A MULTIDIMENSIONAL TEST OF DYNAMIC EQUILIBRIUM THEORY

DISABILITY AND MORBIDITY AMONG US BIRTH COHORTS, 1998-2018

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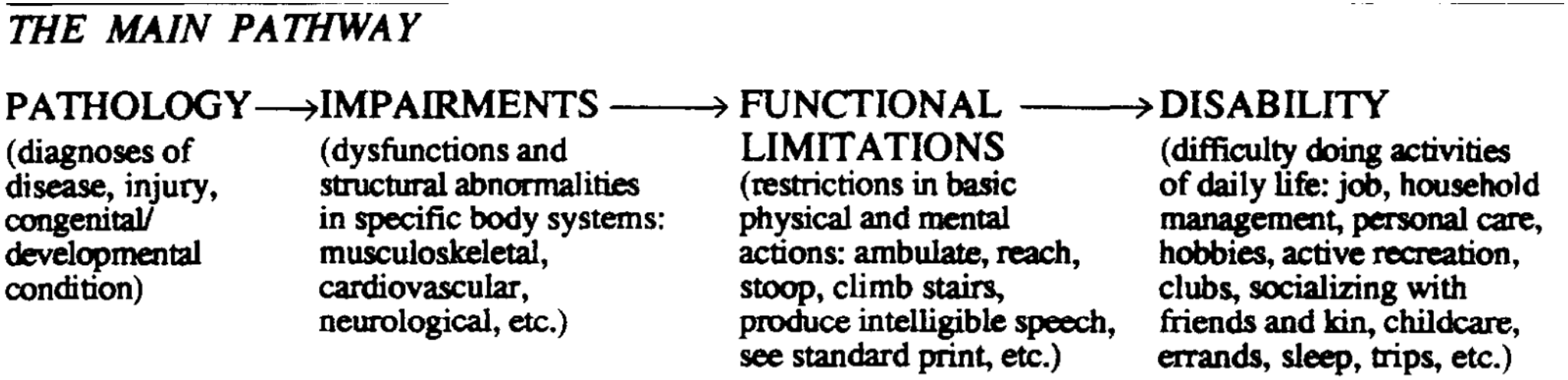
BACKGROUND

- Most studies explored health from multiple dimensions independently
- A few studies focused on specific disease, such as diabetes and cancer, and disability
- Huang et al. (2021) evaluated physical impairment and cognitive-impairment and compute the health expectancy in China
- Rahman et al. (2022) combined morbidity and disability and compute the health expectancy for Australian female
- Their focus is not on the interaction between the health dimensions

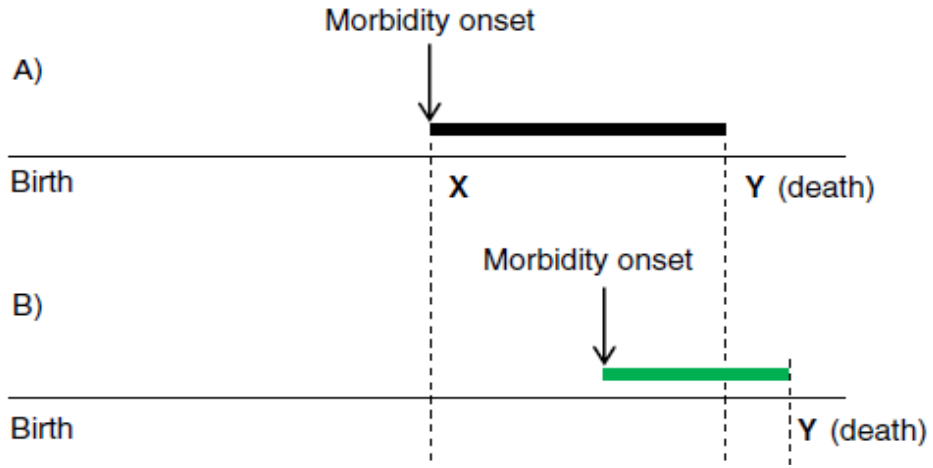
THEORETICAL FRAMEWORK

- ***The Disablement Process*** (Verbrugge & Jette, 1994)
  - Connect diseases and the consequences as in functional loss
  - With personal and environmental factors that speed or slow the disablement
  - This process is not unidirectional, and functional limitation or disability could be mitigated or reverted by personal and environmental factors



THEORETICAL FRAMEWORK

- ***Compression of morbidity*** (Fries 1980)
  Morbidity (including disability) are pushed to older ages



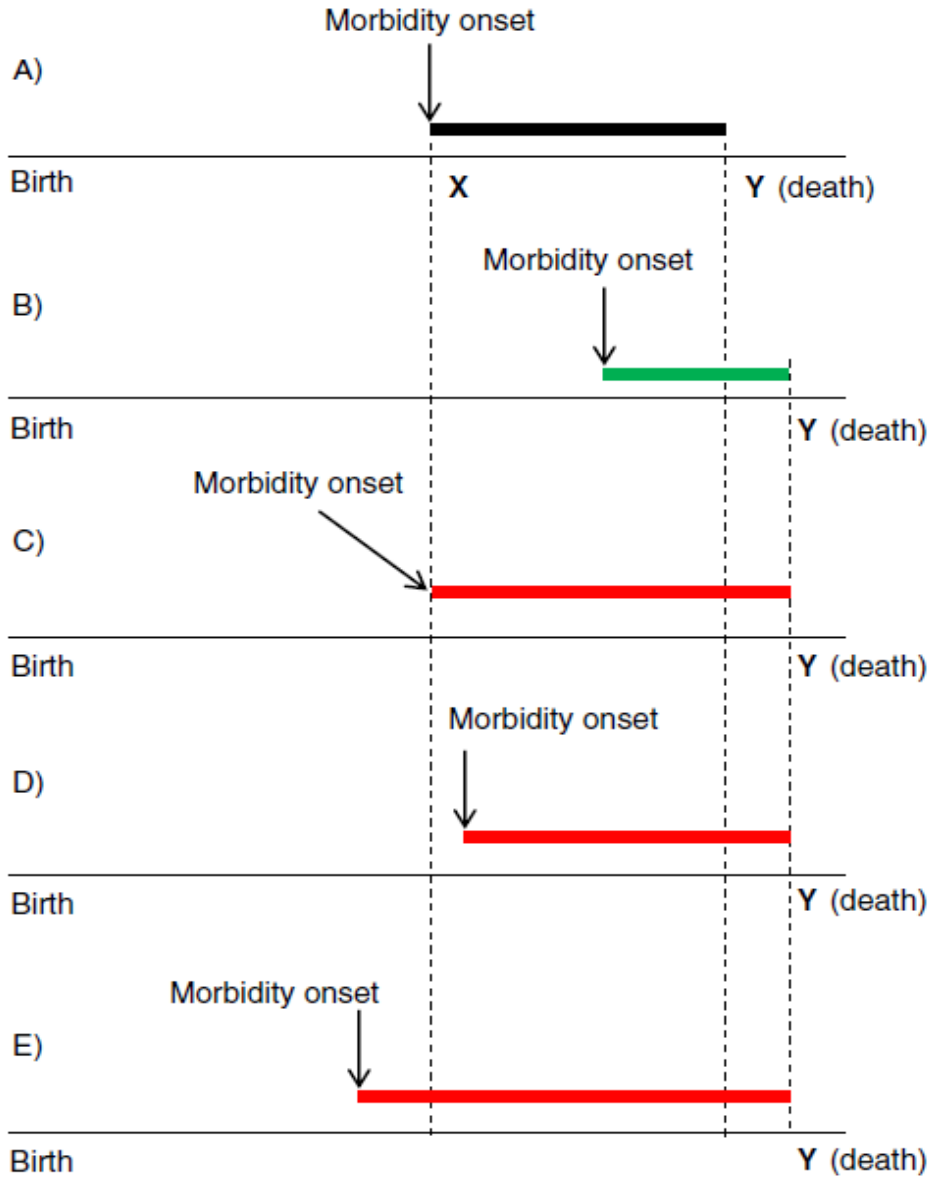
Source: Beltrán-Sánchez *et al.* (2014)

THEORETICAL FRAMEWORK

- ***Compression of morbidity*** (Fries 1980)
  Morbidity (including disability) are pushed to older ages

- ***Expansion of morbidity*** (Gruenberg 1977)
  Unhealthy people survive longer

- ***Dynamic equilibrium*** (Manton 1982)
  More chronic diseases, but lifetime with disability remain unchanged



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THEORETICAL FRAMEWORK

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- ***Dynamic equilibrium theory*** (Manton 1982)
  - Successive generations may be diagnosed with diseases earlier
  - Severe consequence of chronic diseases would delay while mortality improvement
  - Link between disease and disability/mortality is weakened

HYPOTHESIS

Expansion of morbidity

- *Hypothesis 1*: an average individual spends more time with morbidity and disability over time/cohort

Compression of morbidity

- *Hypothesis 2*: an average individual spends less time with morbidity and disability across time/cohort

Dynamic equilibrium

- *Hypothesis 3*: time spent with morbidity of an average individual increases, while the time with disability hardly changes or decline slightly
- *Hypothesis 4*: an average individual with chronic morbidities should spend more time disability-free across successive cohorts, due to a reduction in disease severity

AIMS

- Estimate the **partial cohort** health expectancies by morbidity and disability and compare the change in cohorts

- Provide empirical evidence to demonstrate the disablement process and the **dynamic equilibrium theory**

- Investigate whether there is heterogeneity in these patterns by **educational attainment** and whether different educational groups align with the same dynamic equilibrium theory

DATA

- US Health and Retirement Survey (HRS), 1998-2018
- Morbidity: Cancer, Diabetes, Heart disease, Lung disease and Stroke
- Disability: Bathing, Dressing, Eating, Getting in/out of bed and Walking across a room
- Mortality: Linkage as well as “Exit” interview

Period Observed	**1998-2008**	**2008-2018**
Age Group	Early Cohort	Later Cohort
60-69	1934-1943	1944-1953
70-79	1924-1933	1934-1943
80-89	1914-1923	1924-1933

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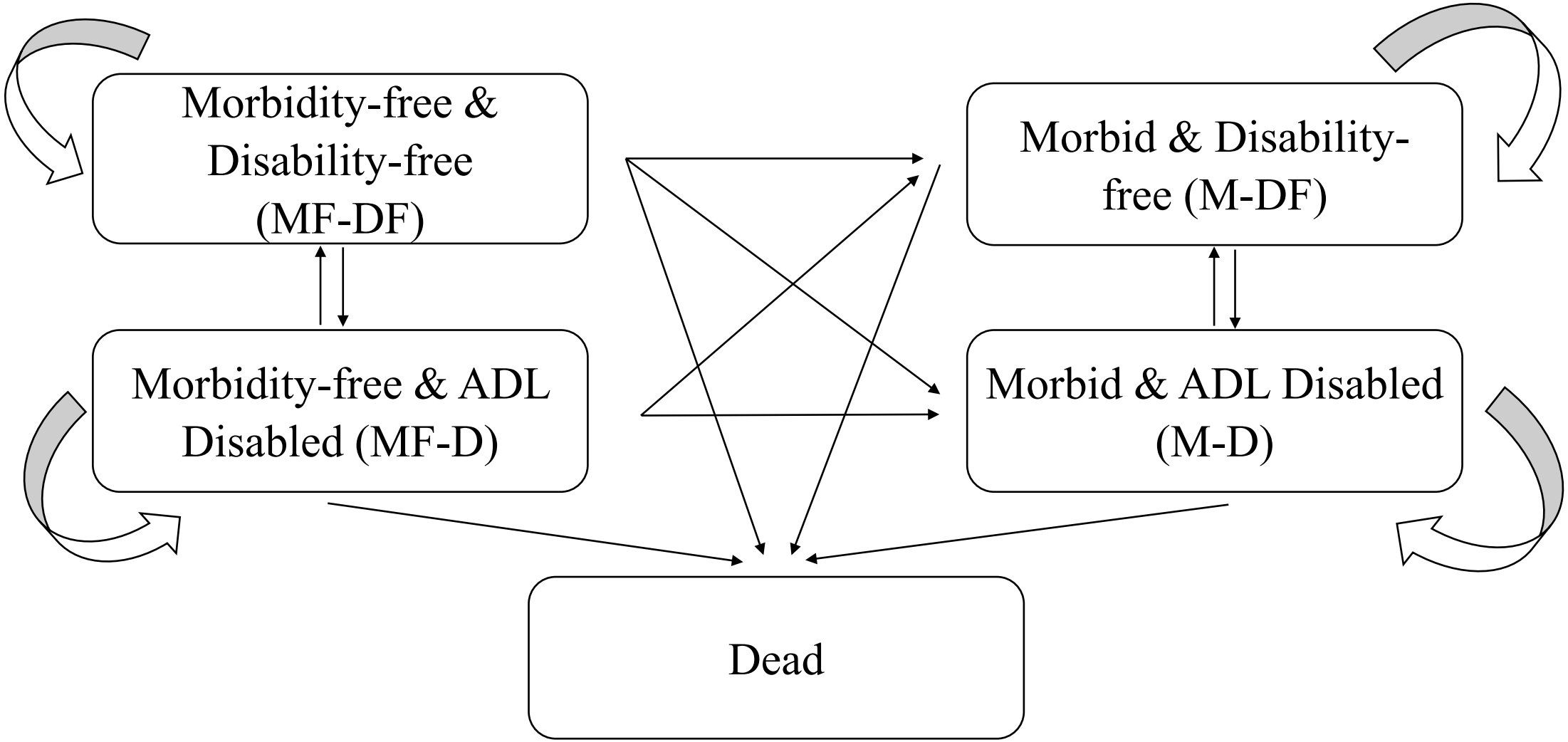
Covariates

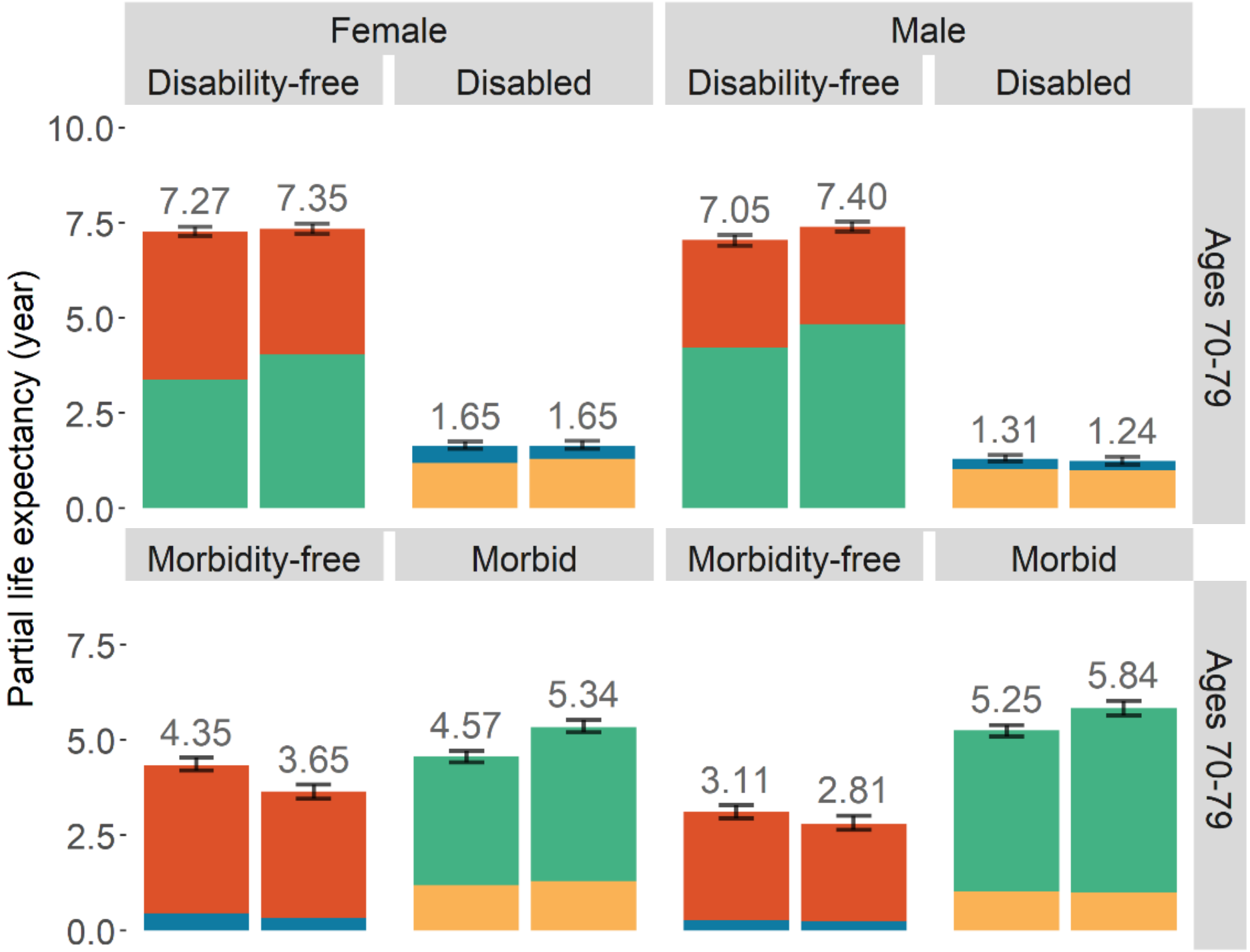
- Educational attainment: below High School diploma, High School graduate, beyond High School diploma

METHOD

- Multistate life table (MSLT) with microsimulation



Age	60		70		80	
Birth Cohort	1934-43	1944-53	1924-33	1934-43	1914-23	1924-33
	Early	Later	Early	Later	Early	Later
N	7,114	4,451	5,389	5,790	3,410	3,593
Sex	(%)	(%)	(%)	(%)	(%)	(%)
Men	47.6	47.7	44.7	46.4	40.0	40.7
Women	52.4	52.3	55.3	53.6	60.0	59.3
Race/ethnicity						
White	80.8	78.1	83.2	80.3	87.3	83.3
Black	9.7	10.2	9.1	9.1	7.1	8.2
Hispanic	7.4	8.5	5.5	8.1	4.1	6.5
Other	2.1	3.2	2.2	2.4	1.5	2.0
Educational attainment						
<HS	20.8	11.0	28.4	20.2	33.0	25.5
HS grad	37.2	31.7	36.0	36.8	36.8	37.2
>HS	42.0	57.3	35.6	43.0	30.2	37.3
1+ ADL-disabled	10.8	10.8	13.7	13.7	22.0	23.7
1+ Morbidity	30.6	37.5	45.9	53.4	57.1	65.0
State						
Morbidity-free & Disability-free	64.5	58.5	49.8	42.9	36.4	29.7
Morbidity-free & ADL Disabled	5.0	4.0	4.3	3.7	6.5	5.2
Morbid & Disability-free	24.7	30.8	36.5	43.4	41.6	46.6
Morbid & ADL Disabled	5.8	6.7	9.4	10.0	15.5	18.5

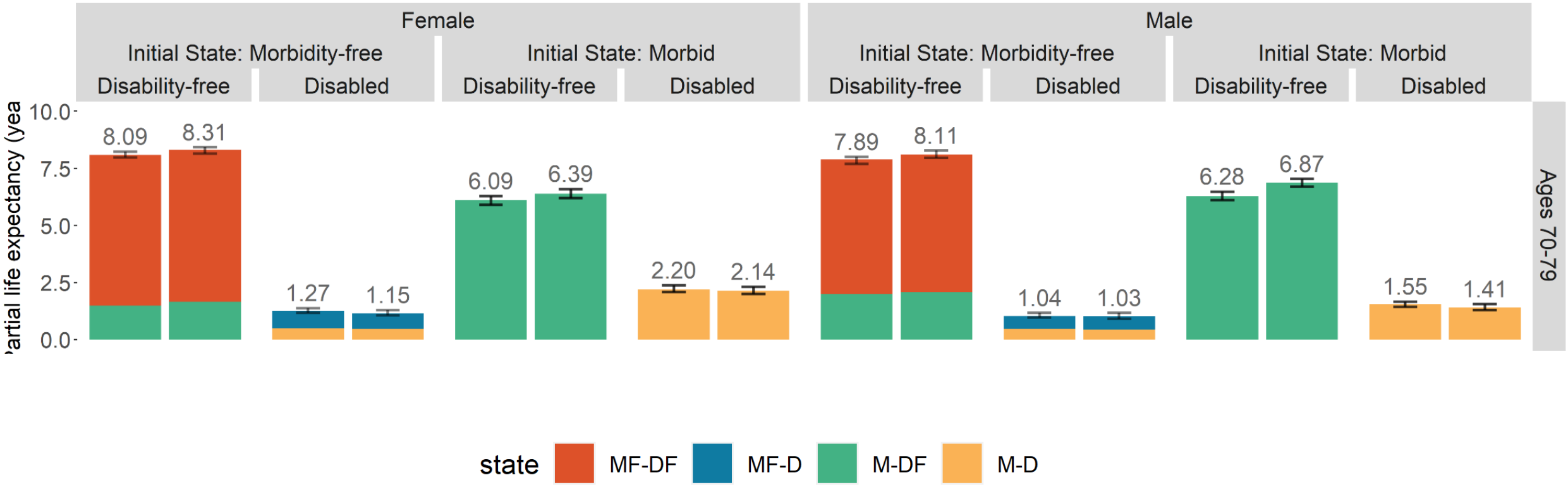


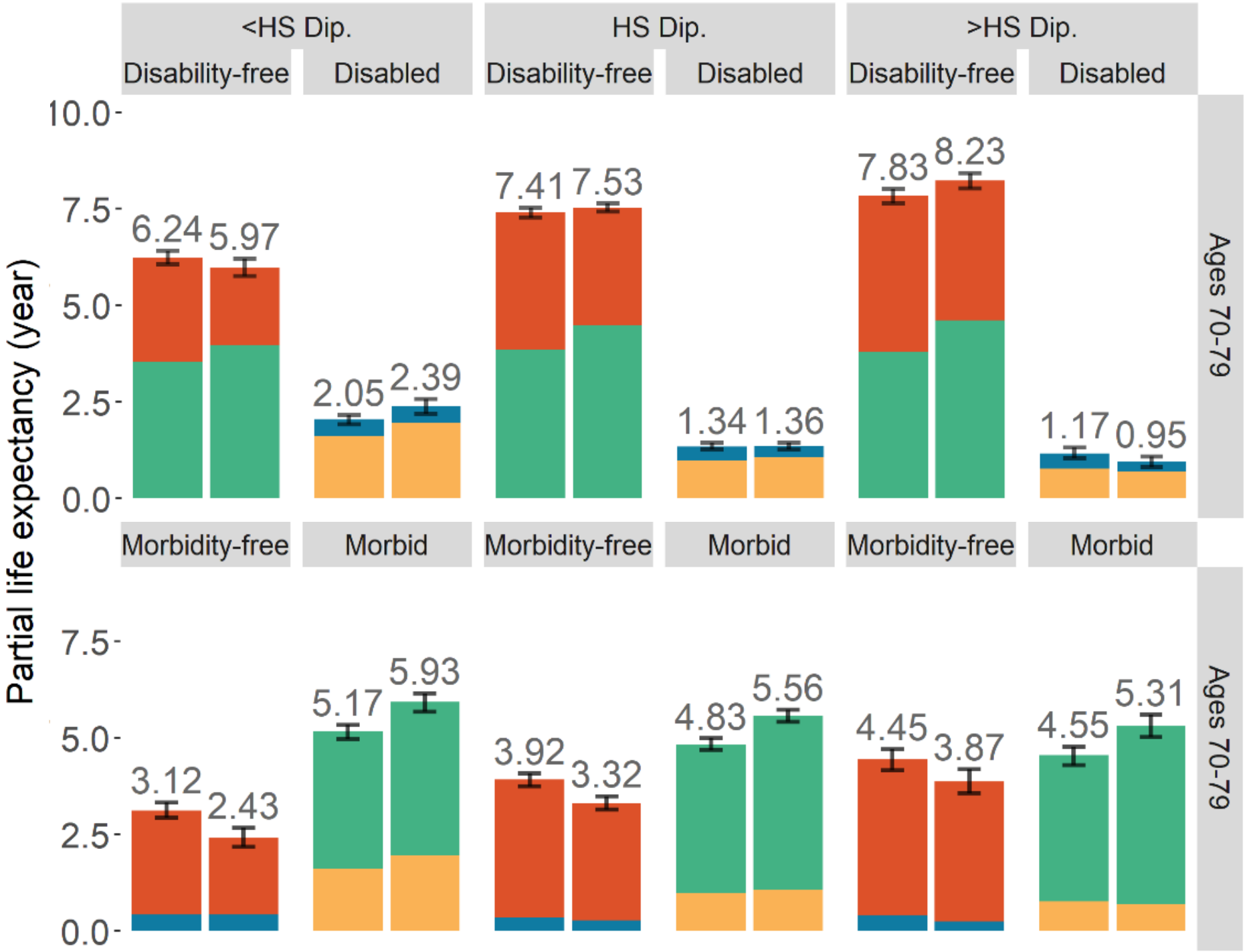
By Disability

state MF-DF MF-D M-DF M-D

By Morbidity

RESULTS BY SEX, INITIAL MORBIDITY AT 70-79



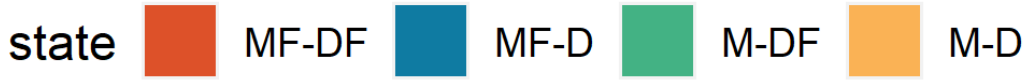


By Disability

state MF-DF MF-D M-DF M-D

By Morbidity

RESULTS BY EDUCATION, INITIAL MORBIDITY AT 70-79



CONCLUSIONS

- Partial cohort (PC) life expectancy **increases** across cohorts

Population level

- PC morbid life expectancy **increases** significantly
  - Expansion in morbidity?
- PC disabled life expectancy **remains** at the same level
  - Neither expansion or compression
- PC disability-free life expectancy has **increased** when starting with some morbidities
  - Dynamic Equilibrium (more time with morbidities but less severe consequences too)

CONCLUSIONS

- Clear Education gradient can be found in the PC life expectancy

By education

- PC morbid life expectancy **increases** significantly
  - Across all education groups
- PC disabled life expectancy **varies**
  - Expansion in disability for individuals without HS
  - Stable or slight decrease for HS graduate or above, respectively
- PC disability-free life expectancy has **increased** when starting with some morbidities for more educated groups
  - Dynamic Equilibrium for HS graduate and above

DISCUSSIONS

- The achievement in medicine seems to control the progression of chronic disease
- **NO improvements in overall PC disability-free life expectancy?**
- Higher prevalence of chronic diseases at old ages
- Align with the dynamic equilibrium theory
- Consequences/progression controlled ≠ Consequences eliminated
- Social consequence of being sick
- Inequality in controlling disease among sub-populations
- The US population is likely becoming unhealthier (either morbid or disabled) with longer life expectancy

LIMITATIONS

- First-order Markov chain
- Survey data with two-year interval and left censored
- Partial cohort is not completed cohort measure

FURTHER STUDY

- Other indexes and the sequence of the health trajectory
- More dimensions of health and more categories in definition (working paper on CEPAR)
- Disparities in other personal and environmental factors
- Effect of initial population structure and transition probability (working paper on SocArXiv)

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Working Paper

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