Adjusting for linkage bias in the New Zealand Longitudinal Census

COMPASS Colloquium
July 2014

COMPASS RESEARCH CENTRE
FACULTY OF ARTS
THE UNIVERSITY OF AUCKLAND
Whare Wānanga o Tāmaki Makaurau

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Outline

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- New Zealand Longitudinal Census (NZLC)
  - Background
  - What is it?
  - How is it being used?
    - Life-course predictors of mortality inequalities
- Linkage Bias
  - What is it?
  - Why is it an issue with the NZLC?
  - Can we adjust for it?
- Conclusions

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NZLC
- Background

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- Census covers whole population, but is cross-sectional snapshot in time
- Greater understanding of time trends and social processes if Census had longitudinal component
  - What is the extent of ethnic mobility and what factors explain changing ethnic identification?
  - Is geographical mobility increasing in NZ
  - What are the long term consequences of poverty?
- Possible if could link records across Censuses
  - Other countries (UK, Australia) have linked Censuses

NZLC
- What is it?

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- A data link between individuals in adjacent Censuses: 1981, 1986, 1991, 1996, 2001, 2006
  - ‘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)
  - 70-76% linkage (approx 3% probabilistic) between adjacent Censuses
  - 15 cohorts altogether
    - Joining links of adjacent Censuses

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NZLC - What is it?

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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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NZLS
-How is it being used?

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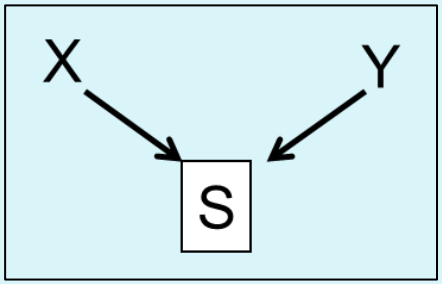
- Description and assessment of bias
  - COMPASS, Stats NZ (Kirsten Nissen, Robert Didham, Wendy Dobson)
- Ethnic mobility
  - Robert Didham
- Life-course predictors of mortality inequalities
  - COMPASS, StatsNZ, UOW (Tony Blakely, June Atkinson) - HRC funded
  - Link between NZLC and NZ Census Mortality Study, allowing assessment of socio-economic risk factors in (up to) 25 years leading up to death.

Linkage Bias -What is it?

- A specific type of ‘selection bias’ (as it concerns us)
  - Those selected (linked) differ from those unable to be linked
  - X-Y associations in the selected sample differ from X-Y associations in the full sample
    - IE., associations are biased by selection



Linkage Bias
-Why an issue with NZLC?

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- There is incomplete linkage between Censuses
  - 31%-75% of theoretical population linked, depending on the cohort
- Linkage varies as a function of various factors
  - Age, Sex, Residential mobility, Deprivation, Relationship Status, Housing Tenure, Ethnicity
- With so many factors associated with linkage, it is possible that biased measures of association will be obtained
- Are associations biased?

Linkage Bias
-Why an issue with NZLC?

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- CAN'T assess full extent of bias for longitudinal associations
  - 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?

Linkage Bias
-Why an issue with NZLC?

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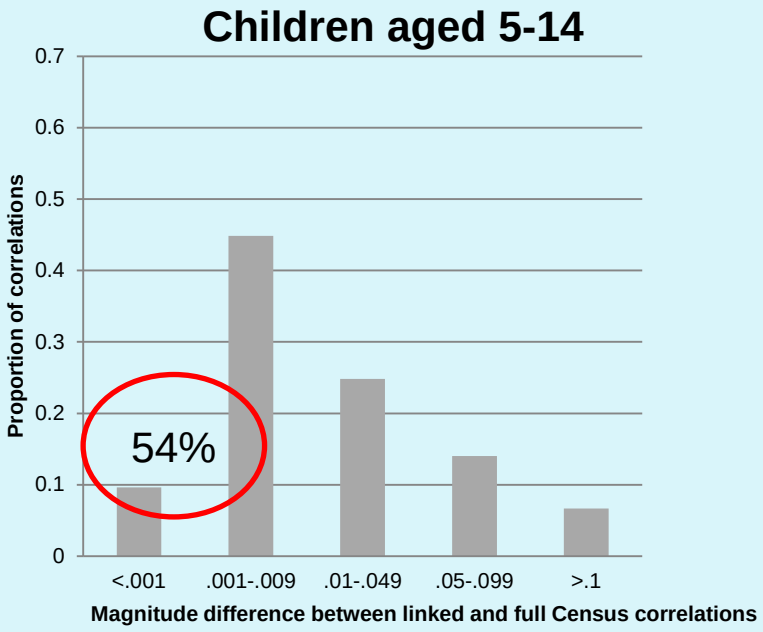
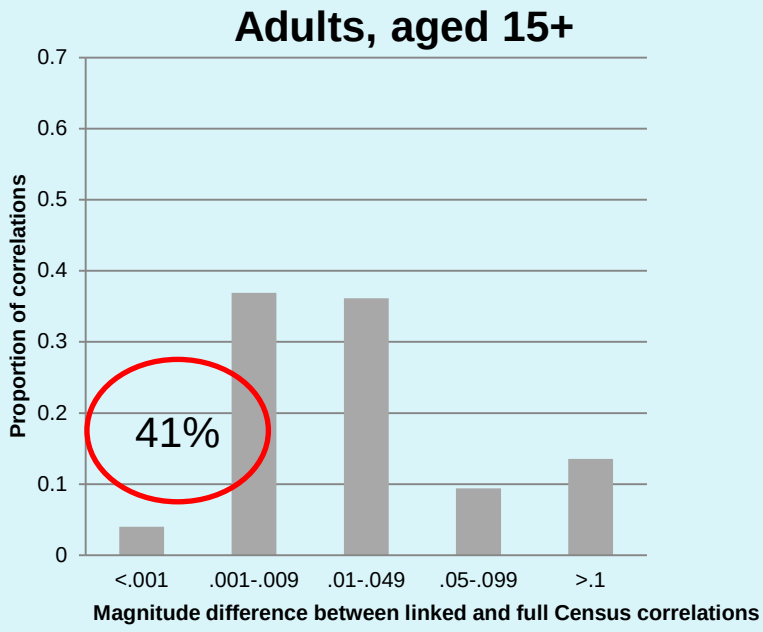
- Assessed 2-way (X-Y) correlations between 30 (children) & 44 (adult) variables for
  - Full (linkable) Census in 2006; Sample linked from 2006 to 2001
  - Assess magnitude of difference between two sets of correlations





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Linkage Bias -Can we adjust for it?

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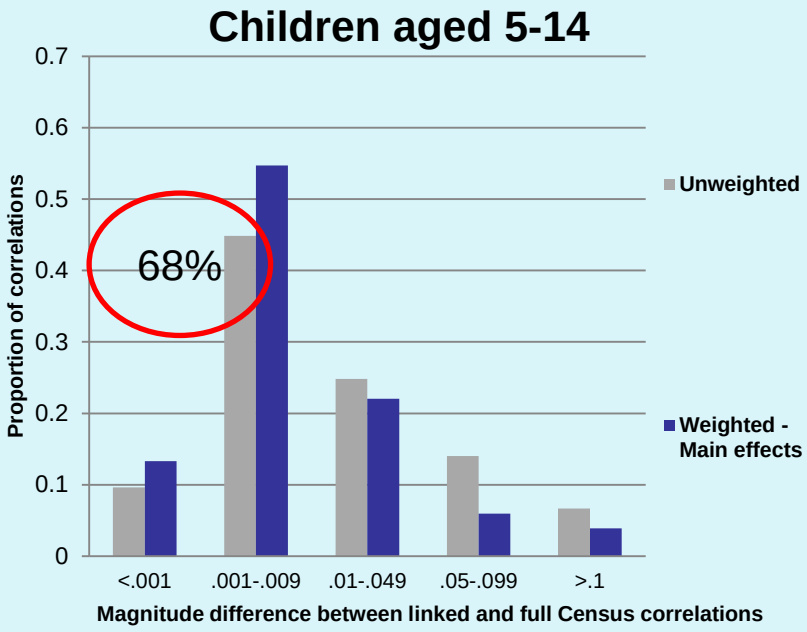
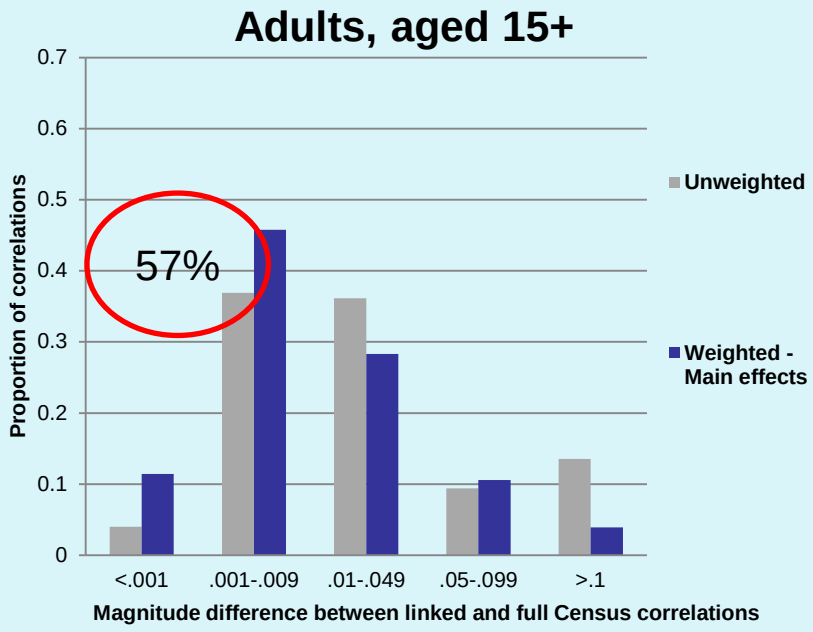
- Calculated each individuals propensity to be linked, based on their characteristics
  - logistic regression model including main effects only
- Weighted by inverse of these propensities in analyses (as per AusLC)





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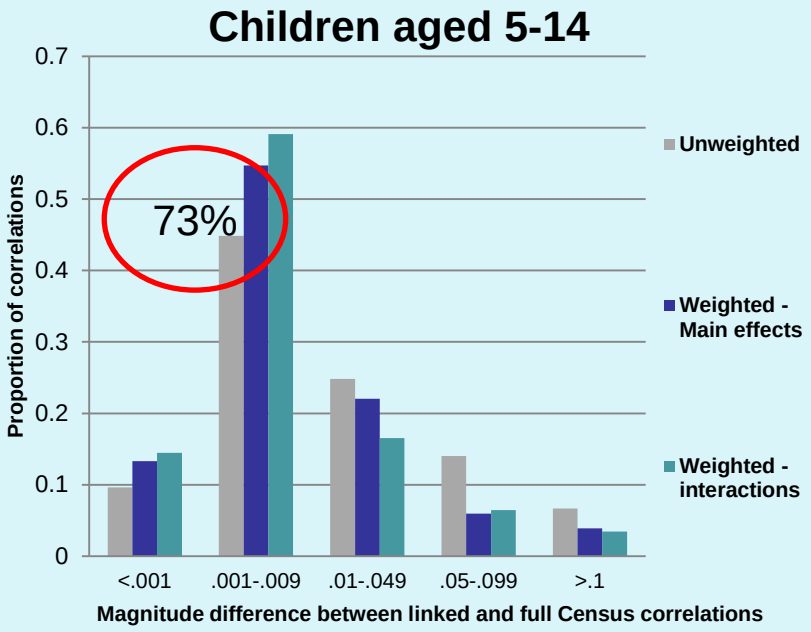
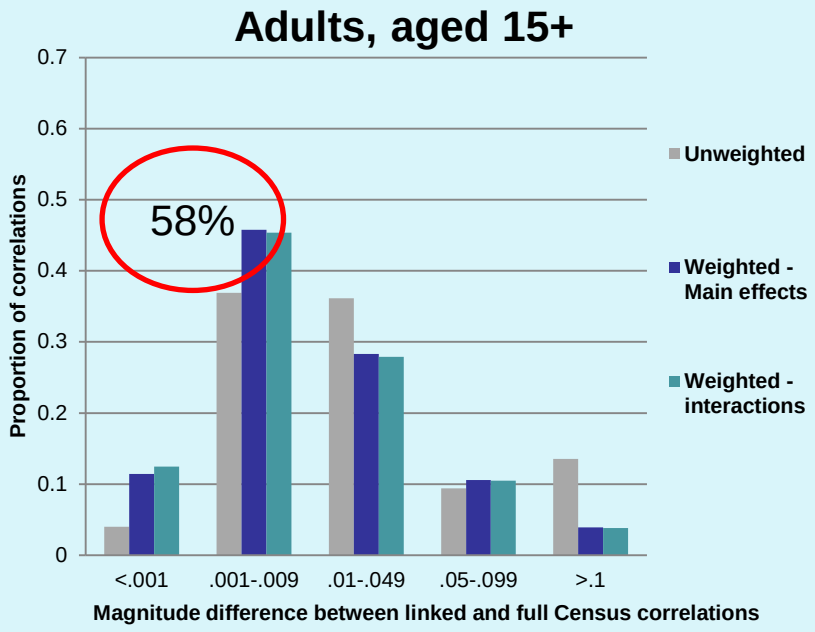
- Calculated each individuals propensity to be linked, based on their characteristics
  - logistic regression model including main effects and interactions
- Weighted by inverse of these propensities in analyses (as per AusLC)





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- Initial attempts suggest we can reduce bias but not eliminate it
  - Only tried one cohort with one approach
  - Other approaches being considered – tree regression
- Suggestion that associations less affected by bias with covariates controlled
  - SOFIE data - Carter et al (2012)
  - Might this help with NZLC data?
  - Worked example: regress income against sex, age, ethnicity, deprivation, education (adults aged 20-69)

Linkage Bias -Can we adjust for it?

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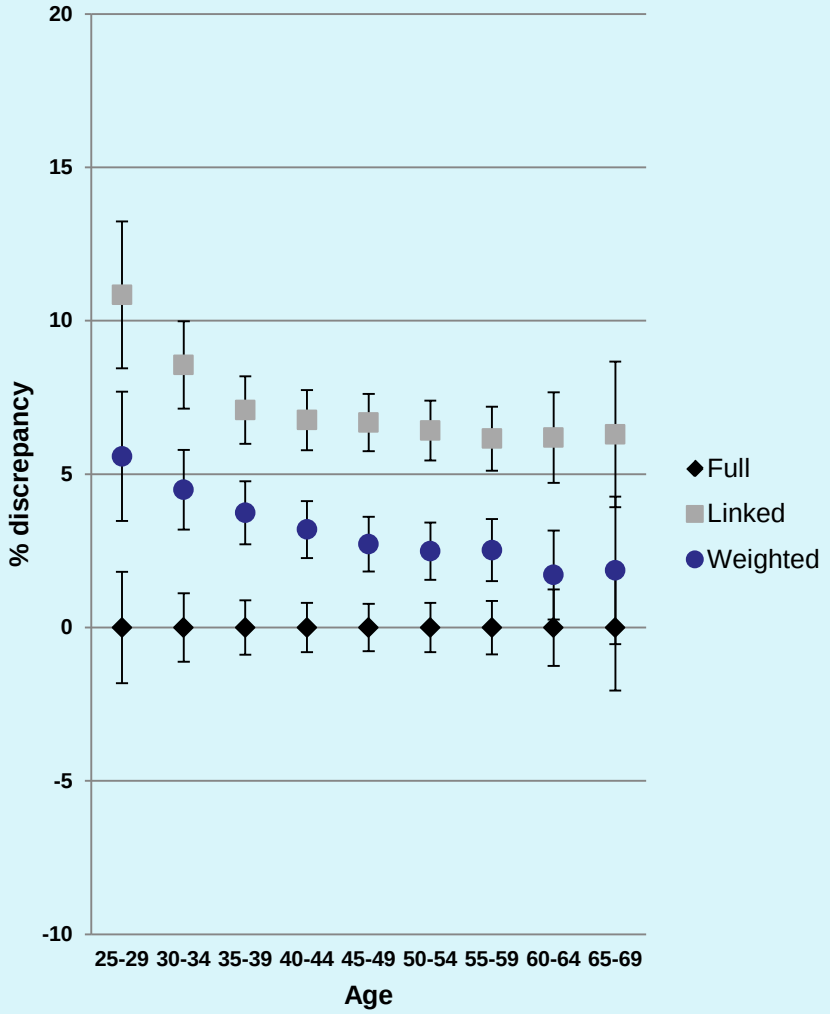
	Full	Linked	Weighted
20-24	--	--	--
25-29	$9,900	$11,000	$10,400
30-34	$15,600	$16,900	$16,300
35-39	$18,800	$20,200	$19,500
40-44	$20,300	$21,700	$21,000
45-49	$21,300	$22,700	$21,800
50-54	$21,000	$22,400	$21,500
55-59	$20,100	$21,400	$20,600
60-64	$16,200	$17,200	$16,400
65-69	$13,200	$14,000	$13,400



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Linkage Bias
-Can we adjust for it?

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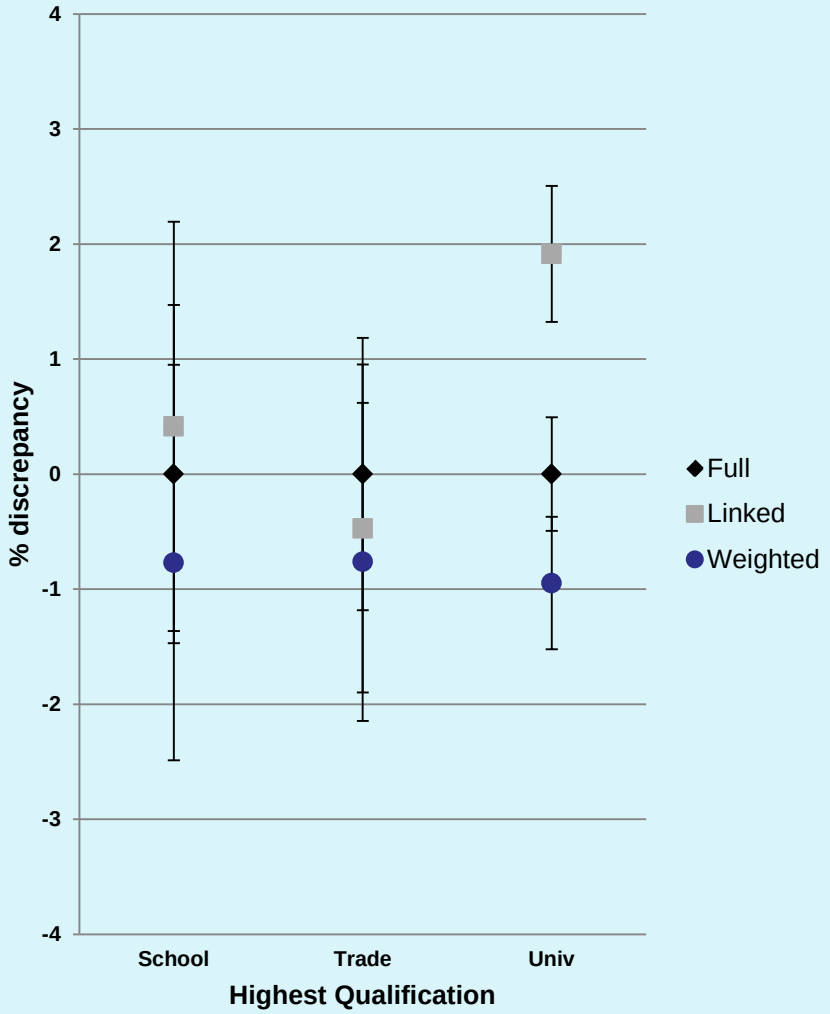
	Full	Linked	Weighted
None	--	--	--
School	$8,000	$8,000	$7,900
Trade	$10,000	$10,000	$10,000
Univ	$26,900	$27,500	$26,700



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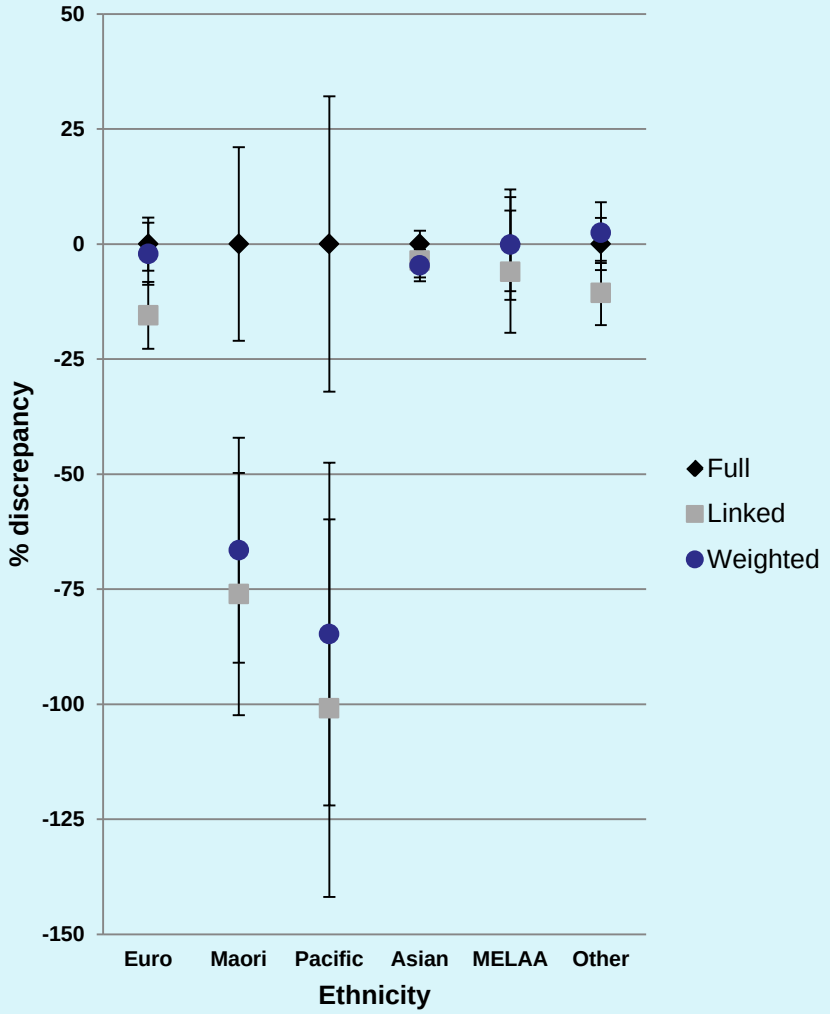
	Full	Linked	Weighted
Euro	$2,800	$2,300	$2,700
Maori	-$700	-$200	-$200
Pacific	-$700	$0	-$100
Asian	-$7,500	-$7,300	-$7,200
MELAA	-$5,900	-$5,500	-$5,900
Other	$3,100	$2,800	$3,200



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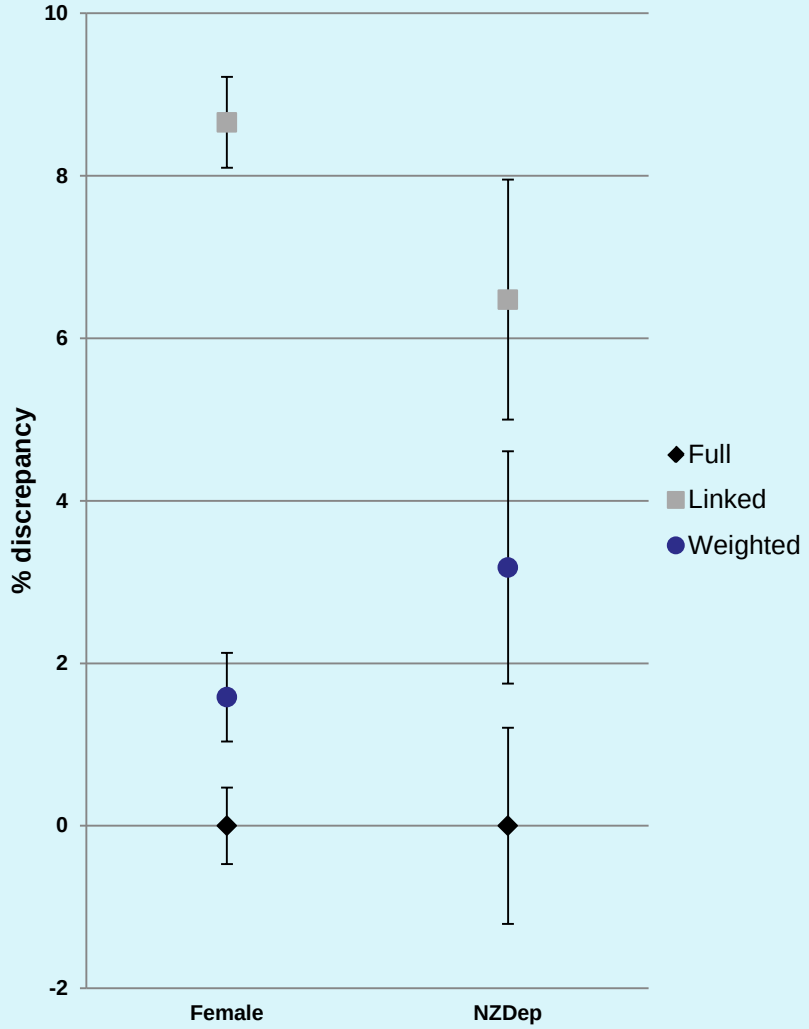
	Full	Linked	Weighted
Female	-$16,700	-$18,100	-$16,900
NZDep	-$1,000	-$1,100	-$1,000



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Conclusions

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- Selection bias as a result of linkage seems a real concern with the NZLC
  - Some association greatly affected; others less so
  - Unadjusted associations more affected than covariate-adjusted associations (one example)
- Early attempts at weighting reduced bias but did not remove it
  - Different cohorts will be examined
  - Different approaches can be tried – Any suggestions?

QUESTIONS?

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- 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
  - Others: Tony Blakely, June Atkinson, Andrew Sporle, Alan Lee

QUESTIONS?

Extra

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- Extra linkage to mortality will make bias adjustment even harder
  - Never sure whether missed mortality links are in theoretical population or not
  - If 200 (in a cell) died 2006-2011 and 150/200 linked to 2006 record, these are weighted 200/150 for NZCMS
  - Can never be sure whether missed 50 belong to theoretical population able to be linked back to 2001 (i.e., had been in country for at least 5 years)
    - Might estimate from unlinked proportion of cell in theoretical population.