Life-course predictors of mortality inequalities

COMPASS Colloquium
Statistics New Zealand
Wellington, July 29 2015

COMPASS RESEARCH CENTRE

FACULTY OF ARTS
THE UNIVERSITY OF AUCKLAND

Whare Wānanga o Tāmaki Makaurau

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Outline

- **Background & Aims**

- **Methods**
  - New Zealand Longitudinal Census (NZLC)
  - New Zealand Census Mortality Study (NZCMS)

- **Some early results**
  - Siblings discordant for income
  - Unemployment

- **Conclusions and Next Steps**

Background

- Mortality rates in New Zealand (and worldwide) continue to decline
  - Number of deaths per year standardised by age, sex
- But socio-economic inequalities have increased (or, at least, not decreased)
  - Large variation in mortality rates by socio-economic conditions (and ethnicity)
- What can be done about this?
  - Need to understand nature of socio-economic influences in mortality in New Zealand, and the factors that ameliorate the effects of socio-economic risk.

Background

- **New Zealand Census Mortality Study (NZCMS)**
  - Linked Mortality Data to each Census from 1981–2006
  - Number of proximal factors important
    - Socio-economic status (SES), ethnicity, smoking, air pollution
  - Determine time trends and cause of death trends

- **New Zealand Longitudinal Census (NZLC)**
  - Link individuals across censuses 1981-2006 (2013)

- **Linking the two gives up to 25 years of socio-economic & other data linked to mortality**
  - Understand life-course factors important for mortality

Aims

Four research aims:

1. To test which 'life-course hypotheses' best explain associations between socio-economic status and mortality
2. To test whether social and cultural factors protect against socio-economic risk
3. To assess whether ethnic disparities in mortality are explained by the greater experiences of long-term socio-economic disadvantage
4. To assess mortality among siblings discordant for (i) socio-economic risk, or (ii) social and cultural factors

Life course Hypotheses
1. Accumulation

- Socio-economic influence on mortality accumulates across the life-course
  - Mortality risk increases with increasing time in poverty

- Evidence?
  - Number of life stages spent in low occupational SES linearly associated with cardiovascular and all-cause mortality (Sweden: Rosvall et al., 2006)

Life course Hypotheses
2. Critical/sensitive period

- *Critical period*

  - Socio-economic circumstances affect mortality <u>only</u> when experienced at certain periods of life

- *Sensitive period*

  - Effect of socio-economic experiences on mortality are <u>stronger</u> at some ages than others.

- Evidence?

  - Socio-economic deprivation experienced age 50-65 had stronger effects on mortality than that experienced earlier (Sweden: Mishra et al., 2013)

Life course Hypotheses
3. Social Mobility

- **Directional change in socio-economic circumstances impact mortality**
  - Mortality risk increases with deteriorating socio-economic conditions; and decreases with improving socio-economic conditions

- **Evidence?**
  - Mortality risk doubled among those whose socio-economic circumstances deteriorated from childhood to adulthood (Finland: Lynch et al., 1994)

Life course Hypotheses
4. Instability

- **Unstable socio-economic conditions over the life-course will be associated with mortality**
  - Mortality risk increases with increasing socio-economic instability

- **Evidence?**
  - Unpredictable incomes associated with mortality (USA: McDonough et al., 1987)
  - Unpredictable environments have independent (and possibly stronger) effects than harsh environments on health

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Life course Hypotheses Intervention Implications

- **Accumulation hypothesis** suggests an intervention targeting all age groups

- **Critical/Sensitive period hypothesis** suggests intervention at certain life-stages only

- **Mobility hypothesis** suggests lifting people out of poverty (or preventing slides into poverty) should be an intervention target

- **Instability hypothesis** suggests buffering against unpredictability

Social and Cultural Factors

- **What ameliorates effects of socio-economic conditions?**

  - Important from intervention point of view

  - Social factors? Social support has been shown to lower mortality risk
    - Other factors: volunteering

  - Cultural factors? Ethnic density (neighbourhood concentration of one's own ethnic group) has been associated with better health among Māori, and with mortality in other jurisdictions
    - Other factors: language, religion, time in New Zealand

Life-course explanations for ethnic disparities

- **Ethnic disparities in mortality in NZ are large**
    - Māori have mortality rates that are 2.5 times, and Pacific 1.6 times, that of non-Maori, non-Pacific.

- **30-40% of inequalities between Māori and non-Māori explained by socio-economic factors in the years immediately preceding death.**
    - How much <u>could</u> be explained if socio-economic factors were assessed over a greater portion of the life course?
    - And do social and cultural factors play a role

Discordant Sibling Analyses

- **Use of a Census cohort containing data within family units allows us to compare mortality rates for siblings differently exposed to socio-economic risk**
  - 'Discordant sibling design' eliminates confounding associated with shared family background, and partly controls for genetic confounding

- **RQ: Is life course SES associated with mortality once family background effects have been controlled using a discordant sibling design**

Questions?

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Methods
- Overview

➡ **Link**

Longitudinal census records (NZLC)

- ➕ Individuals linked between adjacent Censuses: 1981, 1986, 1991, 1996, 2001, 2006

➡ **To**

Mortality records (NZCMS)

- ➕ Individuals from Censuses in 1986, 1991, 1996, 2001 and 2006 linked to mortality records for
  - 3 years following 1986, 1991 and 1996 censuses
  - 5 years following 2001 and 2006 censuses

➡ **Using**

Census IDs

Methods
- Ethics

- **Privacy and Ethics**
    - Individuals <u>not</u> identifiable, and not monitored. Group comparisons only

    - Two privacy impact assessments undertaken for NZLC
        - "risk to an individual of a privacy breach is extremely low"
        - Risk of breach no greater than for individual census data use

    - NZCMS undergone privacy assessment and has ethical approval from the Central Regional Ethics Committee

    - University of Auckland Human Ethics Committee granted approval for proposed research (ref 012400)

NZLC
- What is it?

- A data link between adjacent NZ Censuses: 1981, 1986, 1991, 1996, 2001, 2006, (2013!)

  - 'Backwards': t,t-1 (e.g., 2006->2001)

  - Theoretical population: those >=5yo who have lived in the country for at least 5 years (82-88% of total popn)

  - Largely deterministic, based on sex, dob, area of residence 5y ago, (country of birth, Māori descent)
    - Approx 3% probabilistic

  - 15 cohorts altogether
    - Joining links of adjacent Censuses

NZLC
- 15 Cohorts

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

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Linkage Bias -Why an issue with NZLC?

- **Linkage bias is a specific type of 'selection bias'**
  - Those linked (selected) differ from those not linked
  - X-Y associations in the selected sample differ from X-Y associations in the full sample

- **Bias likely because**
  - Incomplete linkage (31%-75% of population)
  - Linkage varies as a function of various factors
    - Age, Sex, Residential mobility, Deprivation, Relationship Status, Housing Tenure, Ethnicity

- **Are associations biased?**

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Linkage Bias
-Why an issue with NZLC?

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- **CAN'T assess full extent of bias**
  - Don't know associations among the unlinked

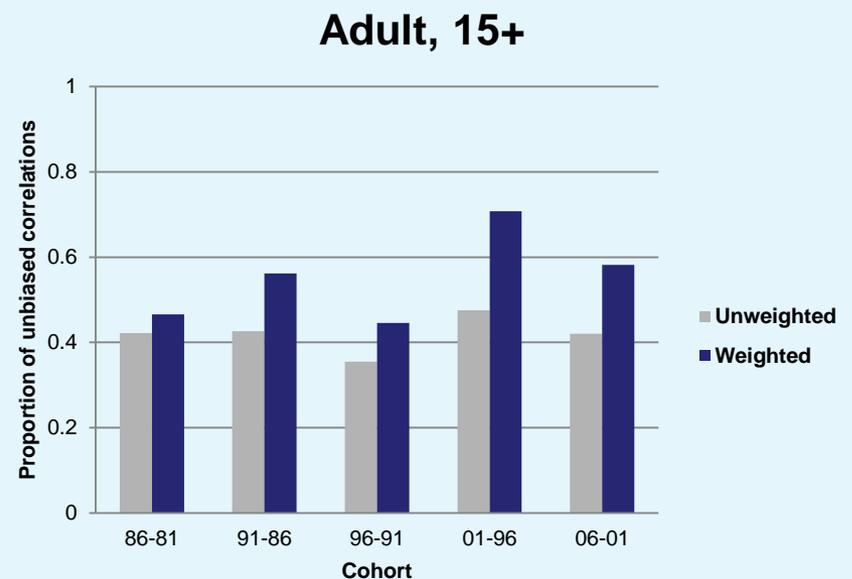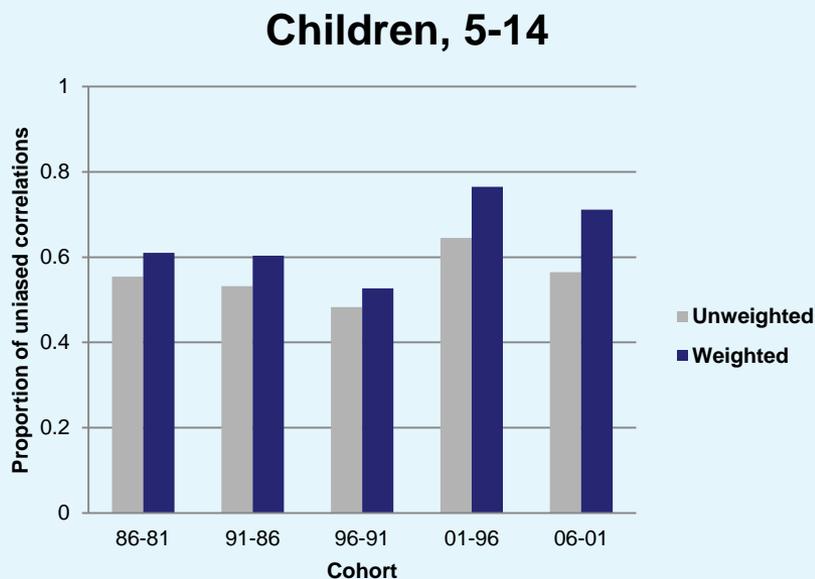- **BUT each linked cohort is nested within another (or within a single Census)**

- **So, CAN assess bias of nested cohort against cohort (or Census) one level up. E.g.,**
  - Among those linked back from 2006 to 2001, are 2006 associations biased?
  - Among those linked back from 2006 to 1996, are 2006-2001 associations biased?

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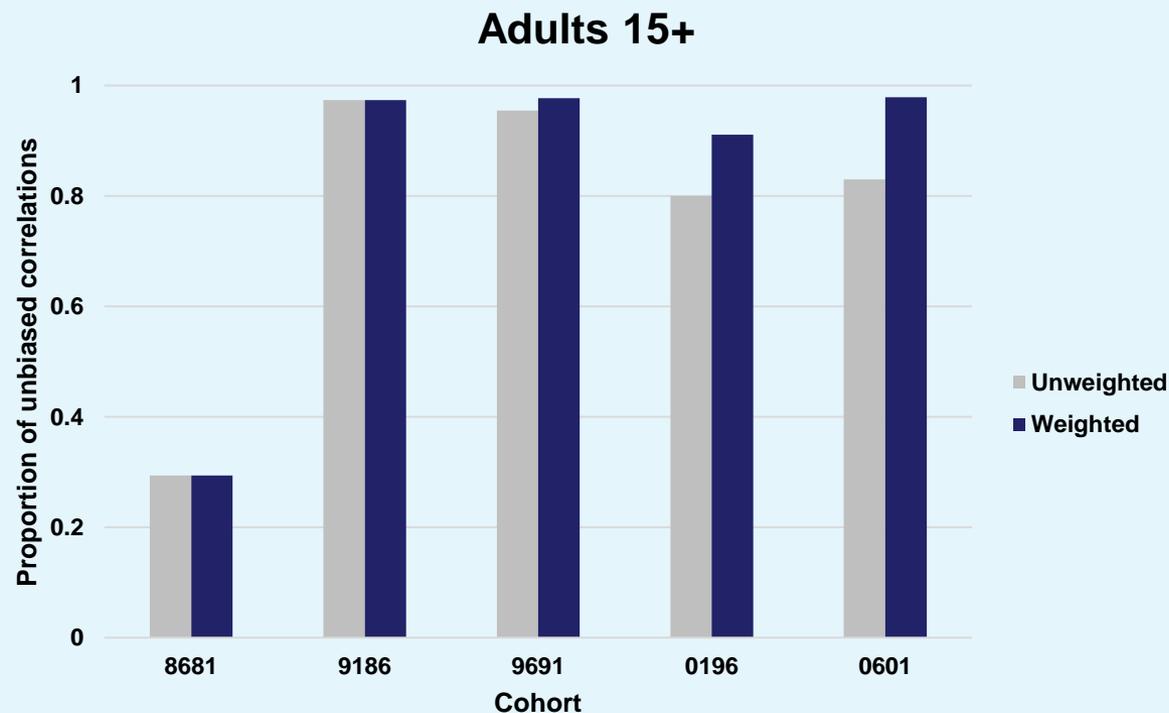# Linkage Bias -Can we adjust for it?

- **Compare two-way correlations**
  - Full census vs sample linked back to previous census
  - Consider <.01 magnitude differences as unbiased...
  - Modest improvement across all cohorts; more for adults
  - Similar results for 'longer' cohorts (3+ censuses)

Children, 5-14

Adult, 15+

Linkage Bias
- Mortality associations

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- However, few associations with mortality biased (except 1986-81)

Adults 15+

Bar chart. Y-axis: Proportion of unbiased correlations (0 to 1). X-axis: Cohort (8681, 9186, 9691, 0196, 0601). Series: Unweighted (grey), Weighted (dark blue).

NZCMS
- What is it?

- Probabilistic linkage of each Census (1981-2006) to subsequent (3 or 5 year) mortality records
    - Proportion of mortality records linked ranges from 71% (1981) to 81% (2001)
    - Accuracy of linkage estimated at 97-98%.
    - We don't use 1981 mortality records (no longitudinal link back)

- Bias weights (similarly) estimated based on the characteristics predicting linkage

Preliminary Analyses

- A first peek (preliminary)

- Adjusted for bias (NZLC bias weight x NZCMS bias weight)

- Logistic regression <u>only</u> (dead vs not)

- All cause mortality <u>only</u>

- Analyses among those surviving 1981-2006, who then died (or not) in the subsequent 5 years

- Rudimentary longitudinal variables

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1. Sibling comparisons - Income and mortality

- �«Is the effect of income on mortality due to familial confounding?

- �«Test by comparing mortality risk (2006-2010) among siblings discordant for income:
  - ◦ <u>Number of times</u> in lowest income quintile 1981-2006
  - ◦ Controls: birth order (age), sex, socio-economic factors (education, unemployment, motor vehicle access), family factors (household size and structure, residential moves), disability

- ◦ First task is to identify sibling pairs

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From 1981 census

All individuals 2.88 million

Family code '00' — 1st family in the dwelling — **Family code '01'** — **Family code '02'** ... **Family code '05'**

Sibling pairs in 1981 — **Son/daughter to occupier** — **Son/daughter to occupier** (n~517,000 pairs)
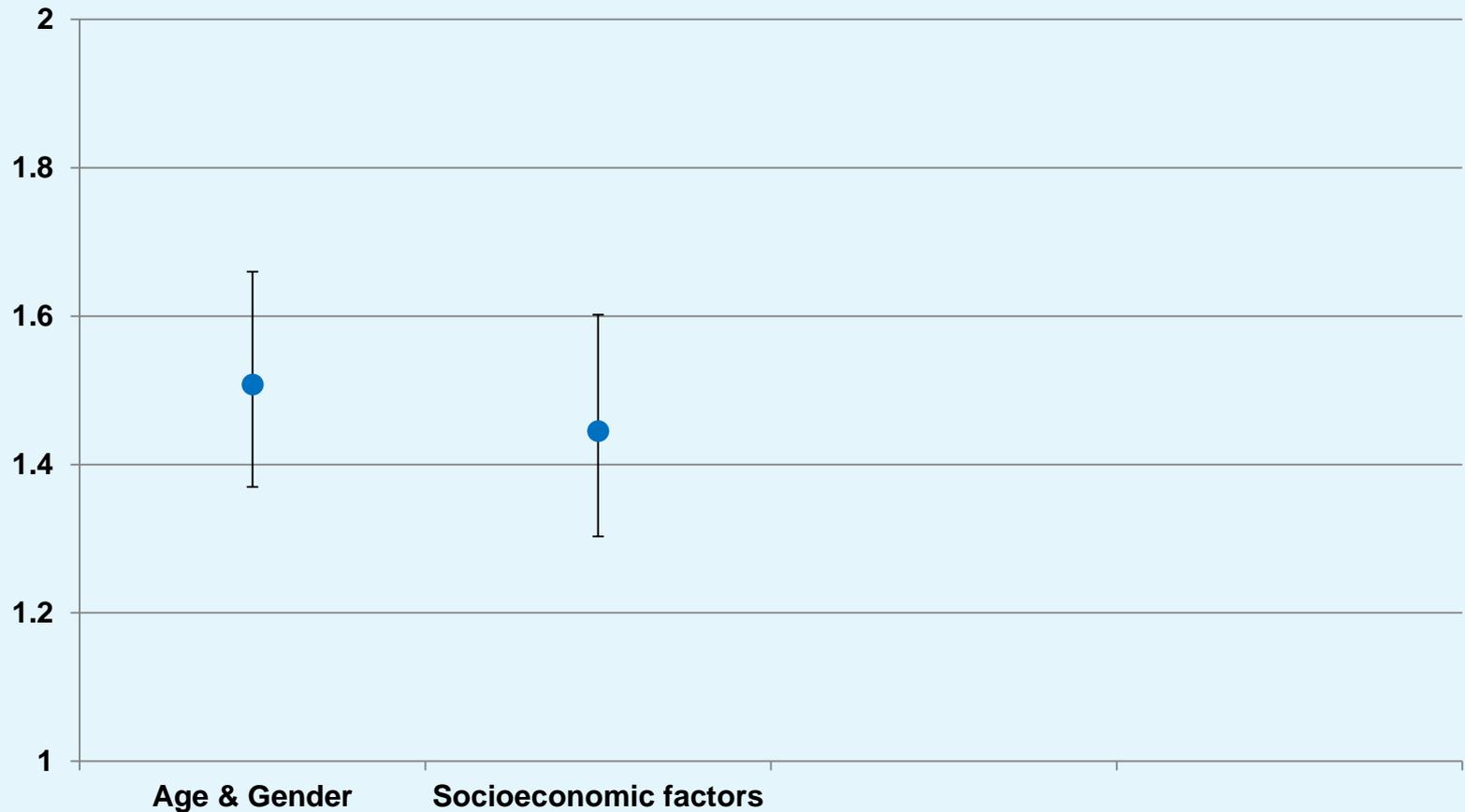
Linked from 1981-2006 — **Siblings** (n~32,000 pairs)

1. Sibling comparisons
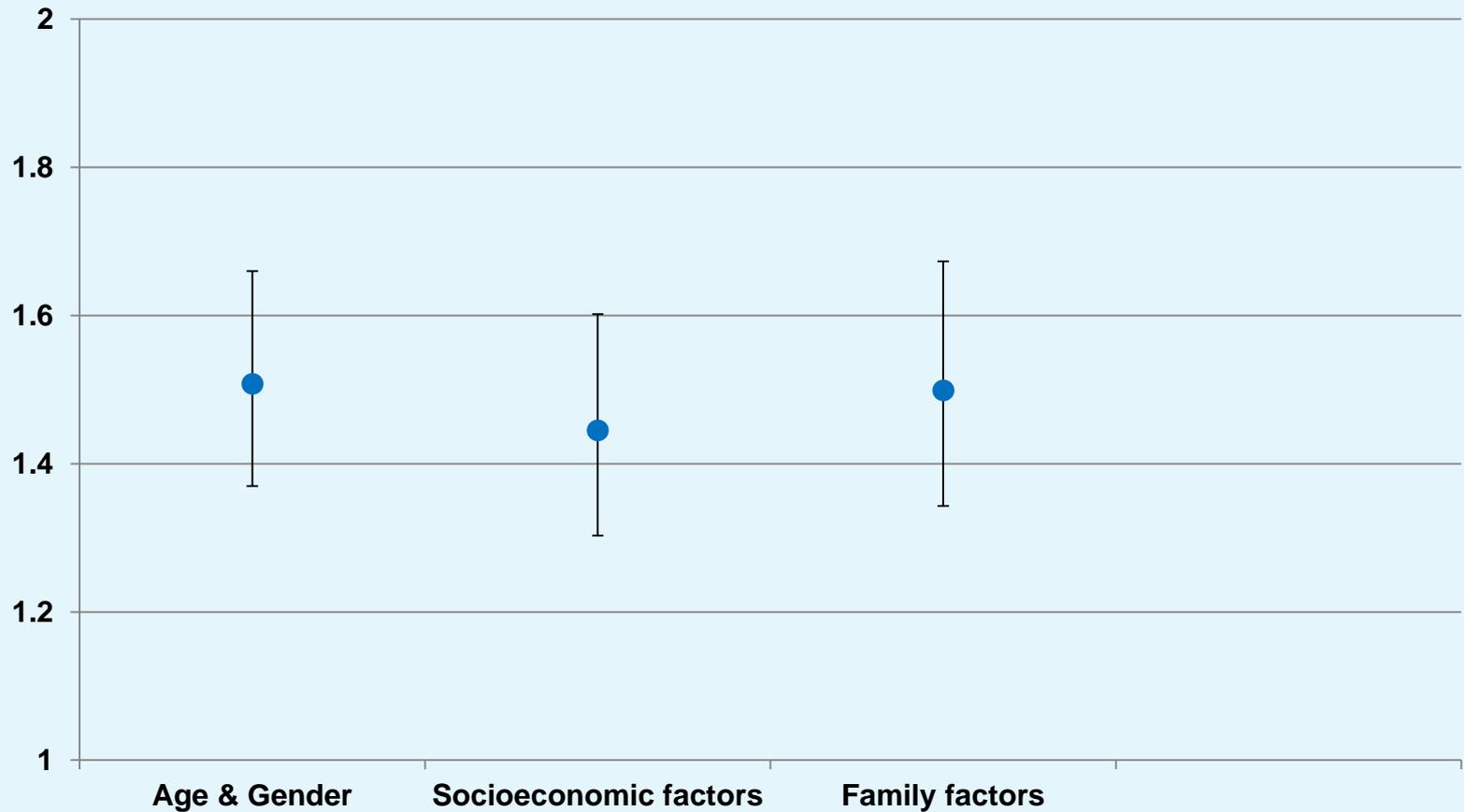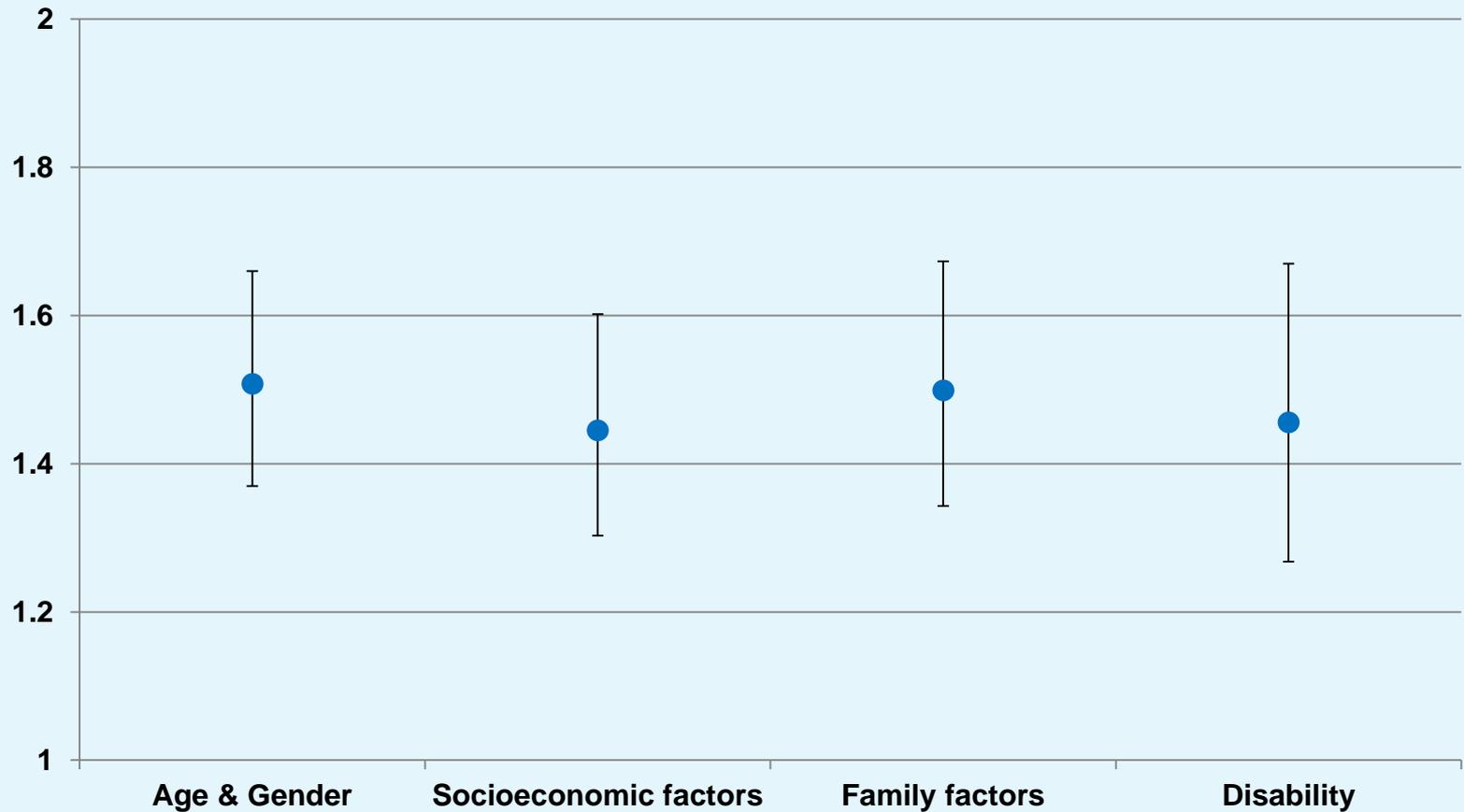- Income and mortality
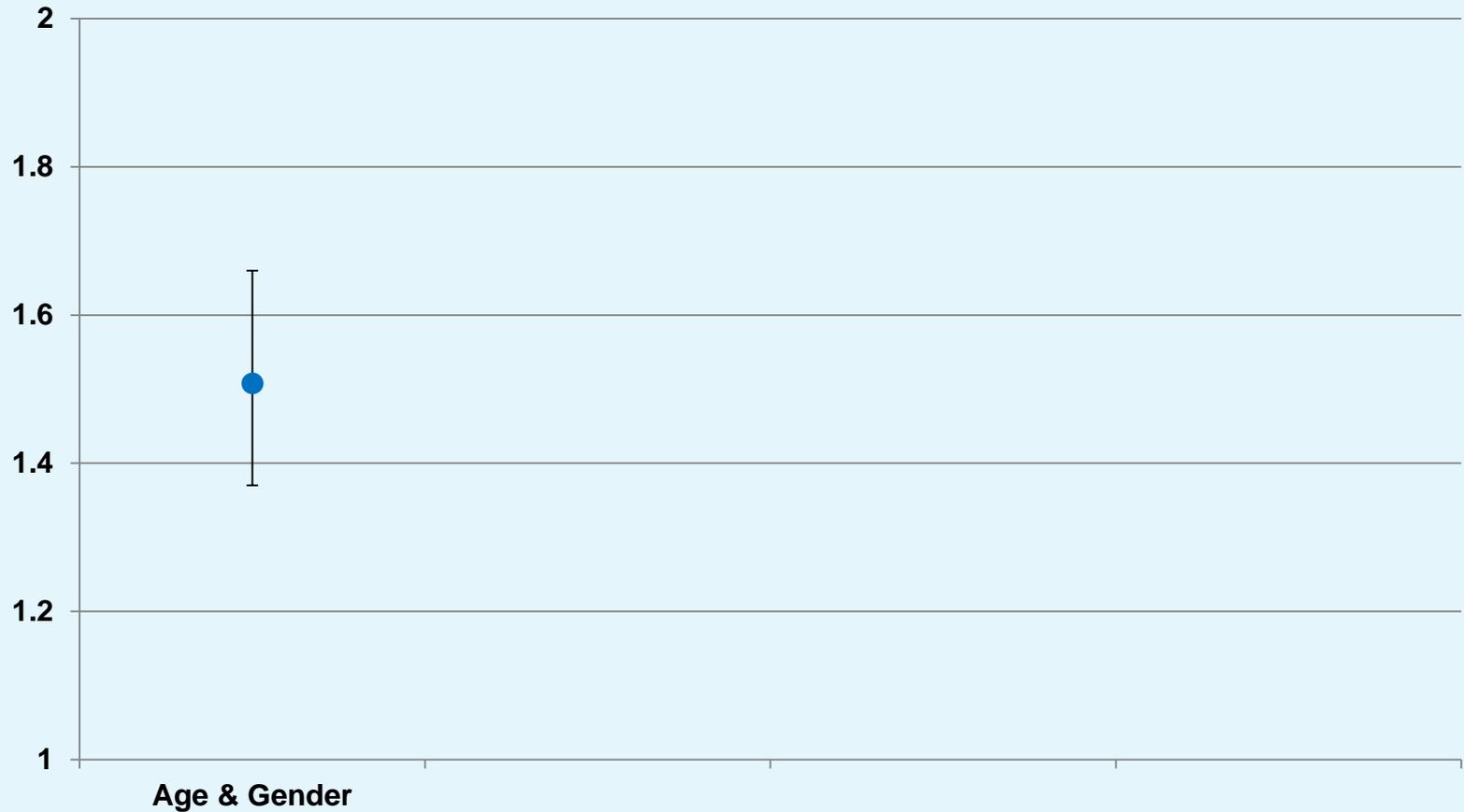
Increased odds of death among 'poorer' sibling
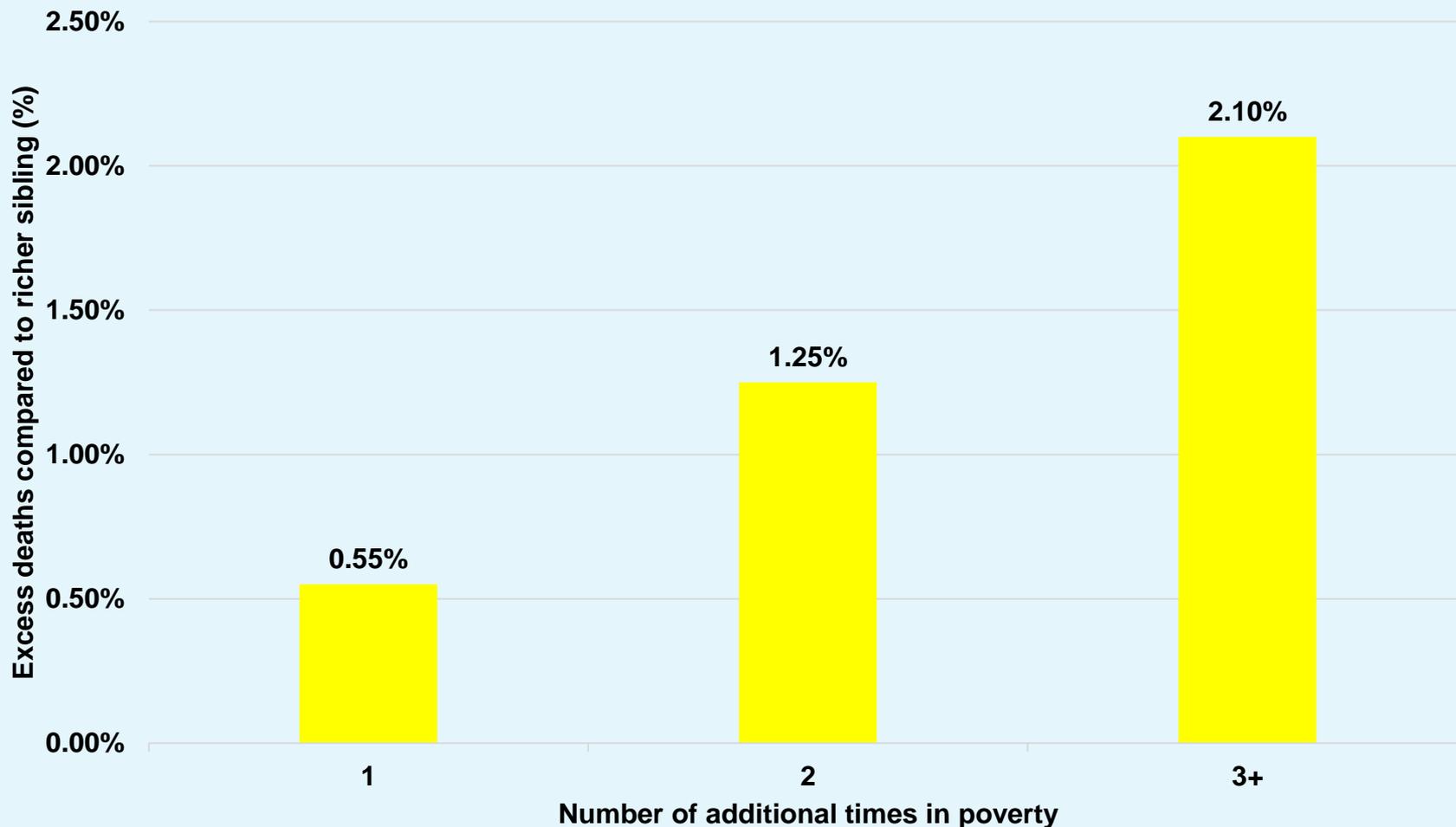
1. Sibling comparisons - Income and mortality

Increased odds of death among 'poorer' sibling

1. Sibling comparisons - Income and mortality

Increased odds of death among 'poorer' sibling

Increased % mortality, poorer sibling

Excess deaths compared to richer sibling (%)

- 2.50%
- 2.00%
- 1.50%
- 1.00%
- 0.50%
- 0.00%

2.10%

1.25%

0.55%

Number of additional times in poverty: 1, 2, 3+

2. Unemployment and mortality

- Evidence that periods of unemployment and mortality
    - Mostly short term
    - Often comparing country/state unemployment <u>rates</u> and their effect on mortality rates (as opposed to associations at the individual level)

- Assess impact of <u>number of times</u> unemployed 1981-2006 on subsequent mortality 2006-2010
    - Control factors: Age and gender, education, socio-economic factors (education, deprivation, crowding, tenure), smoking, family structure, disability)
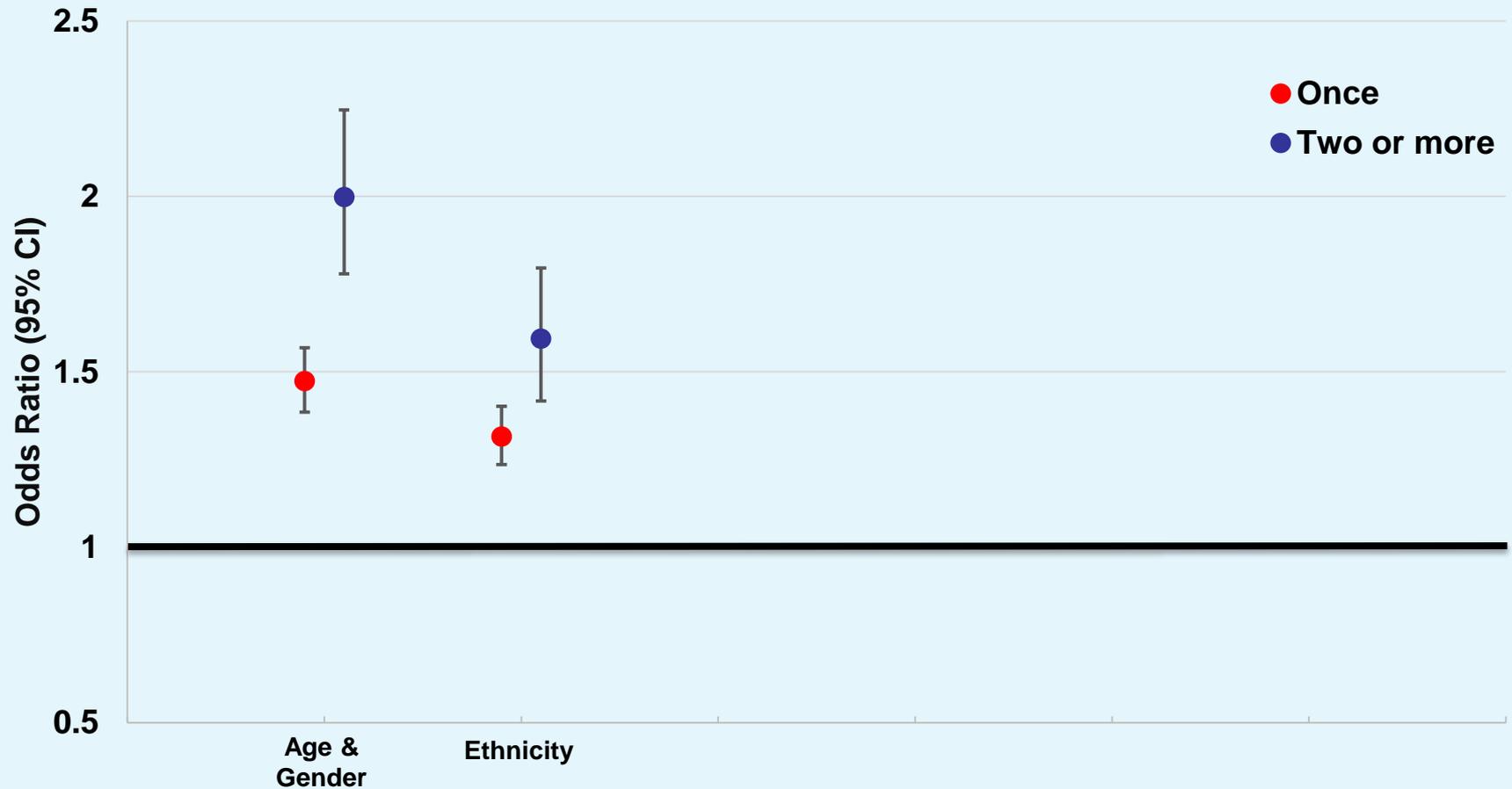
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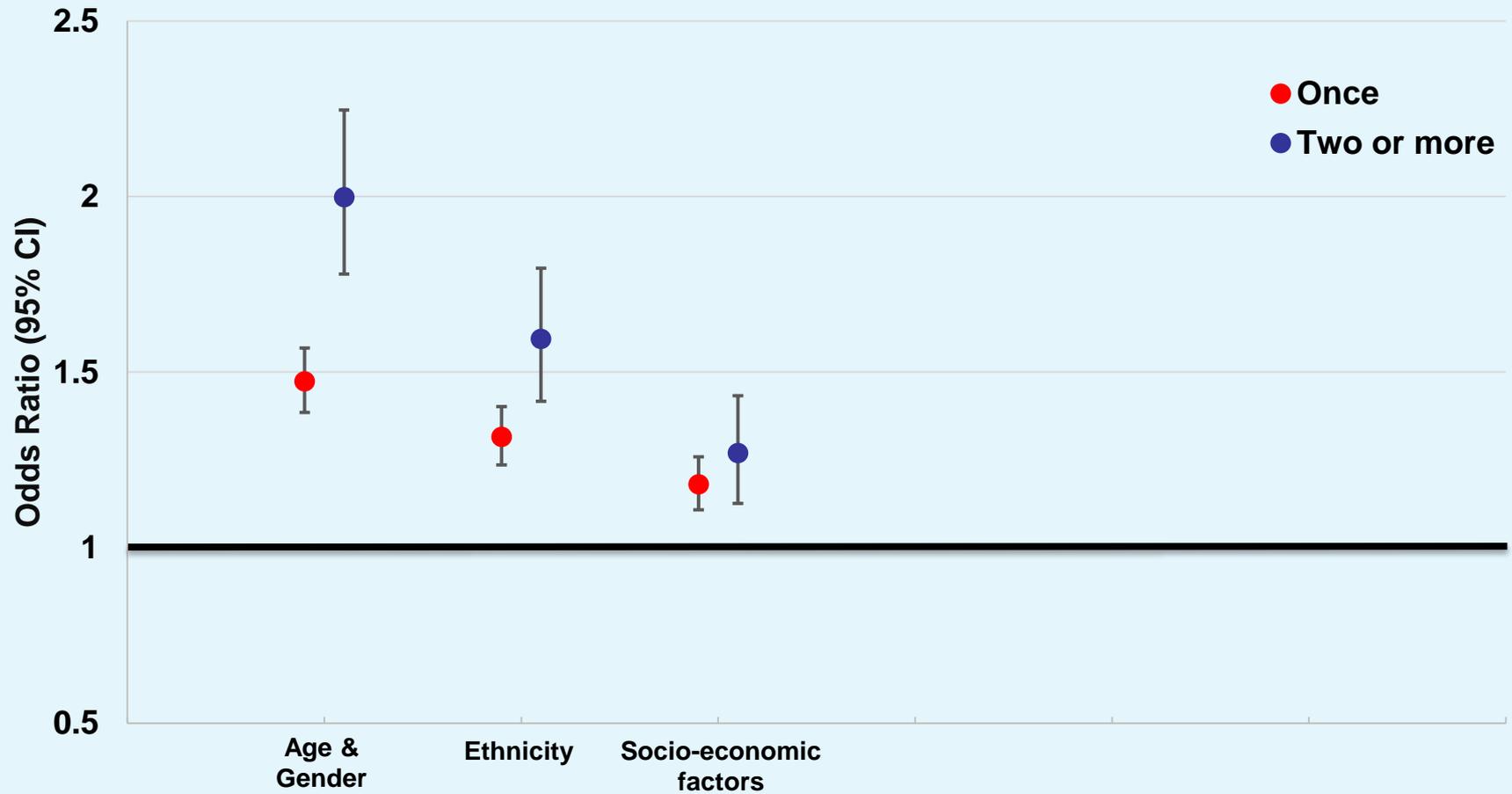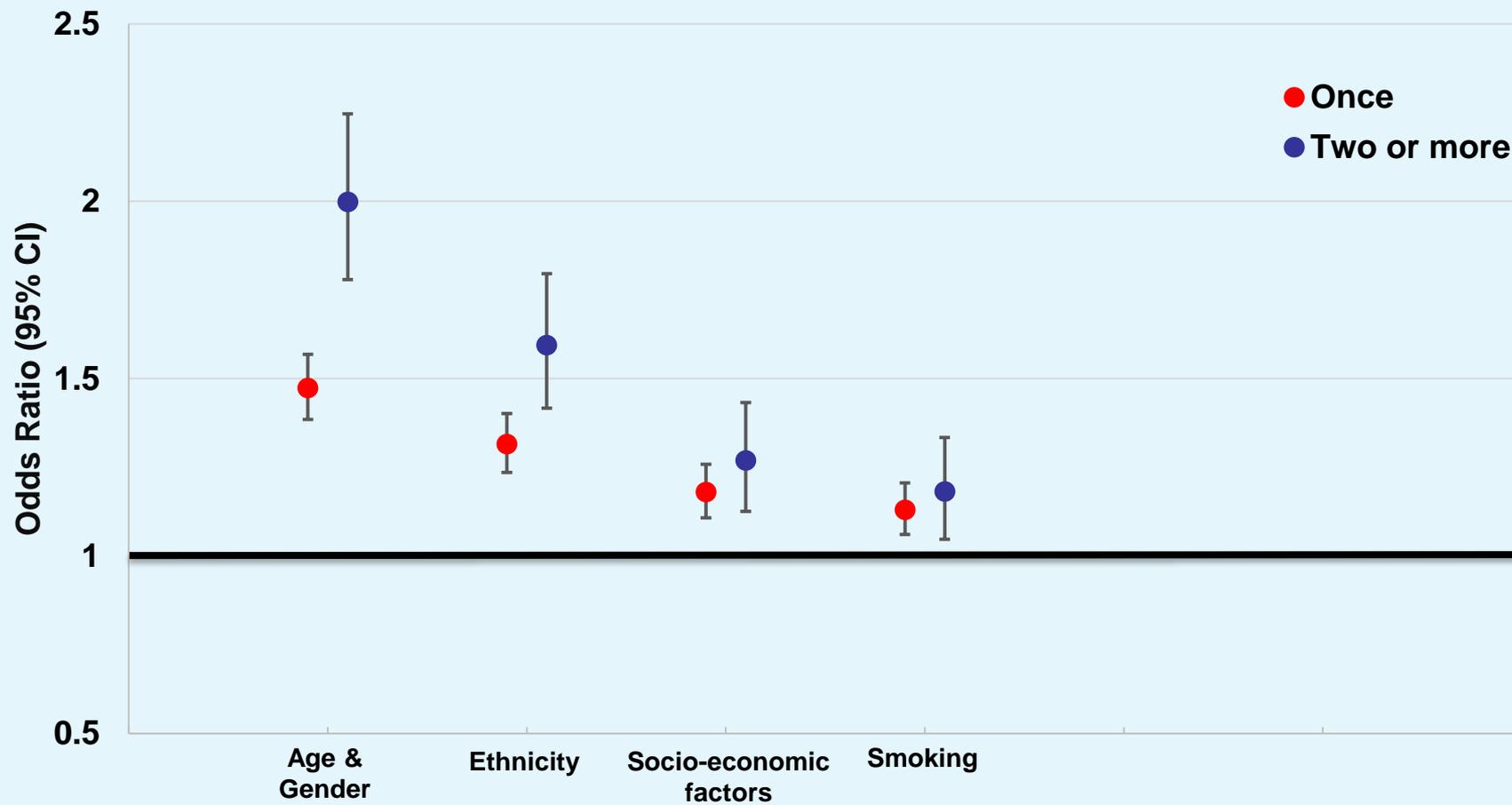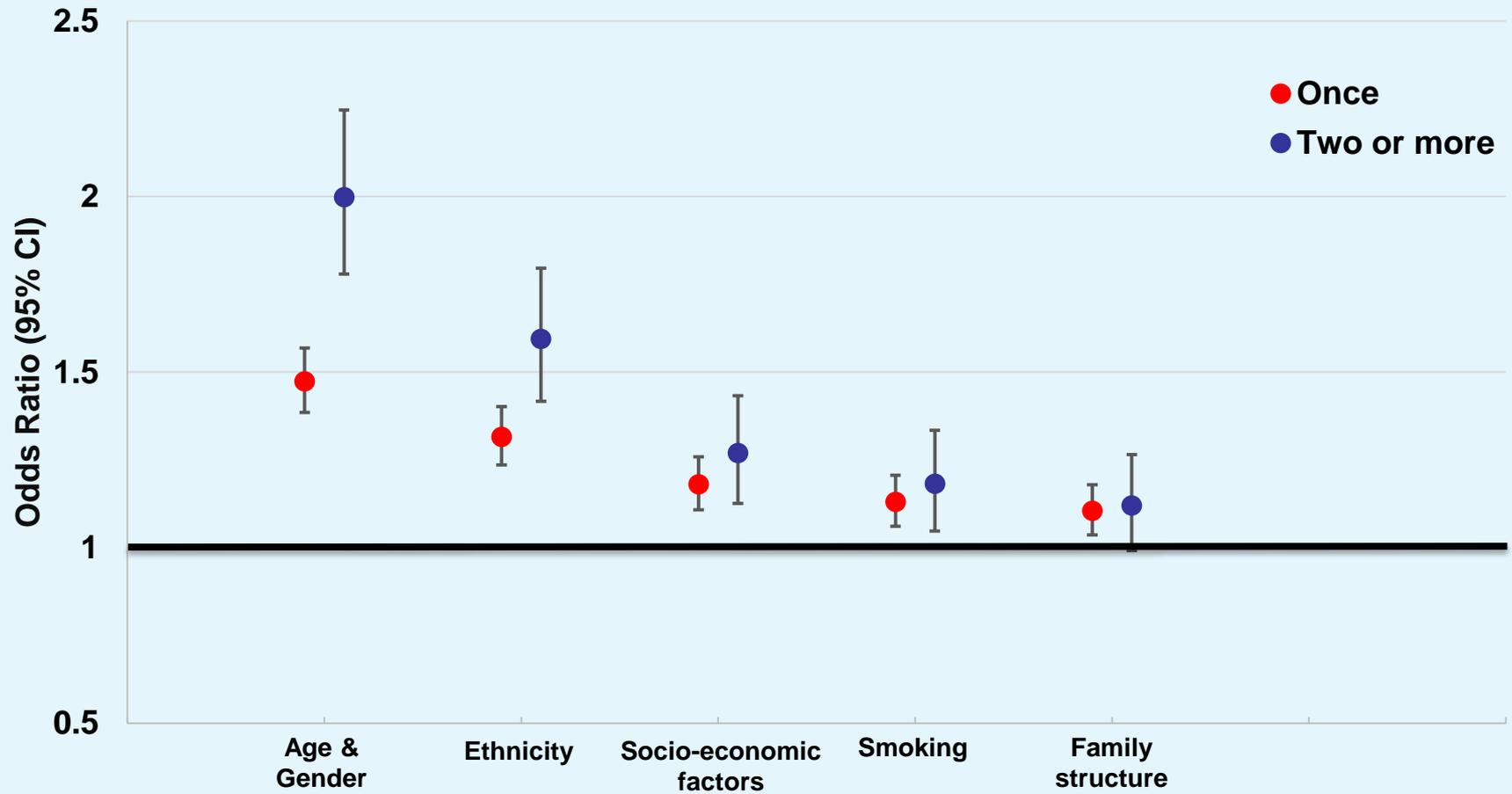# 2. Unemployment and mortality

Unemployment and Mortality

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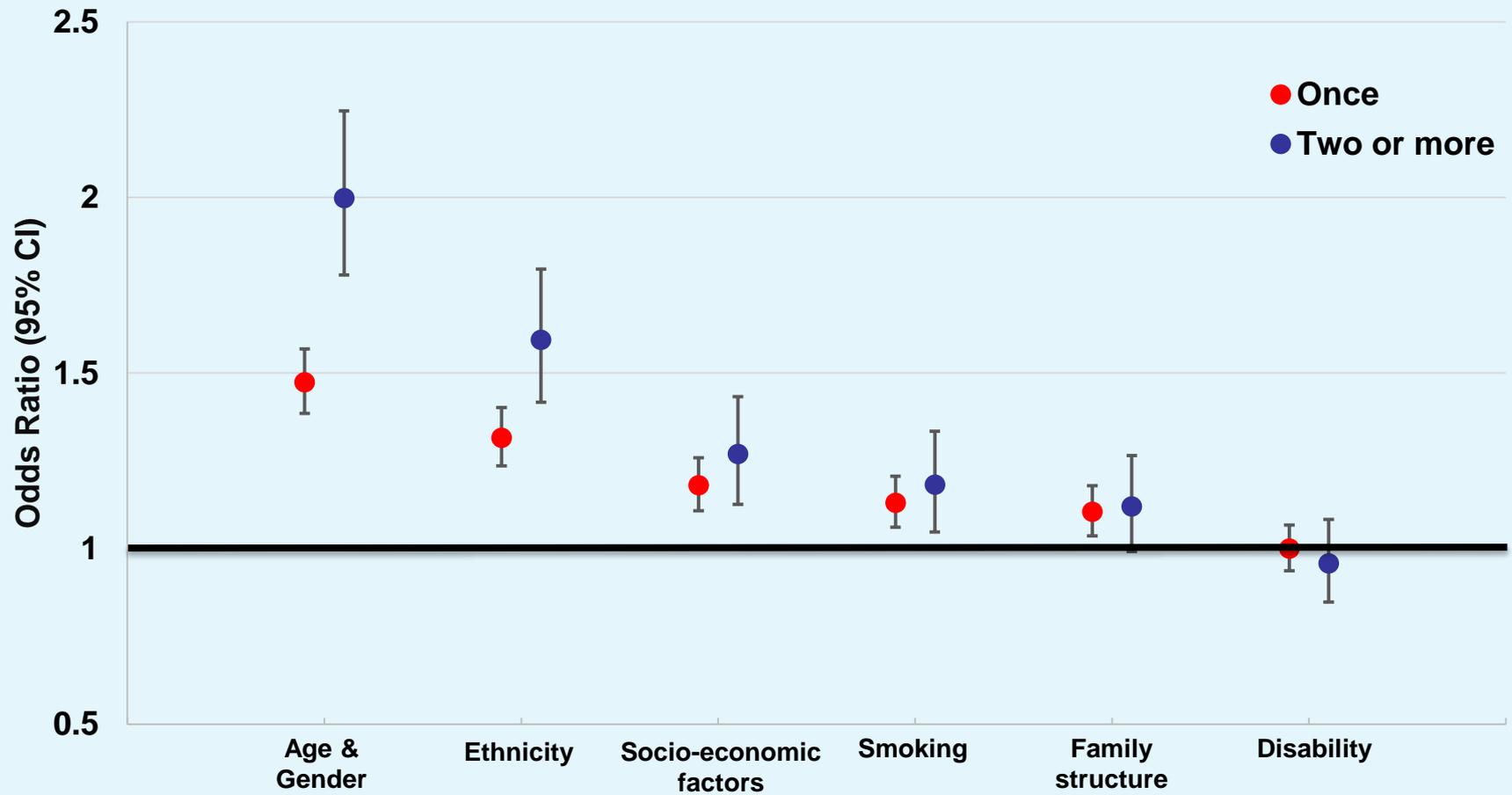
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Unemployment and Mortality

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Unemployment and Mortality

Unemployment and Mortality

Conclusions

- **LOTS** of possibilities with these data
  - More nuanced analyses, with more sensitive variables, will help elucidate association between life-course SES and mortality, and mediating factors

- Early analyses are revealing
  - Association between life-course poverty and mortality robust to family confounding
  - Periods of unemployment increase risk of mortality (mediated by other socio-economic factors, family turmoil and disability)

Next Steps

- Test the life-course hypotheses
- Investigate how much of ethnic differences in mortality risk is explained life-course socio-economic experiences
- Further test of sibling analyses
- Explore the role of social and cultural factors
  - Ethnic density appears to have some effects (need to disaggregate by ethnicity)
  - Living alone (lack of social support) also appeared to be important

QUESTIONS?

- **Acknowledgments**
  - Stats NZ: Robert Didham, Kirsten Nissen, Wendy Dobson, Microdata Access team
  - COMPASS team: Peter Davis, Roy Lay-Yee, Jessica McLay, Vera Puti Puti Clarkson, Rahul Singhal, Liza Bolton, Fui Swen Kuh, Justin Gunter
  - Others: Tony Blakely, June Atkinson, Andrew Sporle, Alan Lee

QUESTIONS?

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Accumulation hypothesis

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