Comparison of real versus simulated distributions or "Too good to be true?"

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Background

Life table approaches widely used to estimate *average* time spent in various health states

New applications:

- Reynolds, et al. 2005: ALE for obese (8.4 yrs) vs other men (9.8 yrs)
- They can be used to produce estimates of *distributions:*
  - Laditka & Wolf, 1998: % of men (54%) and women (42%) will have no spells of severe impairment from 70 to death (via microsimulation)

Distribution Statistics, Examples

- Expected nursing home use at 65 (Kemper & Murtaugh, 1991)
  - None 57%
  - <=3 months 11
  - 3 months to 1 year 8
  - 1-5 years 15
  - >=5 years 9

Question?

Estimates from life table approaches combined with micro simulation could be powerful and policy relevant, but are they accurate?

They are based on models and assumptions

May not capture all relevant variables

Our aim:

- Compare estimates of distribution of persons 65+ by years in bad health over 10 years from life table & micro simulation to statistics from actual sample using same data set

Laditka and Wolf, 1998, "New methods for analyzing active life expectancy"

"We know of no existing data source that would permit an evaluation of the plausibility or accuracy of the lifetime functional status trajectories produced in our microsimulation."

Data and Methods

Cardiovascular Health Study (NIH)

- 5201 persons >=65 from 4 communities in US
- Sampled from Medicare enrollment files
- Non-institutionalized, w/o cancer
- Began in 1989-90
- Follow up with annual examinations and telephone interviews
- Subjects rate health (excellent to poor)
- Asked about difficulty in 6 ADLs (eating, dressing, bathing, toileting, walking in home, getting out of bed or chair)

Methods

Fit multi-state life table (MSLT) model to data from 2, 3 or 5 successive annual interviews

Fit semi markow process-expectation maximization model (SMP-EM) (Cai et al. 2006, JRoyalStatSoc) to data from 5 successive annual intervals

SMP-EM incorporates *duration in current state*

Model transitions among:

- 1. No ADL limitations
- 2. >=1 ADL limitation
- 3. Death

Methods, cont.

Model transitions among:

- 1. No or only one ADL limitation
- 2. >= 2 ADL limitations
- 3. Death

And among:

- 1. Excellent/very good/good self reported health
- 2. Fair/poor health
- 3. Death

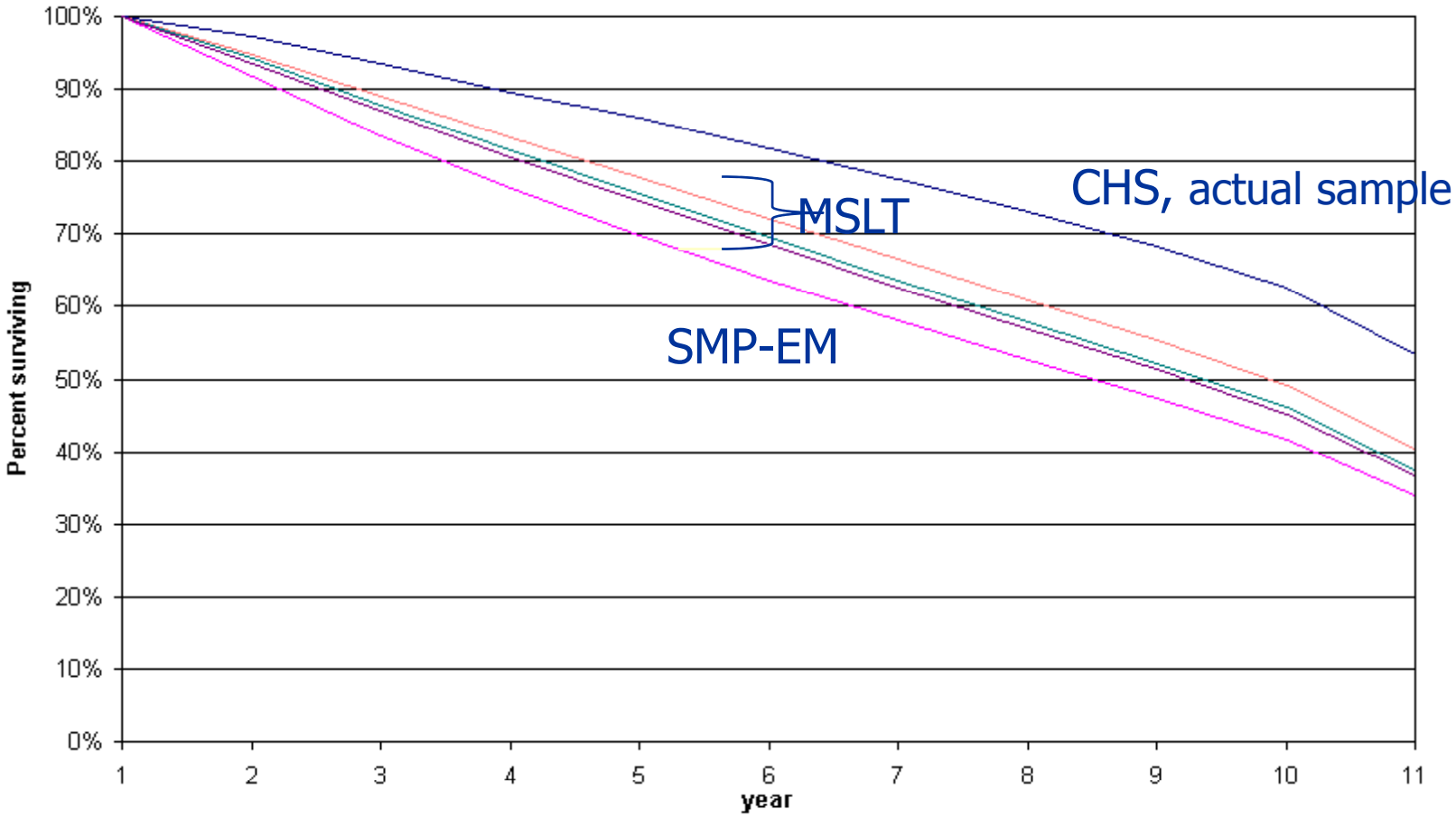
Micro simulation

- Use transitions from models to simulate health trajectories for the 5201 persons in CHS from baseline to death or for 10 years
- Repeat 10 times and average results to create simulated populations
- Develop distributional statistics based on simulated populations
- Compare to actual distribution of sample followed from baseline to death or for 10 years

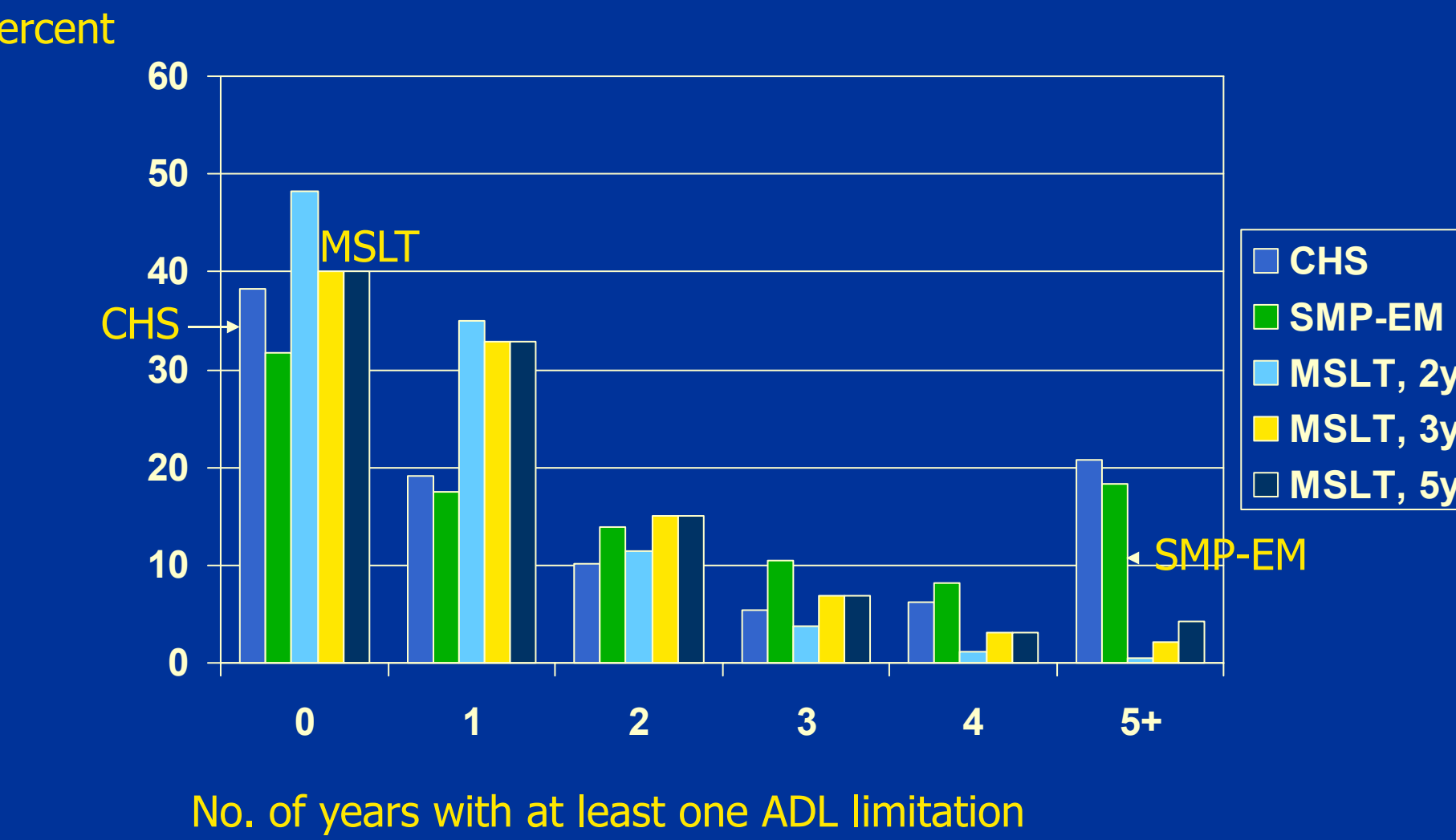
Cardiovascular Health Study Sample

Measure	Study Start	10 yrs later
Number	5528	3342
65-74	66%	0
75-84	30	78
85 +	4	22
ADL limitations		
None	42%	36
At least one	58	64
Self-rated health		
Excellent/VG	38%	25
Good	37	42
Fair/Poor	25	33

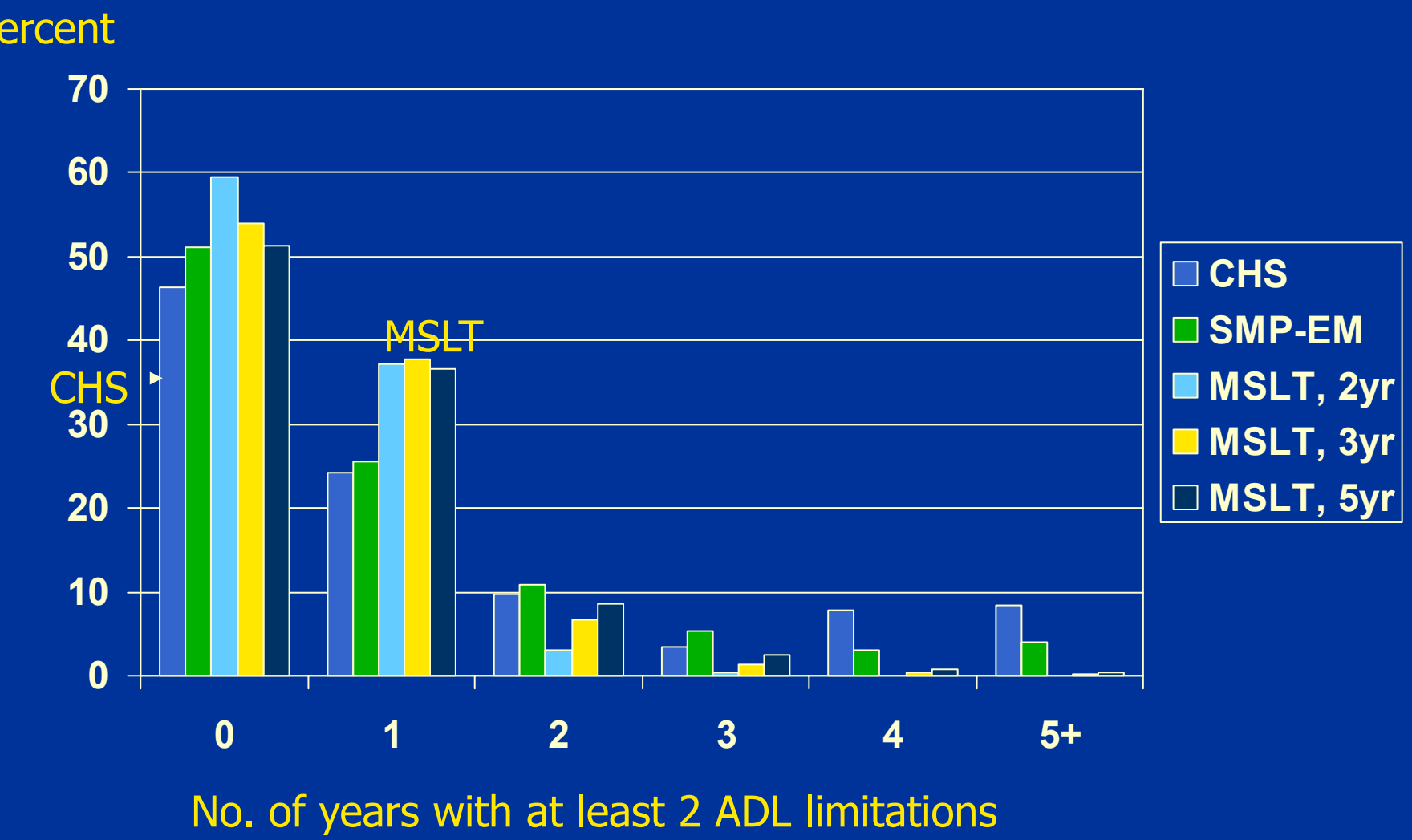
Figure 1. Percent of CHS subjects surviving 10 years according to estimation method



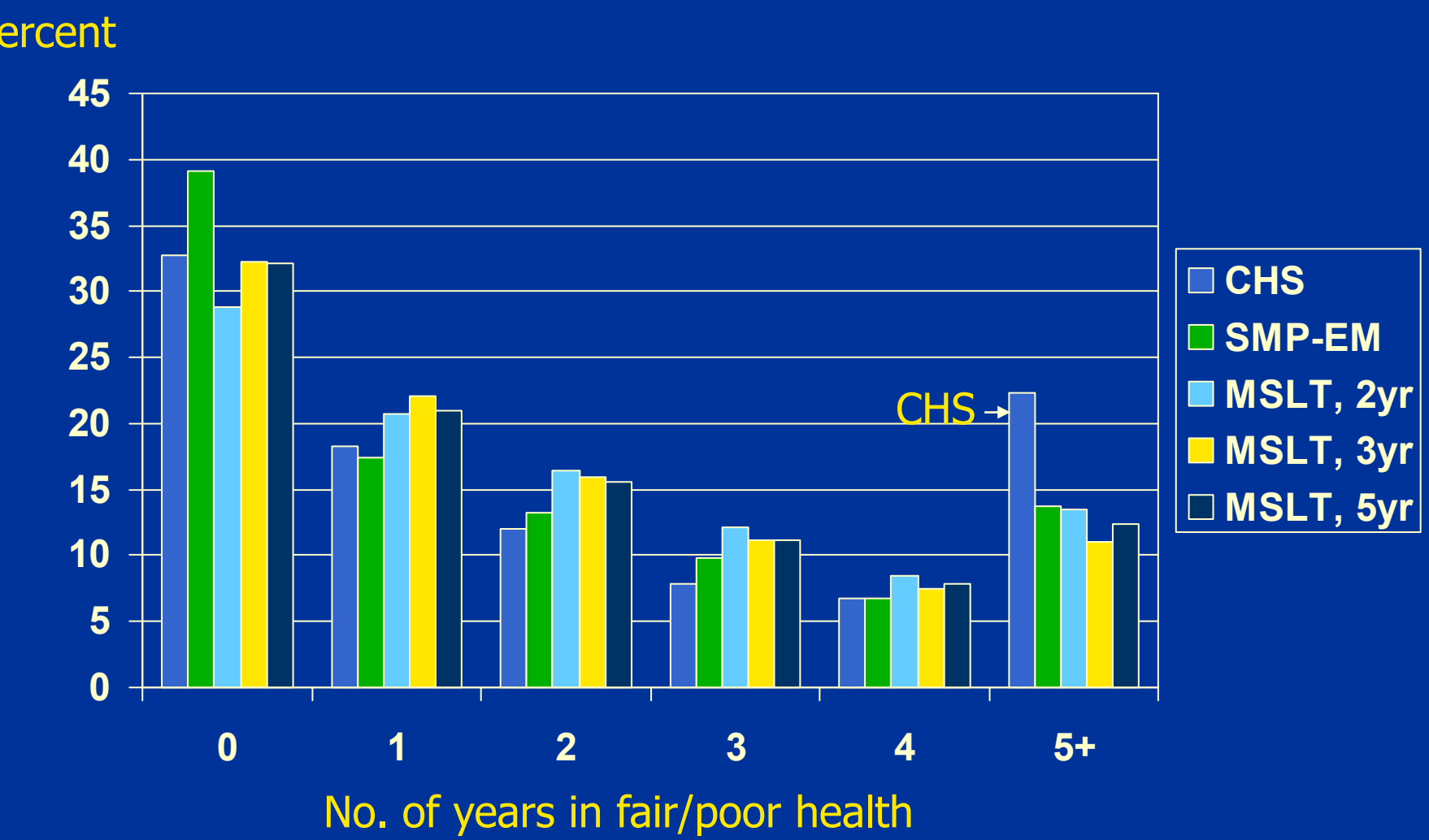
Percent dist. of Medicare beneficiaries in CHS study by years with 1+ ADL limitations over 10 years by estimation method



Percent dist. of Medicare beneficiaries in CHS study by years with 2+ ADL limitations over 10 years by estimation method



Percent dist. of Medicare beneficiaries in CHS sample by years reporting fair/poor health by estimation method



Average absolute difference of estimates from CHS sample versus SMP-EM or MSLT of percent of the sample with 0,1, 2,3,4, & 5+ yrs with ADL limit. or fair /poor health

Measure	SMP-EM	MSLT, 2 data points	MSLT, 3 data points	MSLT, 5 data points
Yrs with 1 or more ADL limit.	3.6	9.0	7.3	6.9
Yrs in fair/poor health	3.2	4.3	3.9	3.5

Characteristics of persons with 5 or more years with an ADL limitation in 10 year period

Characteristic	CMS (actual sample)	SMP-EM	3 MSLT models
% age 65-74	65%	66	41-46
% female	72%	72	85-91

Conclusions

Results from micro simulations give same broad results as actual data—

- More persons in no ADL limitation group than any other

But:

- MSLT models over estimate the % with no ADL limitations over 10 years and fail to reproduce the skewness on the right of the distribution
- MSLT & SMP-EM both fail to reproduce right skewness of yrs in fair/poor health
- Both models produce some bad estimates of characteristics of persons with 0 or 5+ years with an ADL limitation
- Although SMP-EM performs better, it requires 5 yrs of data

Recommendations

Need theoretic work on under what circumstances micro simulation will match reality

Could lead to criteria and tests for “good” micro simulations