Socioeconomic status and all-cause mortality: Testing life course hypotheses in New Zealand

COMPASS Autumn Seminar Series

March 11th, 2016

Liza Bolton

Supervisors: Dr Barry Milne, COMPASS Research Centre, Professor Alan Lee, Department of Statistics

Abstract

Socioeconomic status (SES) has been shown to be related to mortality in a range of contexts. Low **SES tends to increase mortality risk**, but how exposure patterns across the life-course are related to mortality is not well understood, and have not been explored in the **New Zealand context**. This research uses **New Zealand longitudinal census data** to explore whether there is evidence of associations between mortality and cumulative exposure to low SES (**accumulation hypothesis**), changes in SES between life stages (**social mobility hypothesis**) and exposure to low SES during specific life stages (**sensitive period hypothesis**). Understanding these hypotheses in the New Zealand context may allow for better-targetted interventions to address mortality inequalities, for example, disparities between ethnic groups.

Keywords: *accumulation, social mobility, sensitive period, mortality, New Zealand, socioeconomic status*

Outline

1. Introduction
2. Longitudinal Census and NZCMS
3. Life-Course Hypotheses
4. Example Results
5. Model Fits
6. Conclusions

Disclaimer: Access to the data used in this study was provided by Statistics New Zealand under conditions designed to give effect to the security and confidentiality provisions of the Statistics Act 1975. The results presented in this study are the work of the author, not Statistics New Zealand.

University of Auckland Human Participants Ethics Committee (UAHPEC) approval number 012400

Introduction

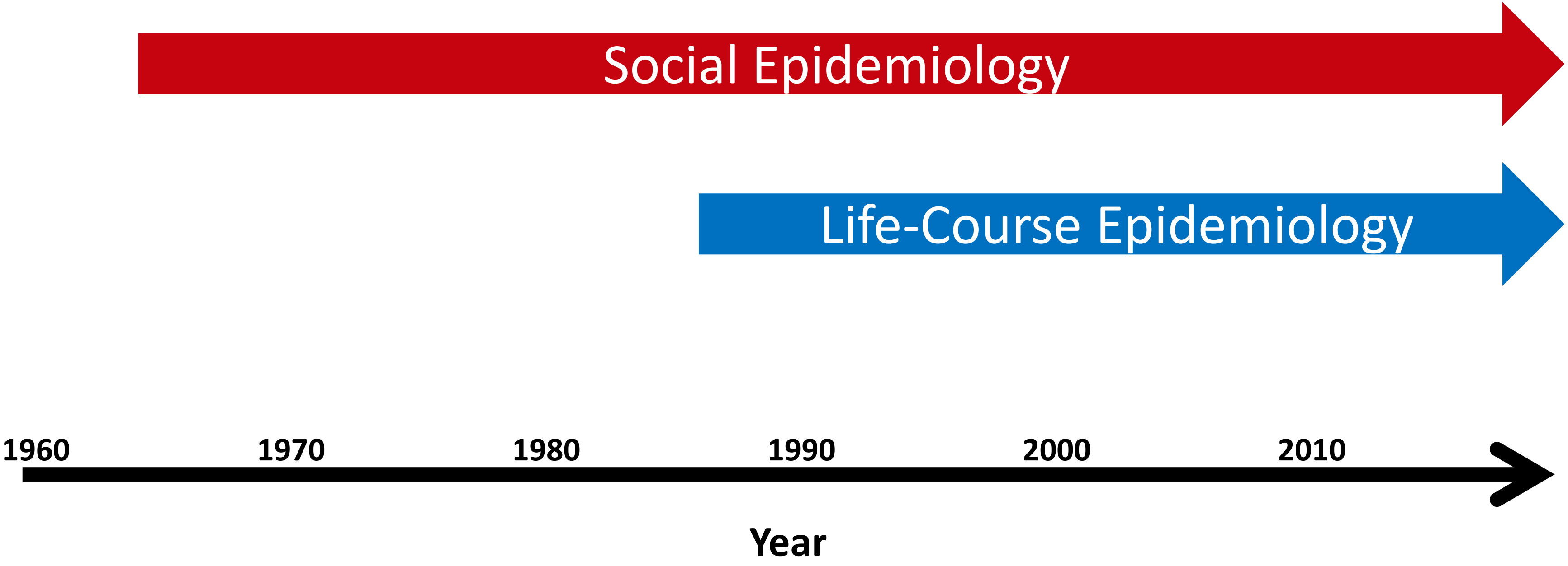
Project Context

This research is part of the first year of my PhD project, examining life-course predictors of mortality inequalities across ethnic groups in Aotearoa New Zealand.

Wish to acknowledge the support of:

- Health Research Council Grant [14/167]
- University of Auckland Doctoral Health Research Scholarship

Social and Life-Course Epidemiology



Socioeconomic Status (SES)

Aims

- Model life-course SES association with mortality

- Test fit of hypotheses against saturated models

Longitudinal Census and NZCMS

The Data

Longitudinal Census and NZCMS

- The New Zealand Longitudinal Census (NZLC) deterministically and probabilistically links records for the the 1981, 1986, 1991, 1996, 2001 and 2006 New Zealand Censuses of Populations and Dwellings.
- The New Zealand Census-Mortality Study probabilistically links mortality records to census records.
- Both have linkage bias, weights have been created to help address this.

Census Linkage Summary

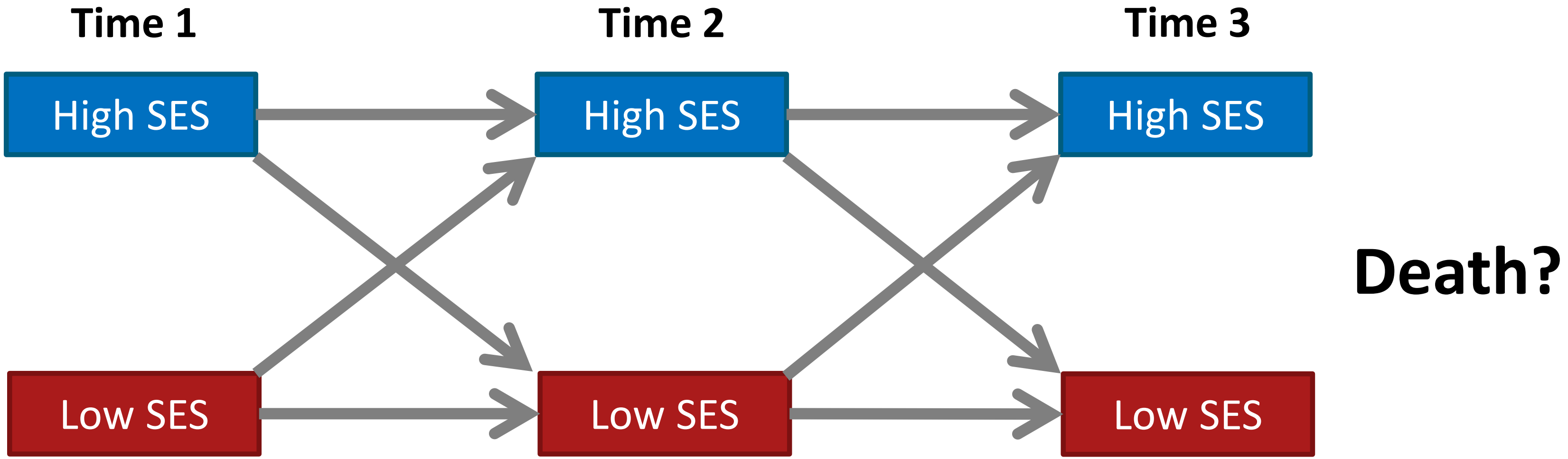
<table>
<tr><th>Cohort</th><th>Number of Censuses</th><th>1981</th><th>1986</th><th>1991</th><th>1996</th><th>2001</th><th>2006</th><th>% linked</th></tr>
<tr><td>06-01</td><td>2</td><td></td><td></td><td></td><td></td><td colspan="2">2,311,000</td><td>70.3</td></tr>
<tr><td>01-96</td><td>2</td><td></td><td></td><td></td><td colspan="2">2,171,000</td><td></td><td>69.5</td></tr>
<tr><td>96-91</td><td>2</td><td></td><td></td><td colspan="2">2,174,000</td><td></td><td></td><td>72.0</td></tr>
<tr><td>91-86</td><td>2</td><td></td><td colspan="2">2,220,000</td><td></td><td></td><td></td><td>75.9</td></tr>
<tr><td>86-81</td><td>2</td><td colspan="2">2,078,000</td><td></td><td></td><td></td><td></td><td>72.1</td></tr>
<tr><td>06-01-96</td><td>3</td><td></td><td></td><td></td><td colspan="3">1,592,000</td><td>54.5</td></tr>
<tr><td>01-96-91</td><td>3</td><td></td><td></td><td colspan="3">1,571,000</td><td></td><td>56.2</td></tr>
<tr><td>96-91-86</td><td>3</td><td></td><td colspan="3">1,603,000</td><td></td><td></td><td>59.4</td></tr>
<tr><td>91-86-81</td><td>3</td><td colspan="3">1,581,000</td><td></td><td></td><td></td><td>59.4</td></tr>
<tr><td>06-01-96-91</td><td>4</td><td></td><td></td><td colspan="4">1,173,000</td><td>45.4</td></tr>
<tr><td>01-96-91-86</td><td>4</td><td></td><td colspan="4">1,177,000</td><td></td><td>47.5</td></tr>
<tr><td>96-91-86-81</td><td>4</td><td colspan="4">1,154,000</td><td></td><td></td><td>47.5</td></tr>
<tr><td>06-01-96-91-86</td><td>5</td><td></td><td colspan="5">882,000</td><td>38.6</td></tr>
<tr><td>01-96-91-86-81</td><td>5</td><td colspan="5">850,000</td><td></td><td>38.3</td></tr>
<tr><td>06-01-96-91-86-81</td><td>6</td><td colspan="6">647,000</td><td>31.5</td></tr>
</table>

Source: Statistics New Zealand

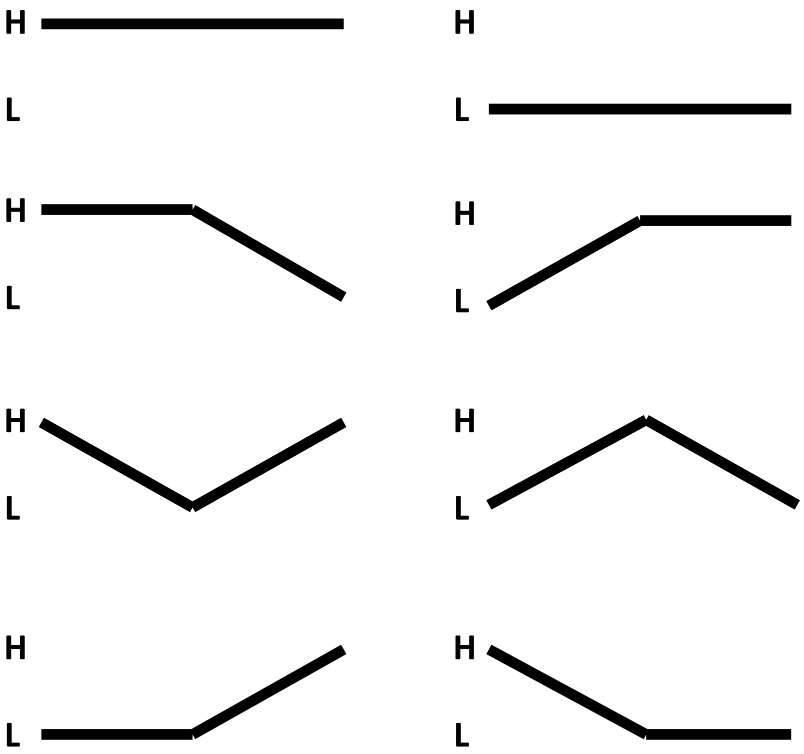
Life-Course Models

The Method

Socioeconomic Trajectories

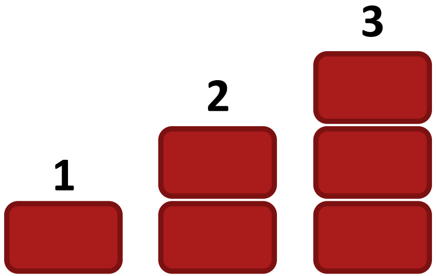


8 Possible Trajectories



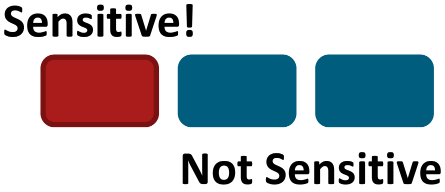
Life-Course Hypotheses

Accumulation



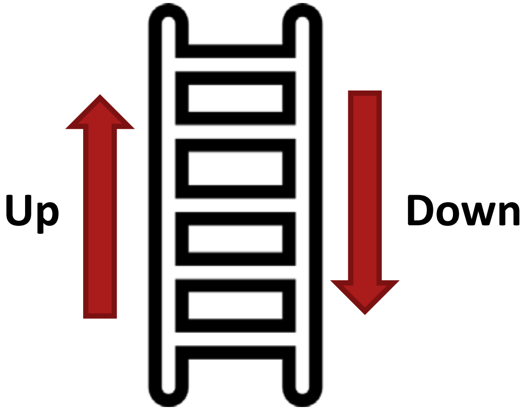
Cumulative exposure to low SES

Sensitive Period



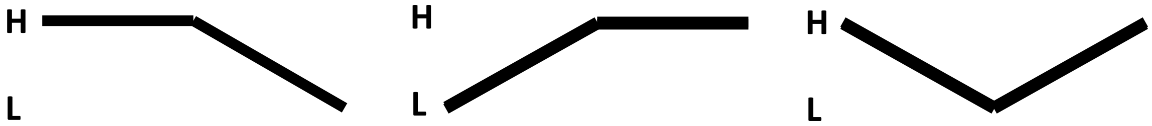
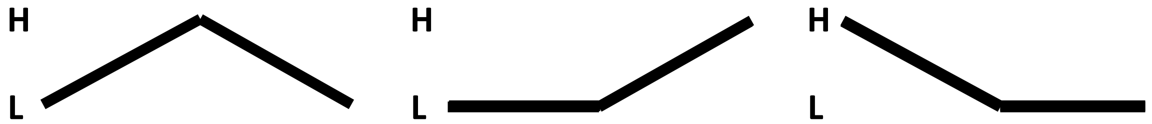
Exposure to low SES at specific time

Social Mobility

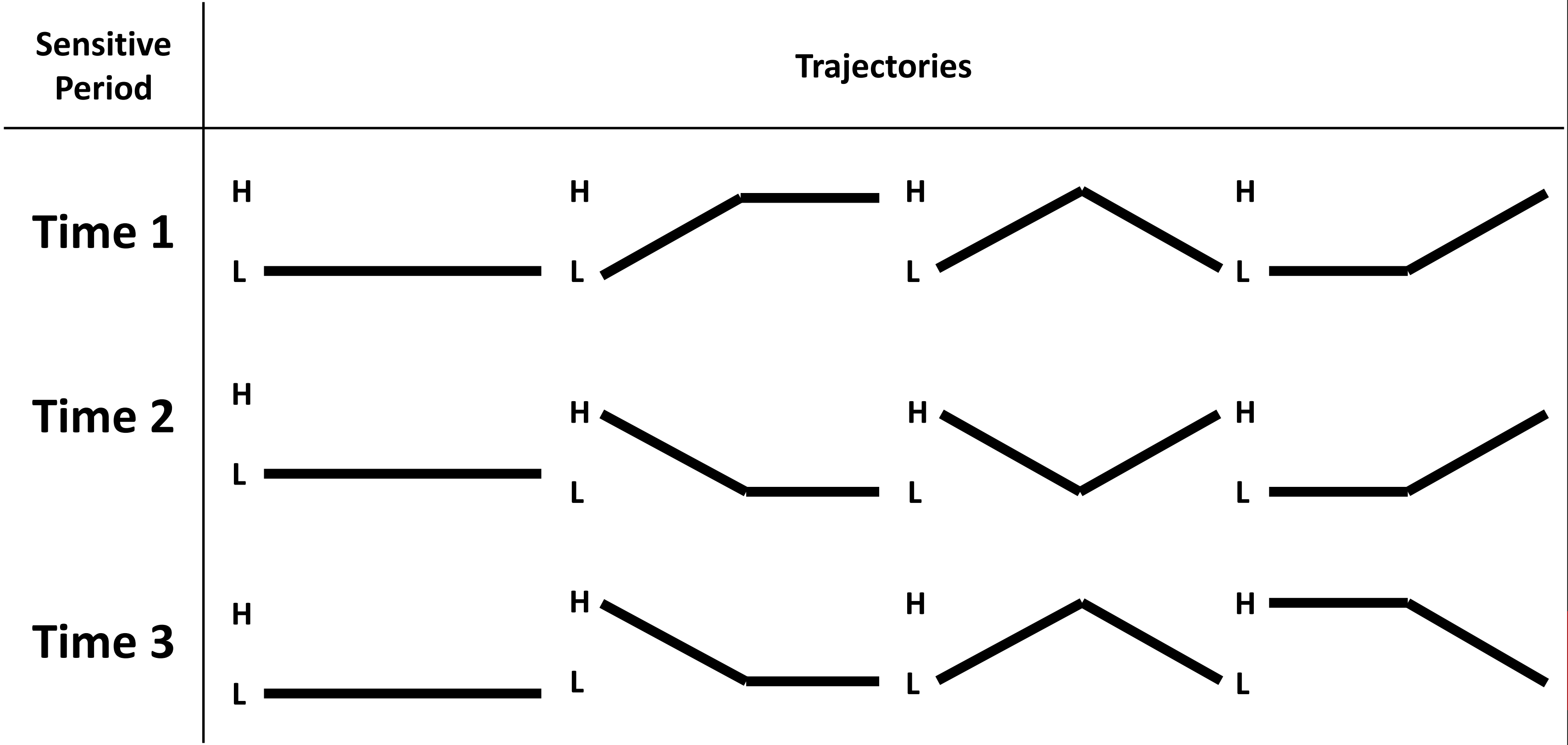


Movement out of or into low SES

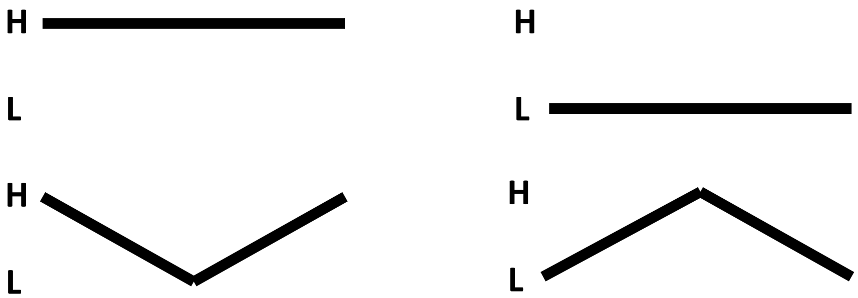
Accumulation

Number of census times at risk	Trajectories
0	
1	
2	
3	

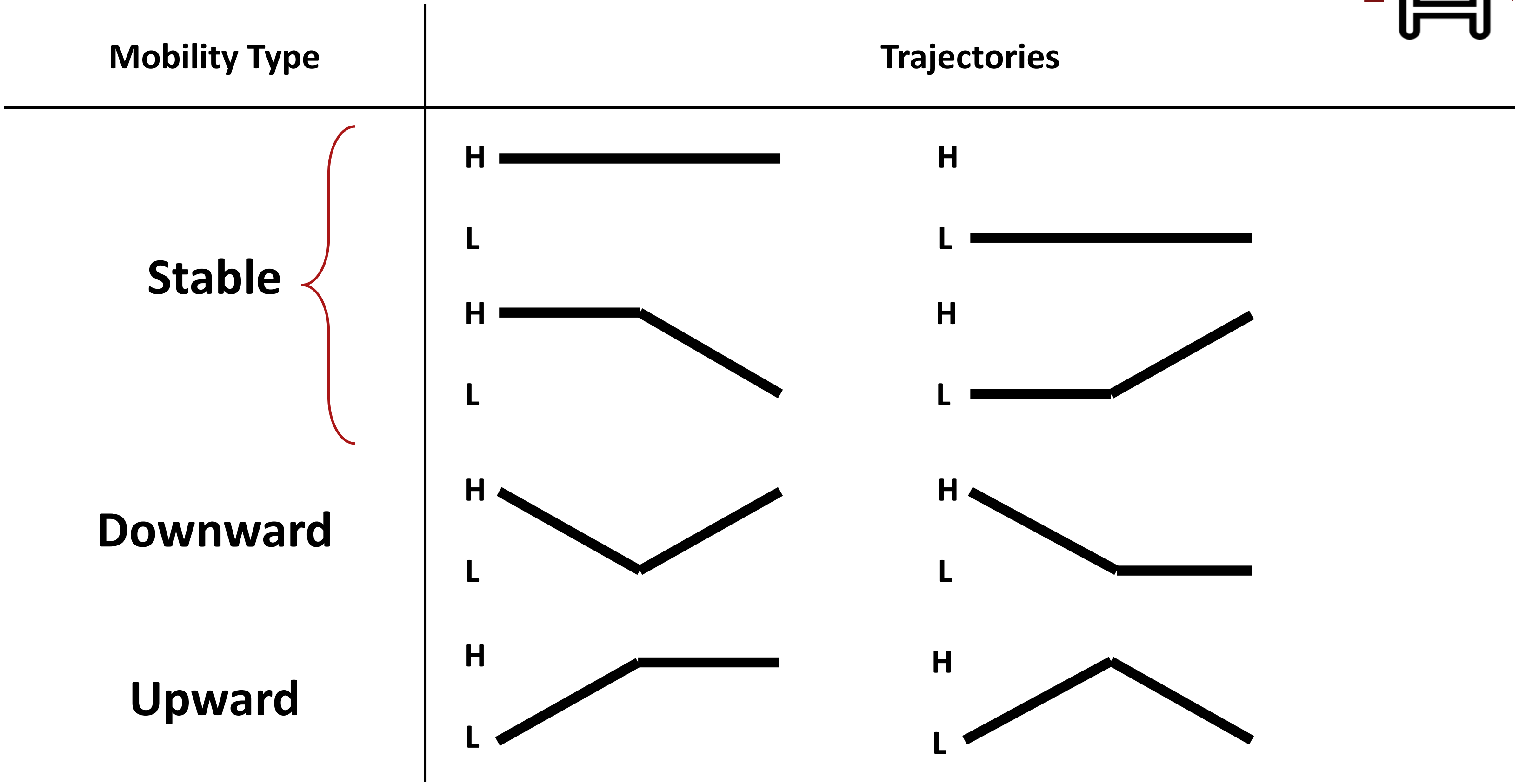
Sensitive Periods



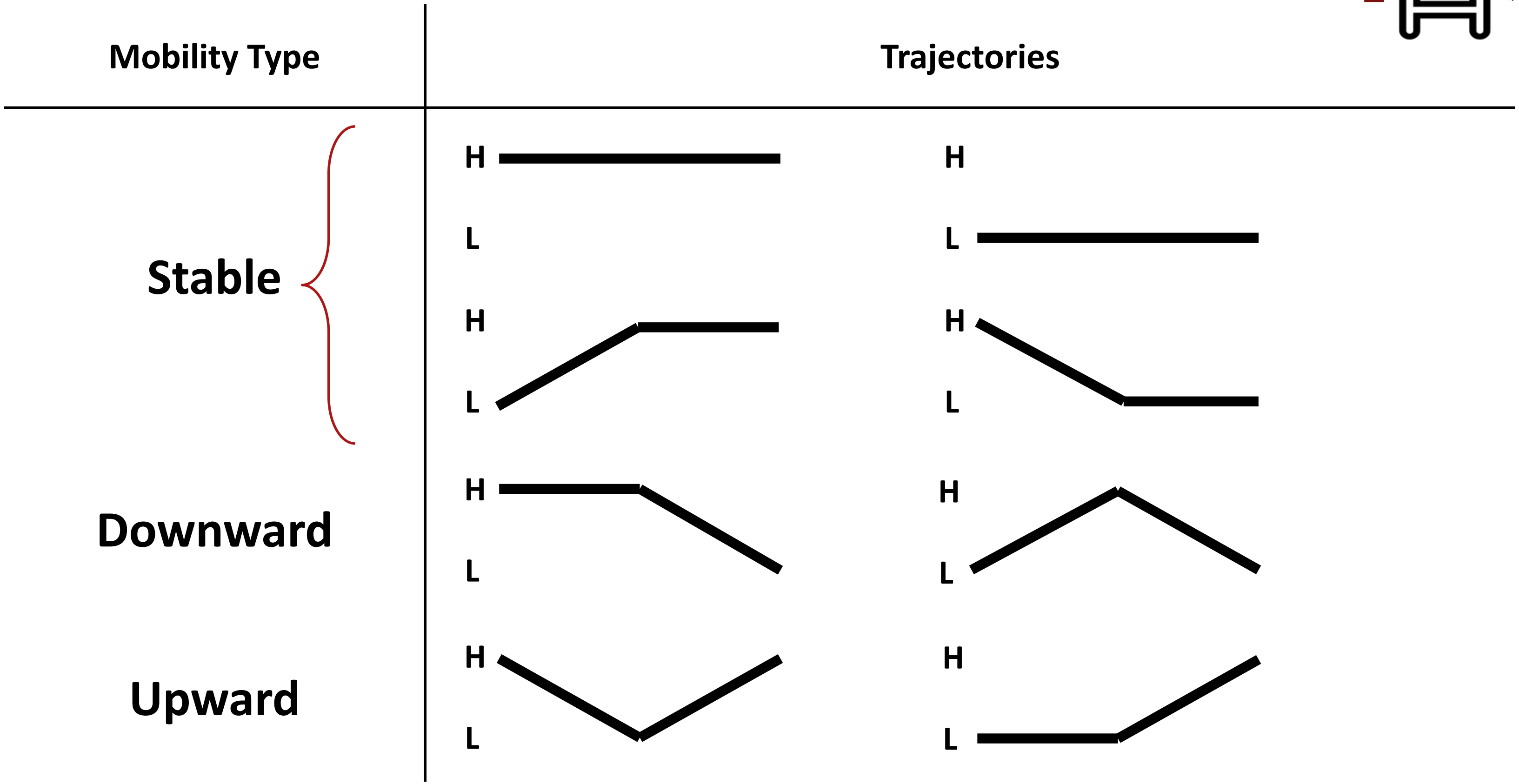
Overall Mobility (Time 1 to Time 3)

Mobility Type	Trajectories
Stable	
Downward	
Upward	

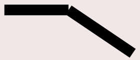
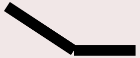
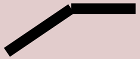
Mobility 1 (Time 1 to Time 2)



Mobility 2 (Time 2 to Time 3)



Summary of Hypotheses

	Accumulation	SES Risk (T1)	SES Risk (T2)	SES Risk (T3)	Mobility Overall	Mobility 1 (T1- T2)	Mobility 2 (T2 – T3)
H  L	0	0	0	0	Stable	Stable	Stable
H  L	1	0	0	1	Downward	Stable	Downward
H  L	1	0	1	0	Stable	Downward	Upward
H  L	2	0	1	1	Downward	Downward	Stable
H  L	1	1	0	0	Upward	Upward	Stable
H  L	1	1	0	1	Stable	Upward	Downward
H  L	2	1	1	0	Upward	Stable	Upward
H  L	3	1	1	1	Stable	Stable	Stable

Examples of Life-Course Results

Author	Female	Male	Outcome	SES Indicator	Country
Murray et al., 2011	Accumulation	Childhood sensitive period	CVD	Occupational social class	UK
Mishra et al., 2009	Accumulation		BMI	Manual / non-manual	UK
Gustafsson et al., 2011	Accumulation; Adolescent sensitive period	Accumulation; Current sensitive period	Allostatic load	Occupation	Sweden
Padyab, et al., 2013	Accumulation	Accumulation	All-cause mortality	SEI, Hollingshead Index of Social Position	Sweden

Specification of Models

- Models were performed seperately for females and males.

- The model for each life-course hypothesis is nested within a saturated model.
  - The saturated model provides a different mortality odds ratio for each of the 8 trajectories

- Logistic models were used and the results will be discussed as odds ratios.

Specification of Models

Saturated Model

$$y = \beta_0 + \beta_1 x_{\text{Asian}} + \beta_2 x_{\text{European}} + \beta_3 x_{\text{Māori}} + \beta_4 x_{\text{Pacific}} + \beta_5 x_{\text{SES1}} + \beta_6 x_{\text{SES2}} + \beta_7 x_{\text{SES3}} + \beta_8 x_{\text{SES1}} x_{\text{SES2}} + \beta_9 x_{\text{SES1}} x_{\text{SES3}} + \beta_{10} x_{\text{SES2}} x_{\text{SES3}} + \beta_{11} x_{\text{SES1}} x_{\text{SES2}} x_{\text{SES3}}$$

Restriction on Saturated Model	Degrees of Freedom (DF)
None	11

Specification of Models

Accumulation Model

$$y = \beta_0 + \beta_1 x_{Asian} + \beta_2 x_{European} + \beta_3 x_{Māori} + \beta_4 x_{Pacific} + \beta_5 x_{SES1} + \beta_5 x_{SES2} + \beta_5 x_{SES3}$$

Restriction on Saturated Model	Degrees of Freedom (DF)
$\beta_5 = \beta_6 = \beta_7$ $\beta_8 = \beta_9 = \beta_{10} = \beta_{11} = 0$	5

Specification of Models

Sensitive Period Models

Time 1: $y = \beta_0 + \beta_1 x_{Asian} + \beta_2 x_{European} + \beta_3 x_{Māori} + \beta_4 x_{Pacific} + \beta_5 x_{SES1}$
Time 2: $y = \beta_0 + \beta_1 x_{Asian} + \beta_2 x_{European} + \beta_3 x_{Māori} + \beta_4 x_{Pacific} + \beta_6 x_{SES2}$
Time 3: $y = \beta_0 + \beta_1 x_{Asian} + \beta_2 x_{European} + \beta_3 x_{Māori} + \beta_4 x_{Pacific} + \beta_7 x_{SES3}$

Restriction on Saturated Model	Degrees of Freedom (DF)
P1: $\beta_6 = \beta_7 = \beta_8 = \beta_9 = \beta_{10} = \beta_{11} = 0$ P2: $\beta_5 = \beta_7 = \beta_8 = \beta_9 = \beta_{10} = \beta_{11} = 0$ P3: $\beta_5 = \beta_6 = \beta_8 = \beta_9 = \beta_{10} = \beta_{11} = 0$	5

Specification of Models

Mobility Models

Overall Mobility : $y = \beta_0 + \beta_1 x_{Asian} + \beta_2 x_{European} + \beta_3 x_{Māori} + \beta_4 x_{Pacific} + \beta_5 x_{SES1} + \beta_7 x_{SES3} + \beta_9 x_{SES1} x_{SES3}$

Mobility 1: $y = \beta_0 + \beta_1 x_{Asian} + \beta_2 x_{European} + \beta_3 x_{Māori} + \beta_4 x_{Pacific} + \beta_5 x_{SES1} + \beta_6 x_{SES2} + \beta_8 x_{SES1} x_{SES2}$

Mobility 2: $y = \beta_0 + \beta_1 x_{Asian} + \beta_2 x_{European} + \beta_3 x_{Māori} + \beta_4 x_{Pacific} + \beta_6 x_{SES2} + \beta_7 x_{SES3} + \beta_{10} x_{SES2} x_{SES3}$

Restriction on Saturated Model	Degrees of Freedom (DF)
Overall: $\beta_6 = \beta_8 = \beta_{10} = \beta_{11} = 0$ Mobility 1: $\beta_7 = \beta_9 = \beta_{10} = \beta_{11} = 0$ Mobility 2: $\beta_5 = \beta_8 = \beta_9 = \beta_{11} = 0$	7

Comparison of Model Fit

Likelihood Ratio Test Statistic / Deviance

$$D = -2(\ln(likelihood\ of\ hypothesised\ model) - \ln(likelihood\ of\ saturated\ model))$$

$$D \sim \chi^2(df\ saturated\ model\ - df\ hypothesised\ model)$$

Looking for non-significant results – no evidence against fit

Variables Considered

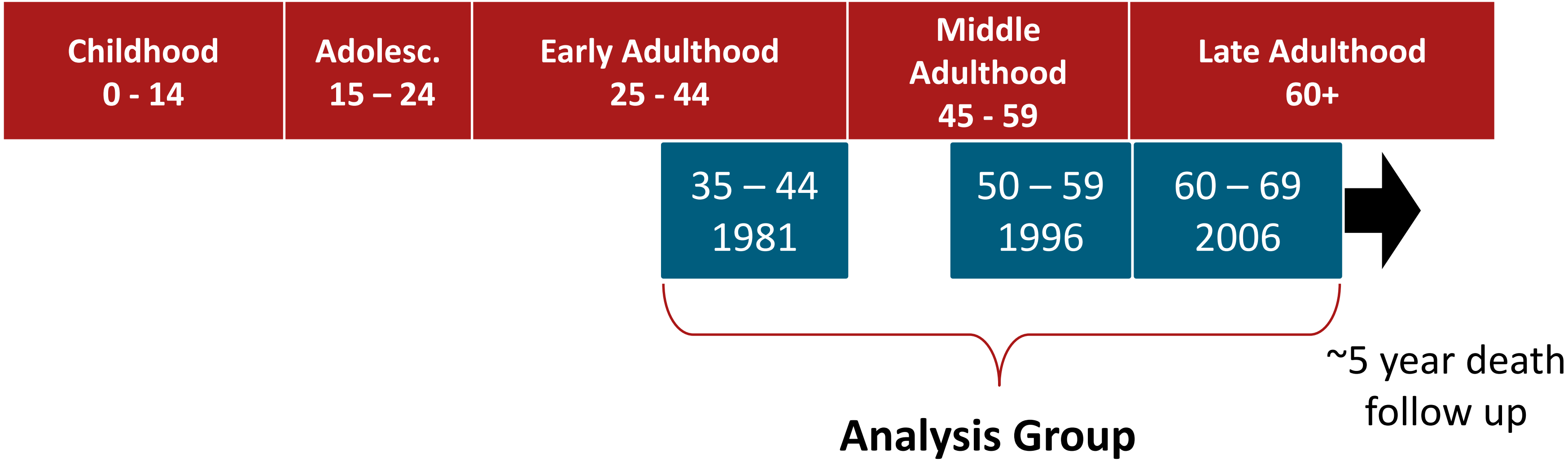
Household Income

NZSEI

Unemployment

Welfare Receipt

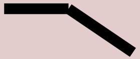
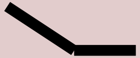
Life-Courses Considered



Household Income Example

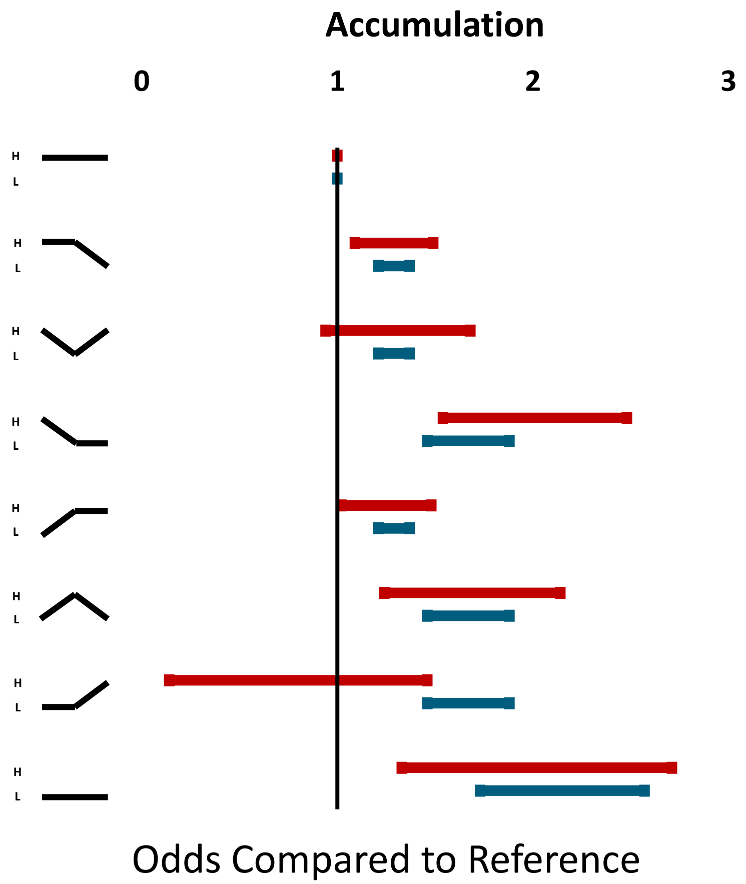
The Results

Household Income Frequencies

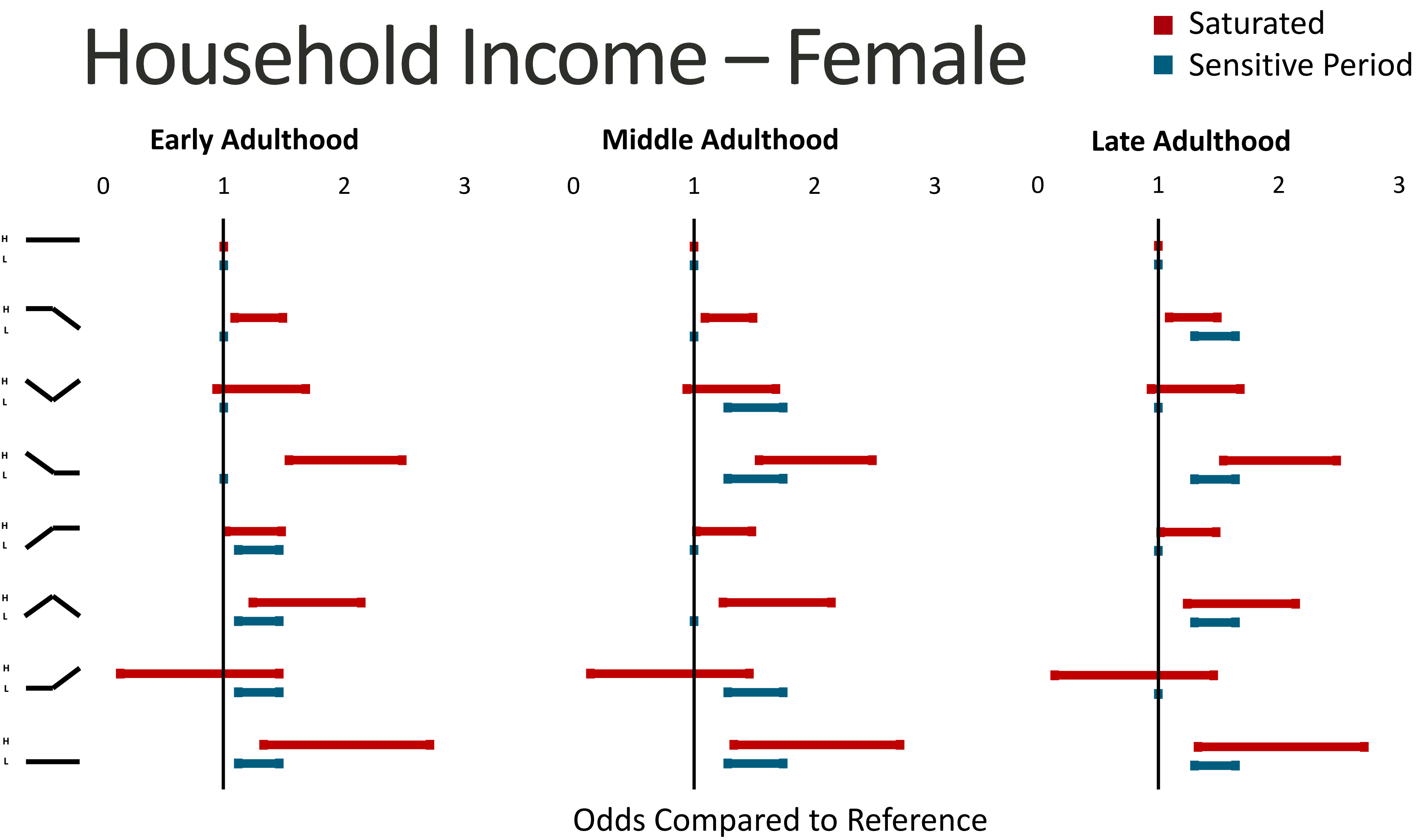
	Female			Male		
	N	% of total	% died	N	% of total	% died
H  L	37,788	69.0%	2.1%	37,302	80.3%	2.8%
H  L	6,393	11.7%	2.8%	3,819	8.2%	4.9%
H  L	1,770	3.2%	2.9%	1,068	2.3%	5.3%
H  L	1,677	3.1%	4.1%	948	2.0%	6.3%
H  L	4,389	8.0%	2.6%	2,403	5.2%	3.0%
H  L	1,509	2.8%	3.6%	444	1.0%	4.1%
H  L	438	0.8%	1.4%	198	0.4%	4.5%
H  L	765	1.4%	4.3%	255	0.5%	4.7%

Household Income – Female

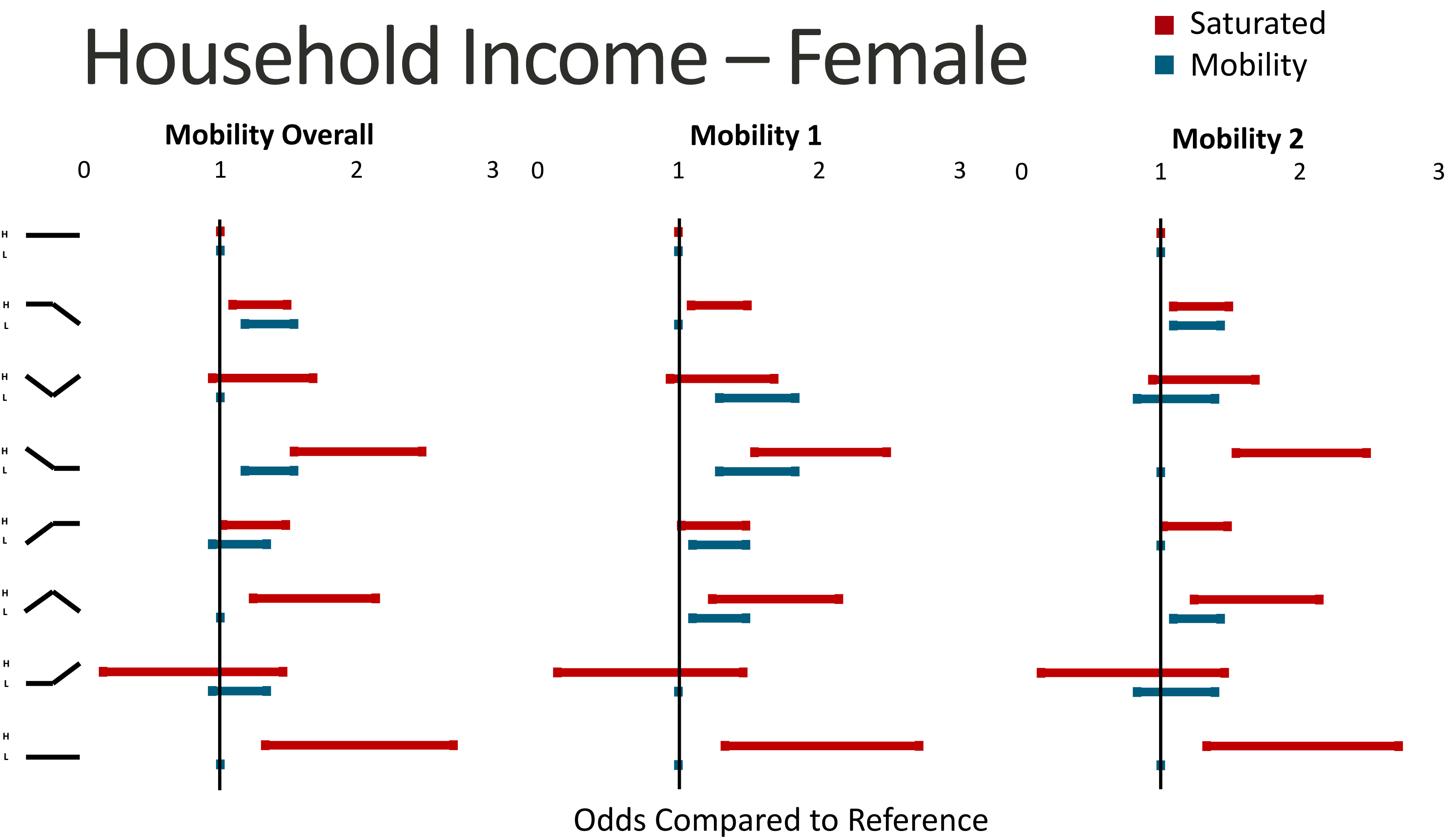
Saturated
Accumulation



Household Income – Female

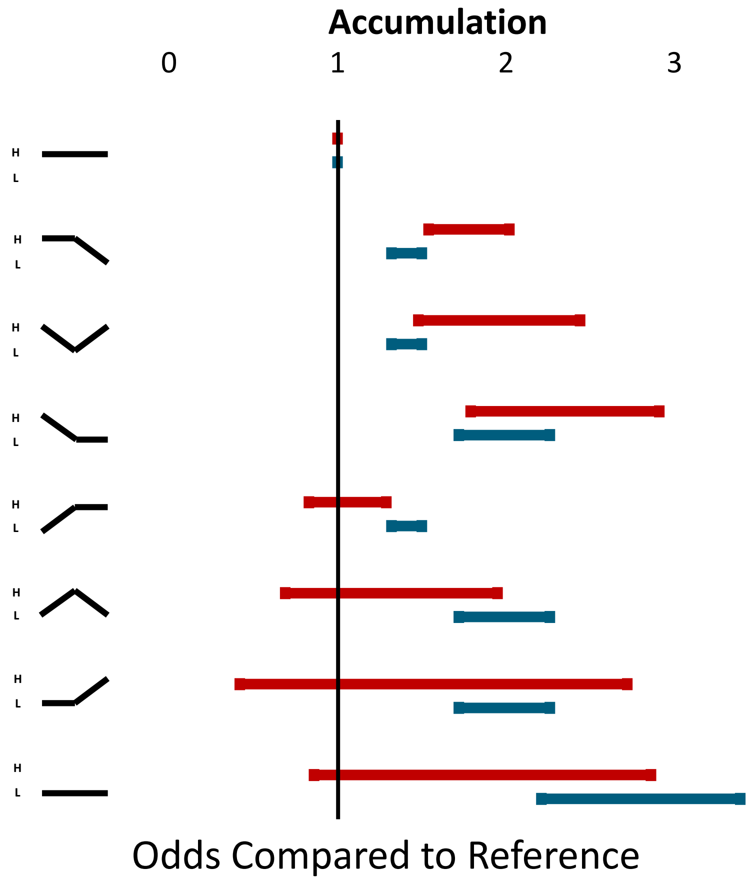


Household Income – Female

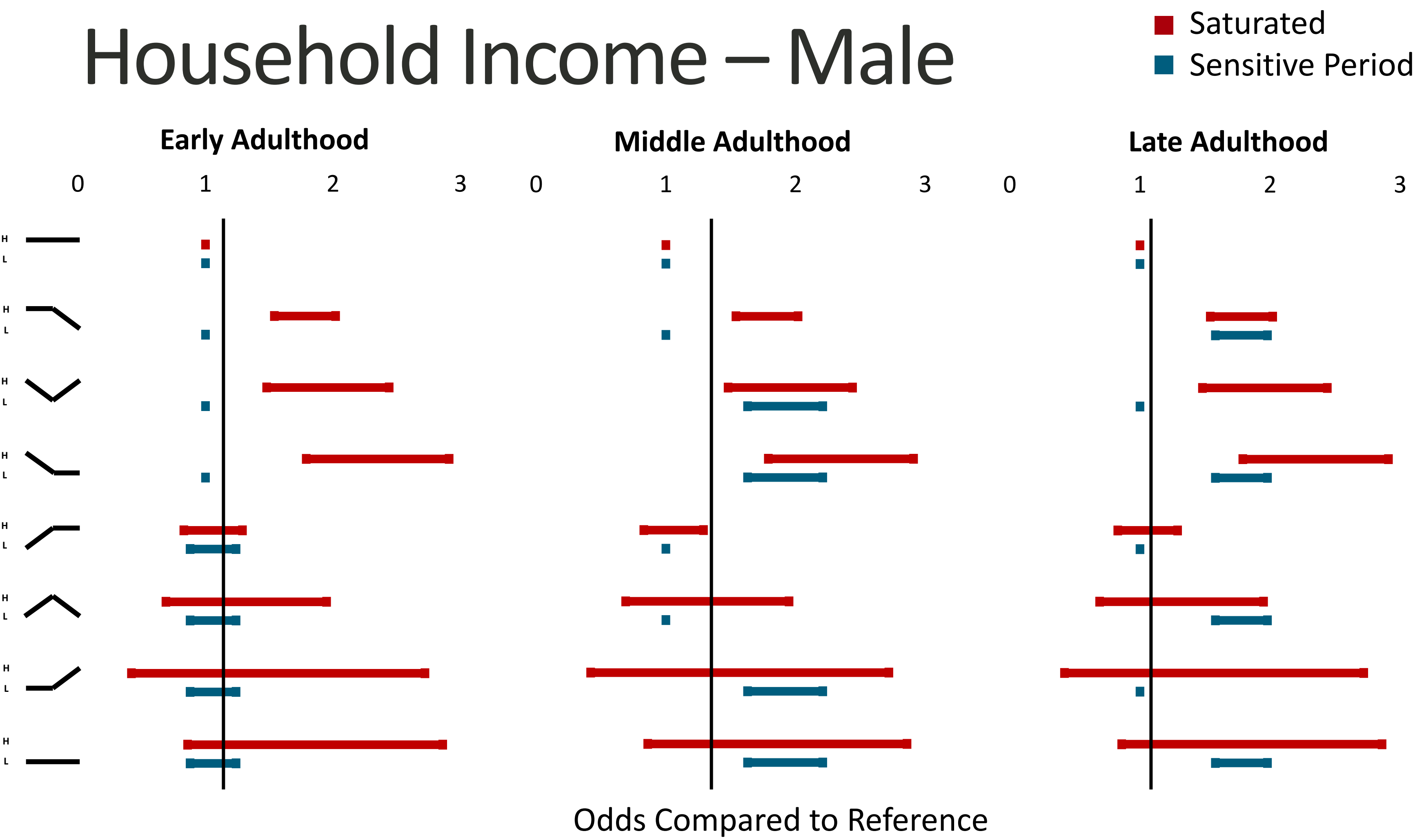


Household Income – Male

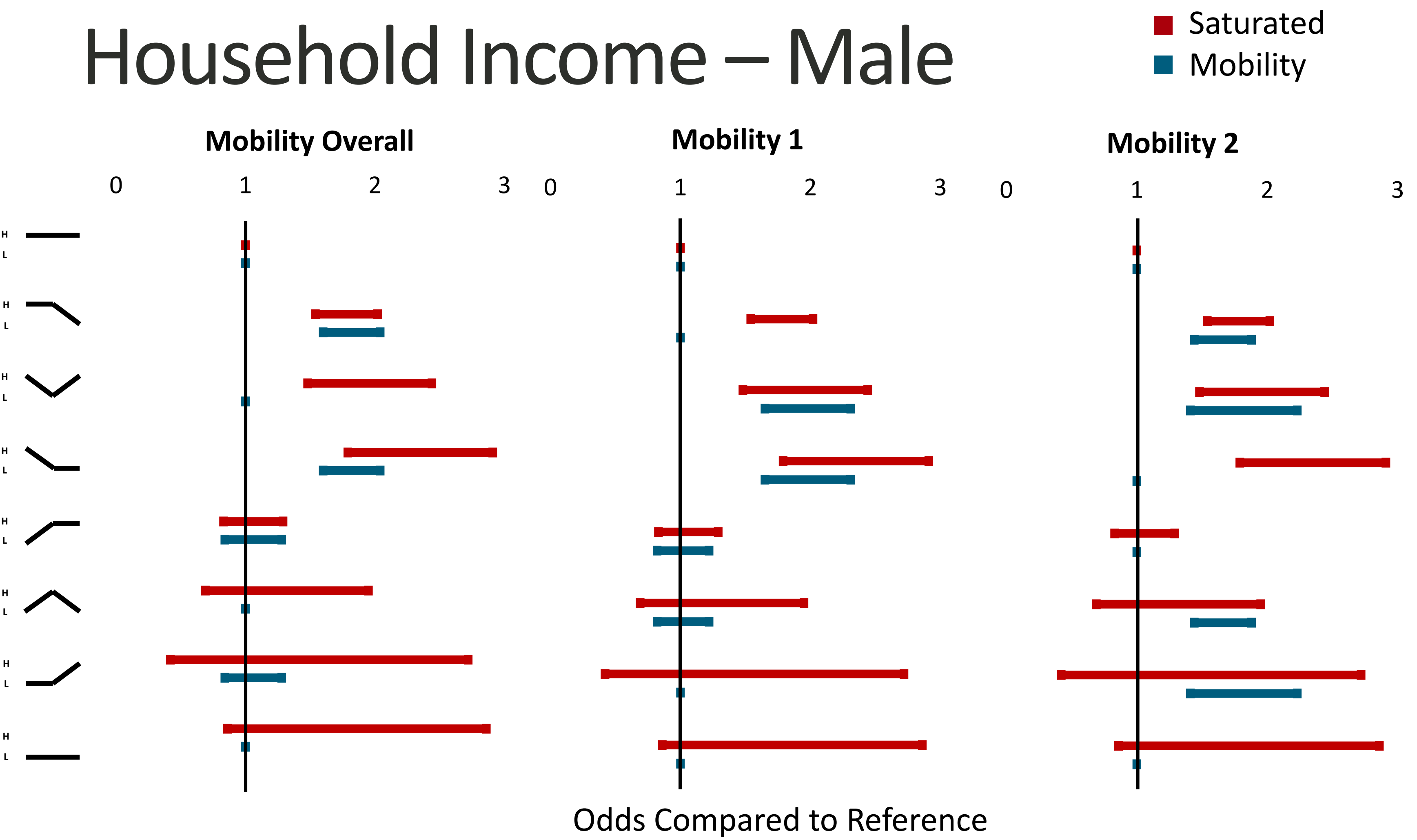
Saturated
Accumulation



Household Income – Male



Household Income – Male



Model Fits

Model Fit Summary

	Accumulation	Sensitive Period	Mobility
Household income	Females		
NZSEI	Females	Females (late adulthood)	
Unemployment	Females	Females (middle adulthood)	Females (early to middle and middle to late adulthood)
Welfare Receipt		Females (late adulthood)	

No models fit as well as the saturated model for males

Conclusions

Implications, Limitations and Next Steps

Conclusions

- Differences by sex in life-course trajectories and hypotheses
- Household income, NZSEI group, unemployment and welfare receipt showed associations with mortality
- Accumulation, certain sensitive periods and some mobility hypotheses fit for females observed at early, middle and late adulthood (variable dependent)
- There was no evidence of a life-course model that was as good as knowing the full life-course trajectory when considering males observed over the same period

Limitations

- Limited to 25 year period
- Census variables do not perfectly represent the variables we wish we could measure
- Premature mortality rare so models using childhood unstable

Next Steps – HRC Grant

HRC Project Aims:

1. Testing life-course hypotheses
2. Protective effects of social and cultural capital
3. Understanding ethnic disparities
4. Testing hypotheses among discordant siblings

Next Steps – My Thesis

- Developing a SES Index and testing life-course hypotheses
- Instability as a life-course hypothesis
- Protective effects of social and cultural capital
- Understanding ethnic disparities
  - Life-course trajectory differences
  - Social and cultural capital differences

References

- Gustafsson, P.E., Janlert, U., Theorell, T., Westerlund, H., Hammarstrom, A., 2011. Socioeconomic status over the life course and allostatic load in adulthood: results from the Northern Swedish Cohort. J. Epidemiol. Community Heal. 65, 986–992. doi:10.1136/jech.2010.108332
- Mishra, G., Nitsch, D., Black, S., DeStavola, B., Kuh, D., Hardy, R., 2009. A structured approach to modelling the effects of binary exposure variables over the life course. Int. J. Epidemiol. 38, 528–537. doi:10.1093/ije/dyn229
- Murray, E.T., Mishra, G.D., Kuh, D., Guralnik, J., Black, S., Hardy, R., 2011. Life Course Models of Socioeconomic Position and Cardiovascular Risk Factors: 1946 Birth Cohort. Ann. Epidemiol. 21, 589–597. doi:10.1016/j.annepidem.2011.04.005
- Padyab, M., Malmberg, G., Norberg, M., Blomstedt, Y., 2013. Life course socioeconomic position and mortality: a population register-based study from Sweden. Scand. J. Public Health 41, 785–91. doi:10.1177/1403494813493366

Acknowledgements

- COMPASS Team: Barry, Nichola, Martin, Roy, Kevin, Peter
- Past summer scholars in this area: Chris Liu, Rahul Singhal and Vera Puti Puti Clarkson
- Advisor Andrew Sporle
- Statistics New Zealand
- NZCMS

Questions and Comments?