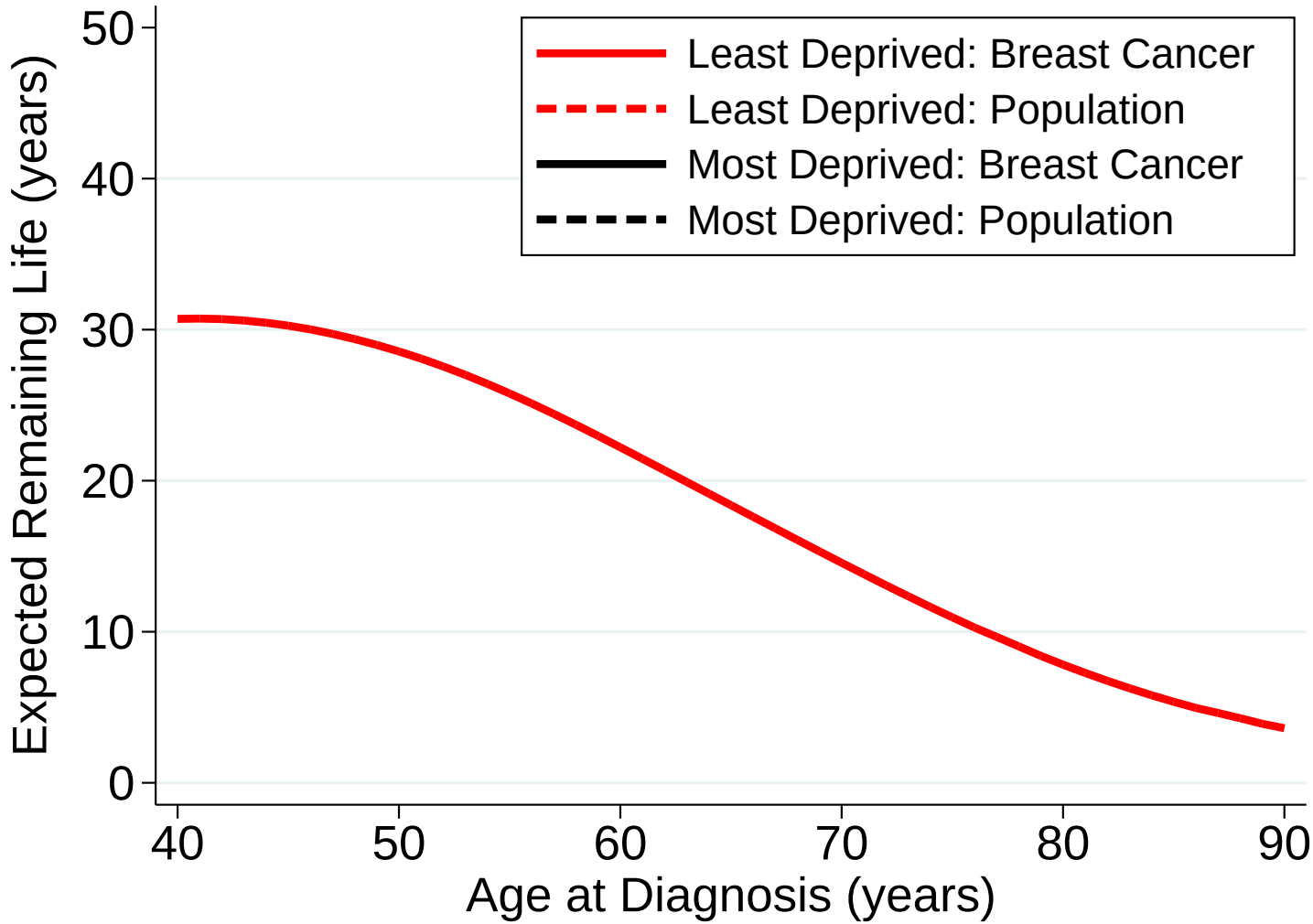
Breast Cancer (Sweden)



Deprivation Differences in England and Wales

- Woman diagnosed with breast cancer in England and Wales 1999-2009.
- Follow-up to end of 2010
- Five quintiles of deprivation (income domain of IMD).
- Expectation of life estimated from flexible parametric excess mortality model incorporating age and deprivation quintile.
- Period Analysis used with 3 year window.
- For illustration I compare the most and least deprived groups.

Breast Cancer: Expected Remaining Life



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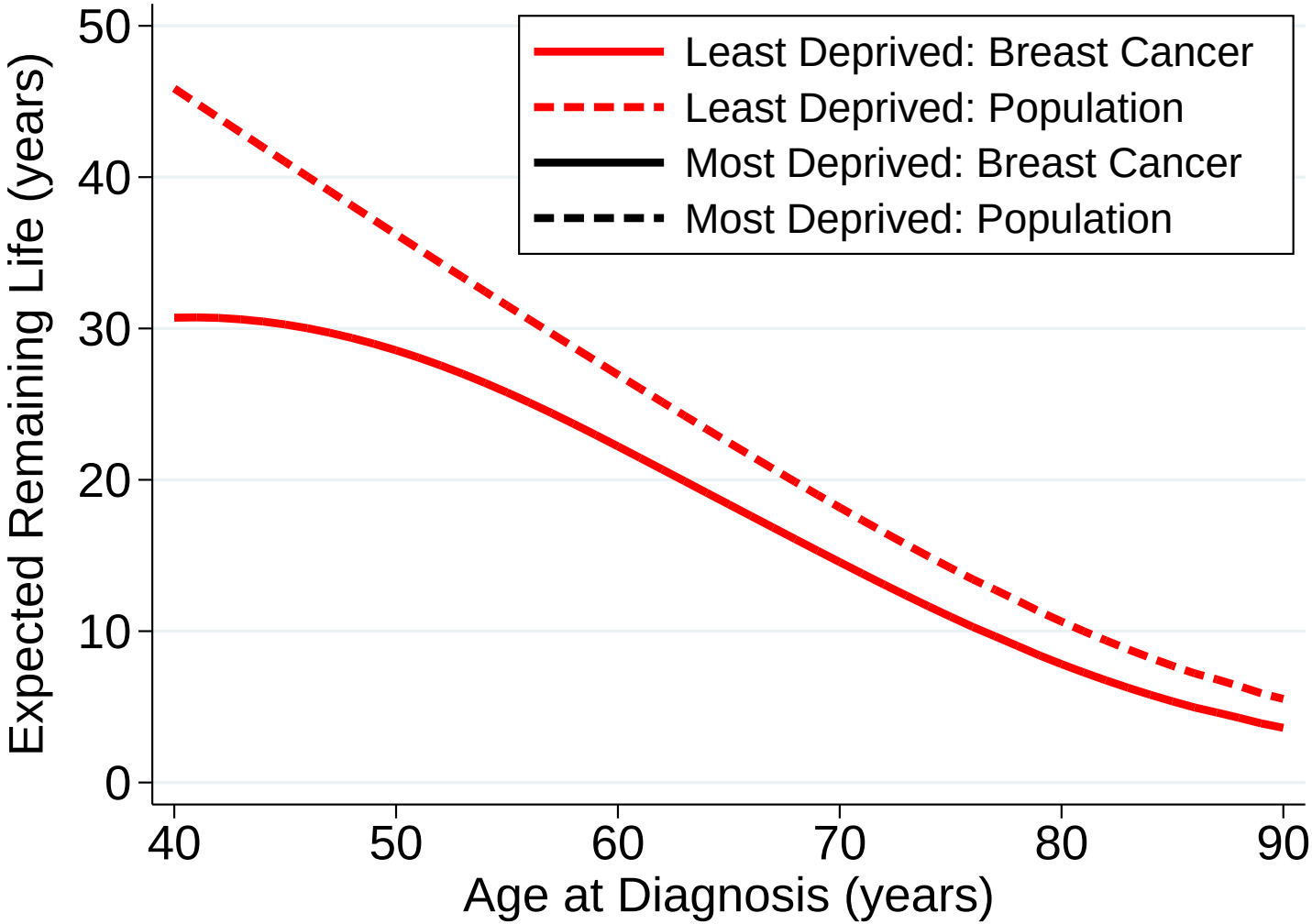

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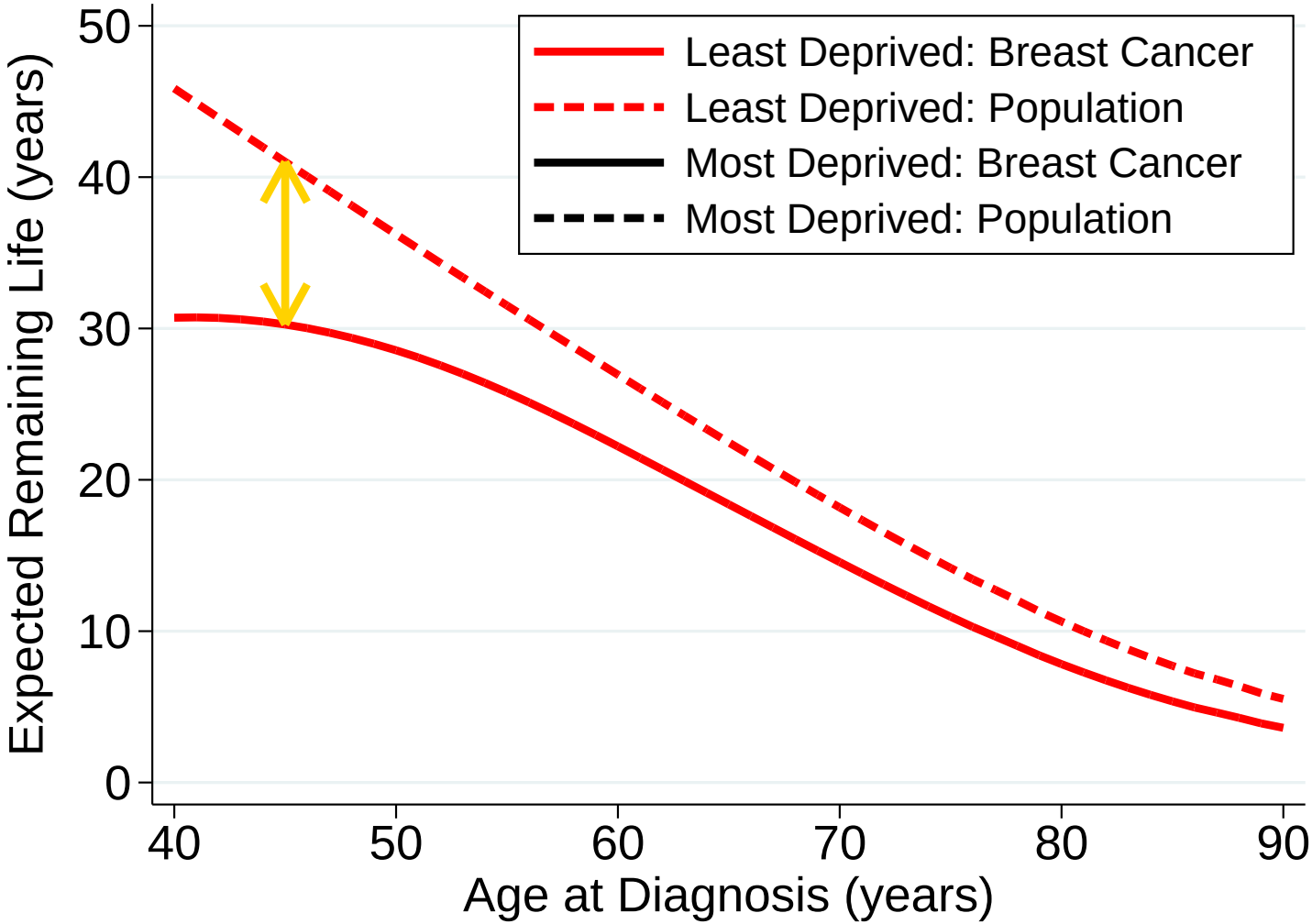

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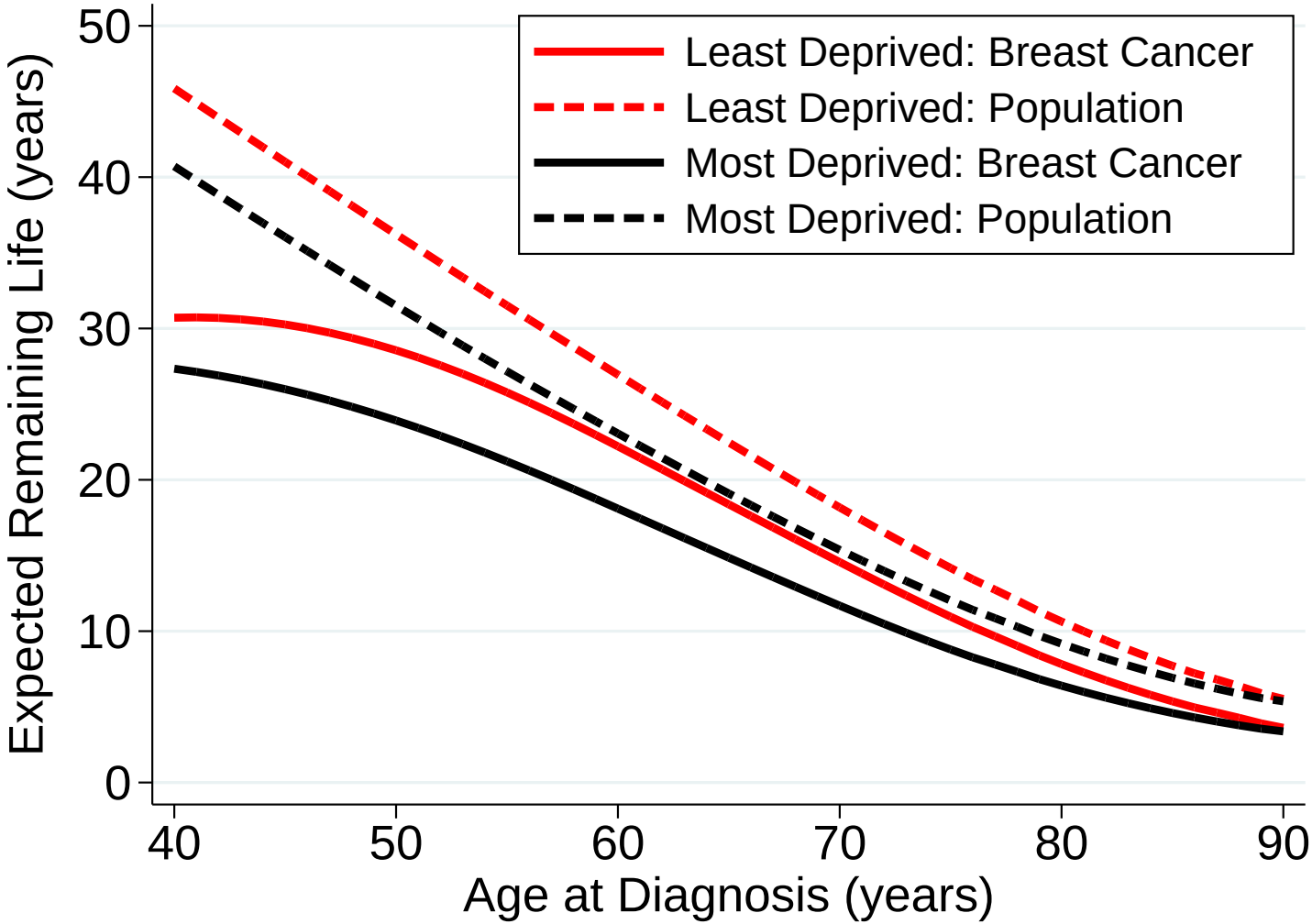

Expected Remaining Life

Age 60	Expected Remaining Life		Loss in	% of
	Breast Cancer	Population	Exp. of Life	Life Lost
Least Deprived				
Most Deprived				
Difference				

Expected Remaining Life

Age 60	Expected Remaining Life		Loss in	% of
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Least Deprived	22.2			
Most Deprived	18.1			
Difference	4.1			

Expected Remaining Life

Age 60	Expected Remaining Life		Loss in	% of
	Breast Cancer	Population	Exp. of Life	Life Lost
Least Deprived	22.2	26.9		
Most Deprived	18.1	23.0		
Difference	4.1	3.9		

Expected Remaining Life

Age 60	Expected Remaining Life		Loss in	% of
	Breast Cancer	Population	Exp. of Life	Life Lost
Least Deprived	22.2	26.9	4.7	
Most Deprived	18.1	23.0	5.0	
Difference	4.1	3.9	-0.3	

Expected Remaining Life

Age 60	Expected Remaining Life		Loss in	% of
	Breast Cancer	Population	Exp. of Life	Life Lost
Least Deprived	22.2	26.9	4.7	17.6%
Most Deprived	18.1	23.0	5.0	21.5%
Difference	4.1	3.9	-0.3	-4.0%

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Over All Ages

Estimated total life years lost in England Wales associated with a diagnosis of breast cancer 2009 is 241,363.

Impact of inequality on breast cancer survival

Age 60	Expected Remaining Life	Eliminating Inequality	
		All	Cancer
Least Deprived			
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Age 60	Expected Remaining Life	Eliminating Inequality	
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Most Deprived	18.1	22.2	
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- Difference of 4.1 years between deprivation groups.
- 0.9 years (22%) due to inequality in breast cancer survival.
- 3.2 years (78%) due to inequality in other cause survival.

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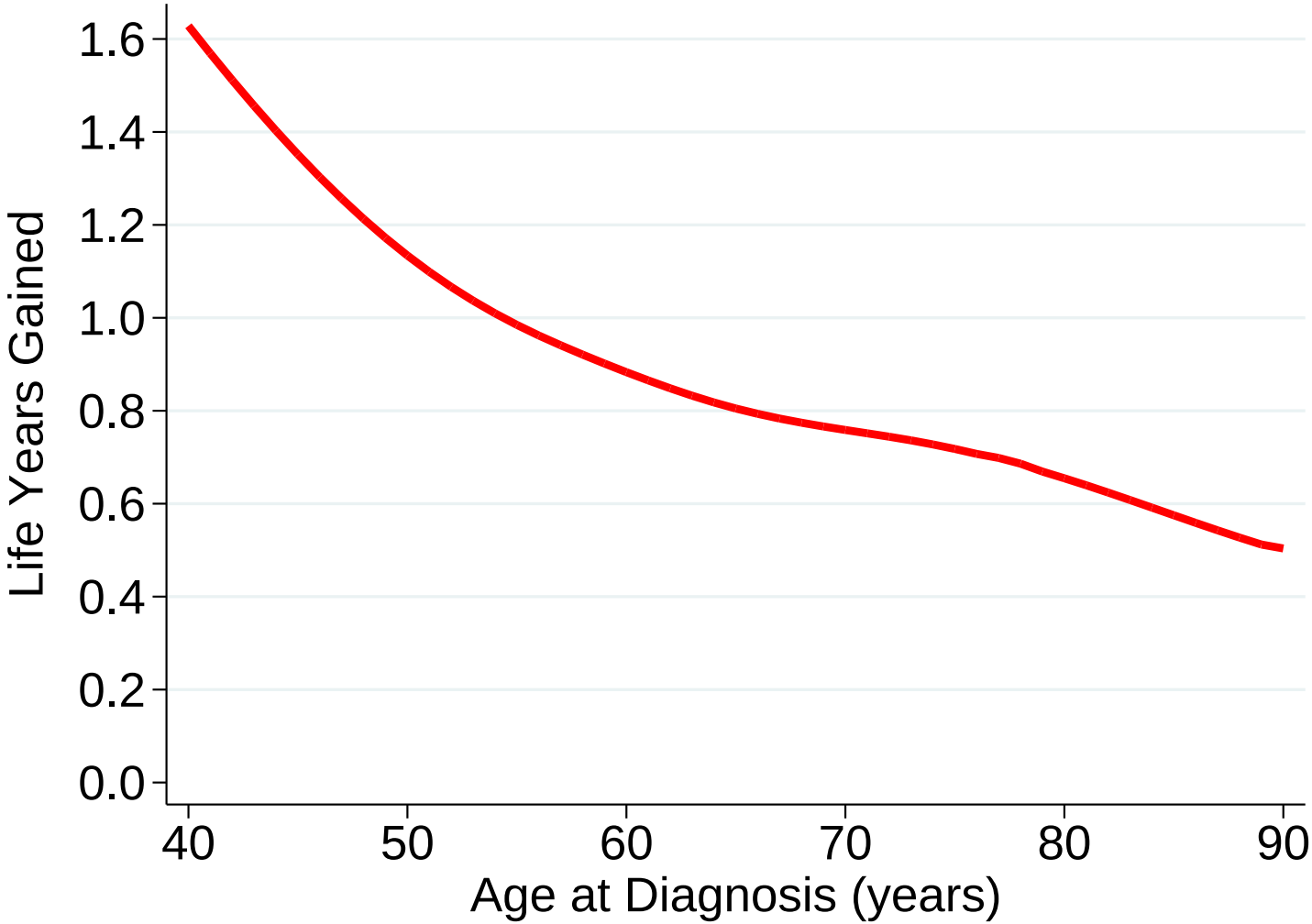
Over All Ages and Deprivation Groups

Estimated total life years lost in England and Wales for those diagnosed in 2009 due to breast cancer survival inequality is 12,484.

Potential gain in expected remaining life



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- Need to move from hypothetical to real world.
- Loss in expectation of life is an intuitive measure.
- Extrapolation methods works well[5].
- Estimated from model that gives excess mortality/relative survival.
- Measure is different to potential years of life lost (PYLL).
- Stata software available[6]

References

[1] Lambert PC, Dickman PW, Nelson CP, Royston P. Estimating the crude probability of death due to cancer and other causes using relative survival models. *Statistics in Medicine* 2010;**29**:885 – 895.

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[6] Lambert PC, Royston P. Further development of flexible parametric models for survival analysis. *The Stata Journal* 2009;**9**:265–290.