

Adjusting for linkage bias in the New Zealand Longitudinal Census

COMPASS Colloquium
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FACULTY OF ARTS
THE UNIVERSITY OF AUCKLAND

Whare Wānanga o Tāmaki Makaurau

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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

NZLC - Background



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Whare Wānanga o Tāmaki Makaurau

- ❑ 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?



- ❑ A data link between individuals in adjacent Censuses: 1981, 1986, 1991, 1996, 2001, 2006
 - 'Backwards': $t, t-1$ (e.g., 2006- \rightarrow 2001)
 - Theoretical population: those ≥ 5 yo 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

NZLC

- What is it?



Cohort	Number of Censuses	Number of					% linked
		1981	1986	1991	1996	2001	
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

NZLS

-How is it being used?

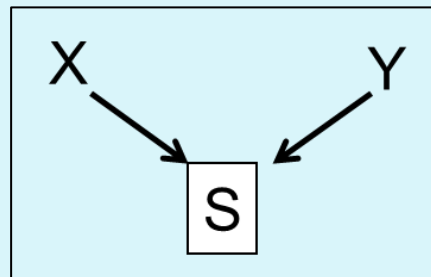
- ❑ Description and assessment of bias
 - COMPASS, Stats NZ (Kirsten Nissen, Robert Didham, Wendy Dobson)
- ❑ Ethnic mobility
 - Robert Didham
- ❑ Life-course predictors of mortality inequalities
 - COMPASS, StatsNZ, UOW (Tony Blakely, June Atkinson) - HRC funded
 - Link between NZLC and NZ Census Mortality 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?

- ❑ 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?

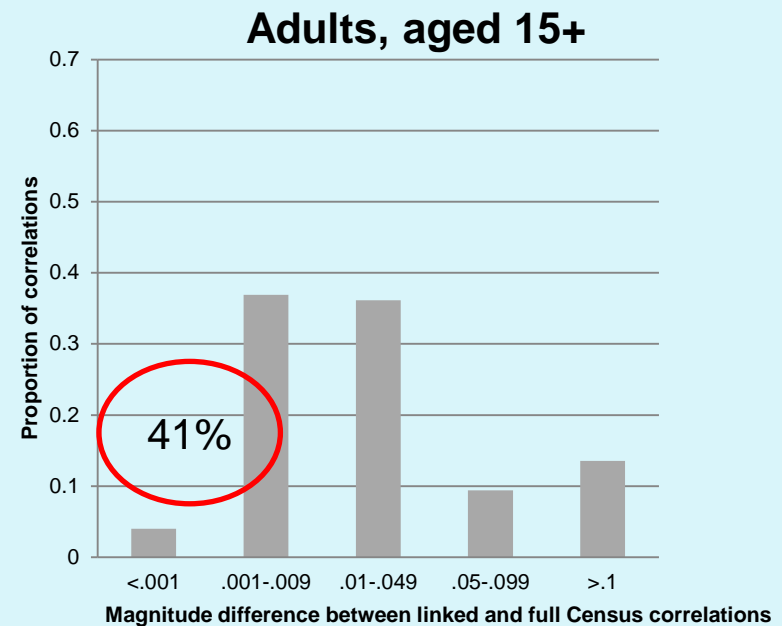
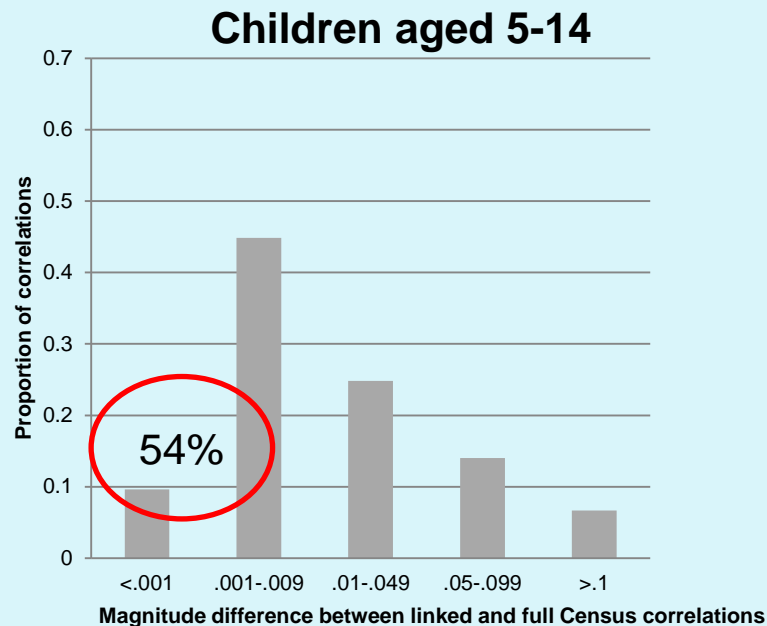


- ❑ CAN'T assess full extent of bias for longitudinal associations
 - Don't know associations among the unlinked
- ❑ BUT each linked cohort is nested within another (or within a single Census)
- ❑ So, CAN assess bias of nested cohort against cohort (or Census) one level up. E.g.,
 - Among those linked 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?

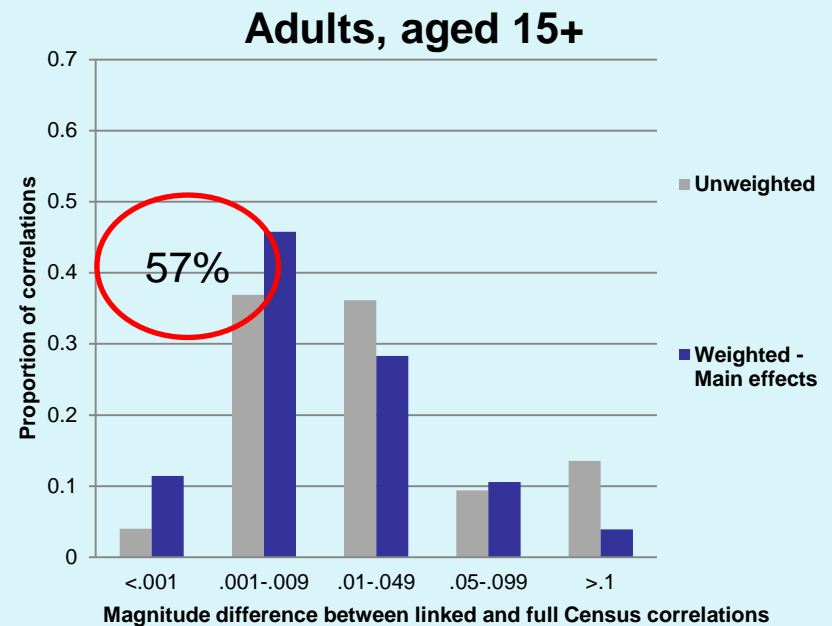
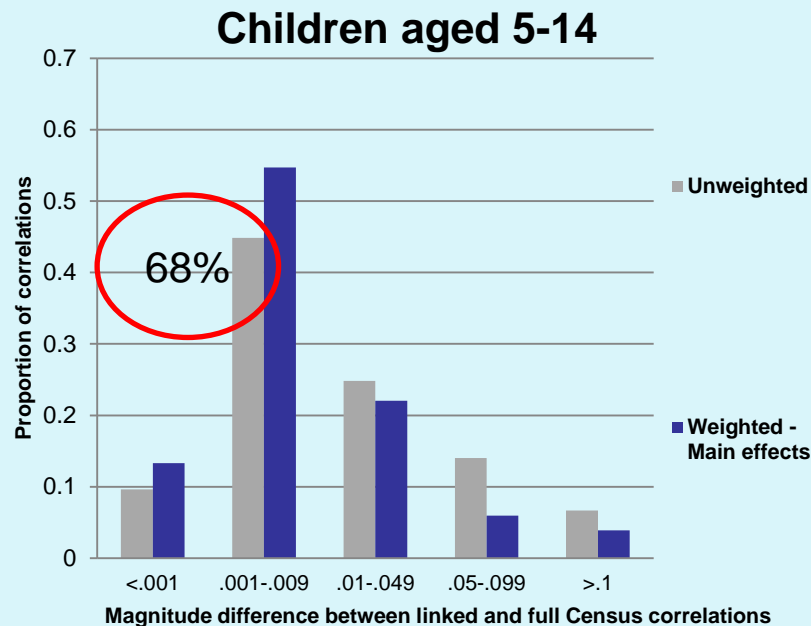
- Assessed 2-way (X-Y) correlations between 30 (children) & 44 (adult) variables for
 - Full (linkable) Census in 2006; Sample linked from 2006 to 2001
 - Assess magnitude of difference between two sets of correlations



Linkage Bias

-Can we adjust for it?

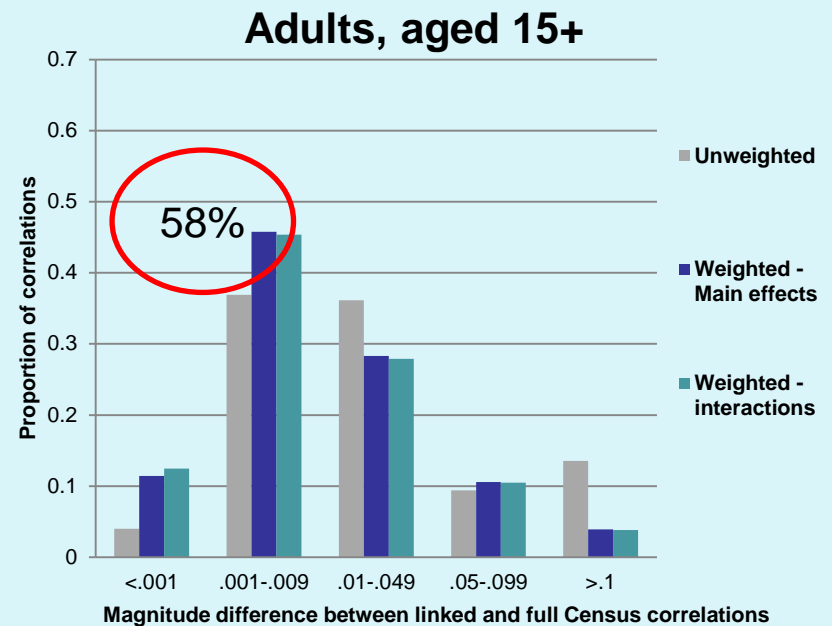
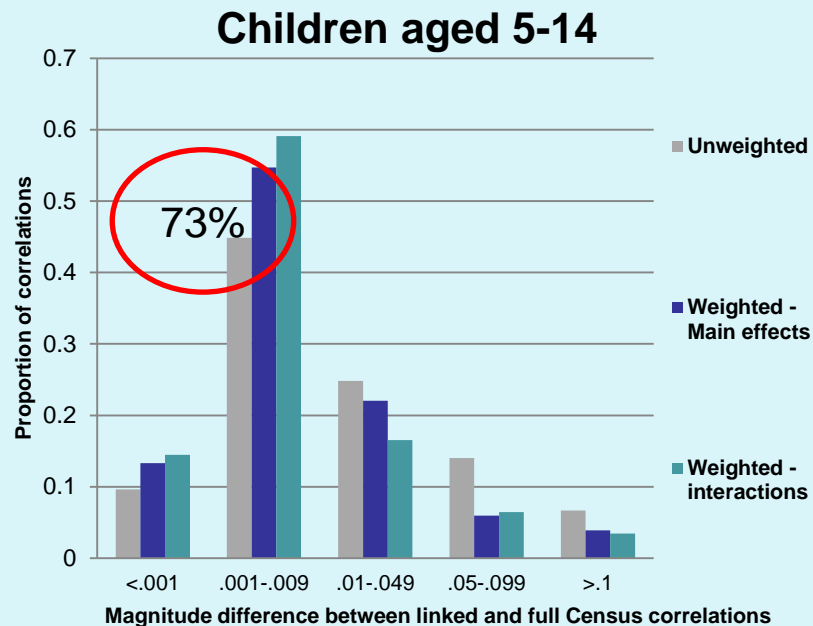
- Calculated each individual's propensity to be linked, based on their characteristics
 - logistic regression model including main effects only
- Weighted by inverse of these propensities in analyses (as per AusLC)



Linkage Bias

-Can we adjust for it?

- ❑ Calculated each individual's 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)



Linkage Bias

-Can we adjust for it?



- ❑ Initial attempts suggest we can reduce bias but not eliminate it
 - Only tried one cohort with one approach
 - Other approaches being considered – tree regression

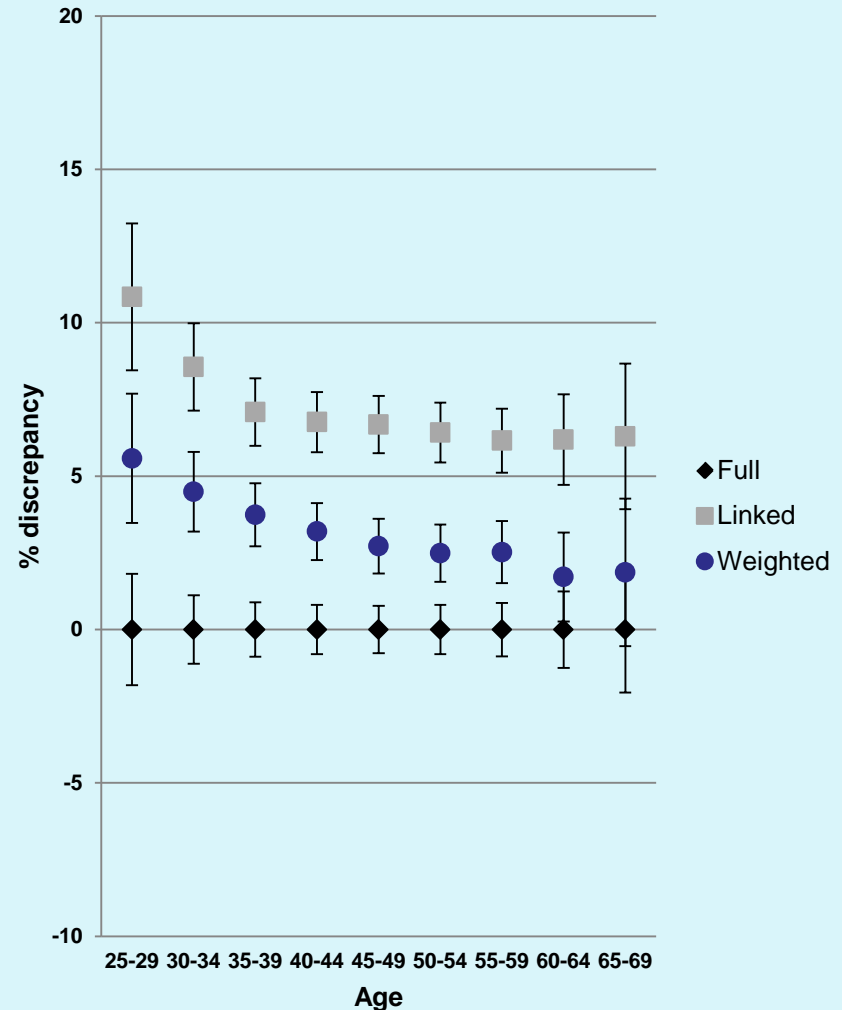
- ❑ Suggestion that associations less affected by bias with covariates controlled
 - SOFIE data - Carter et al (2012)
 - Might this help with NZLC data?
 - Worked example: regress income against sex, age, ethnicity, deprivation, education (adults aged 20-69)

Linkage Bias

-Can we adjust for it?



	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

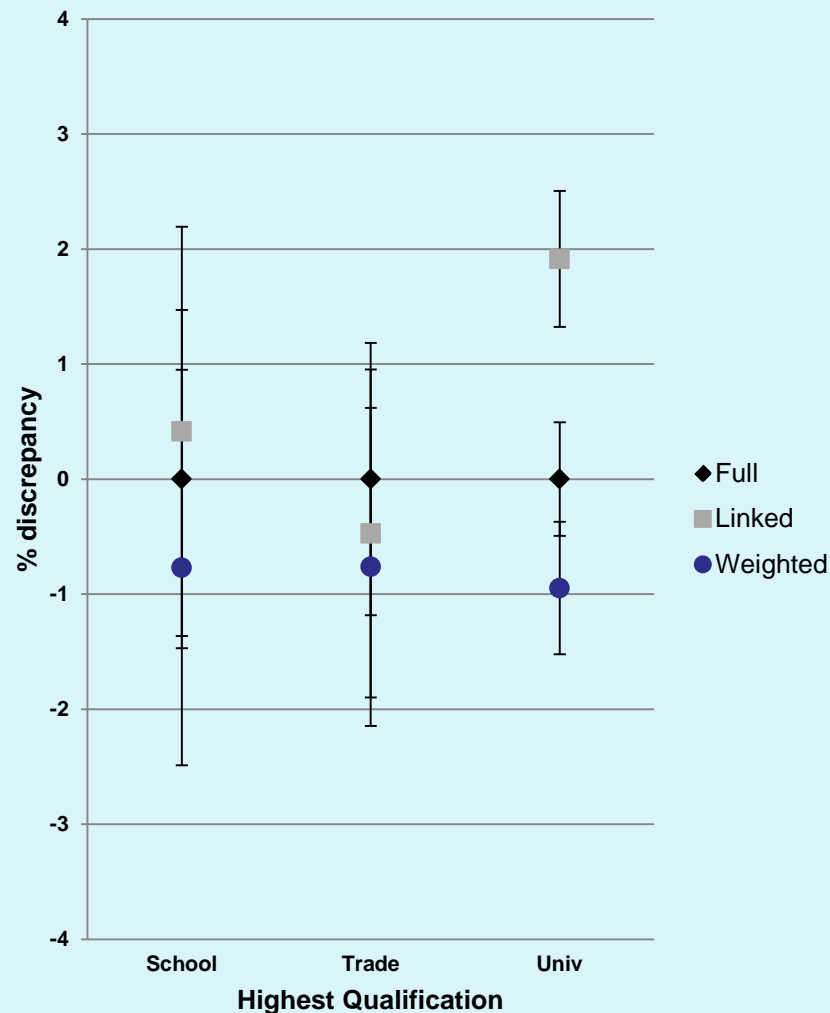


Linkage Bias

-Can we adjust for it?



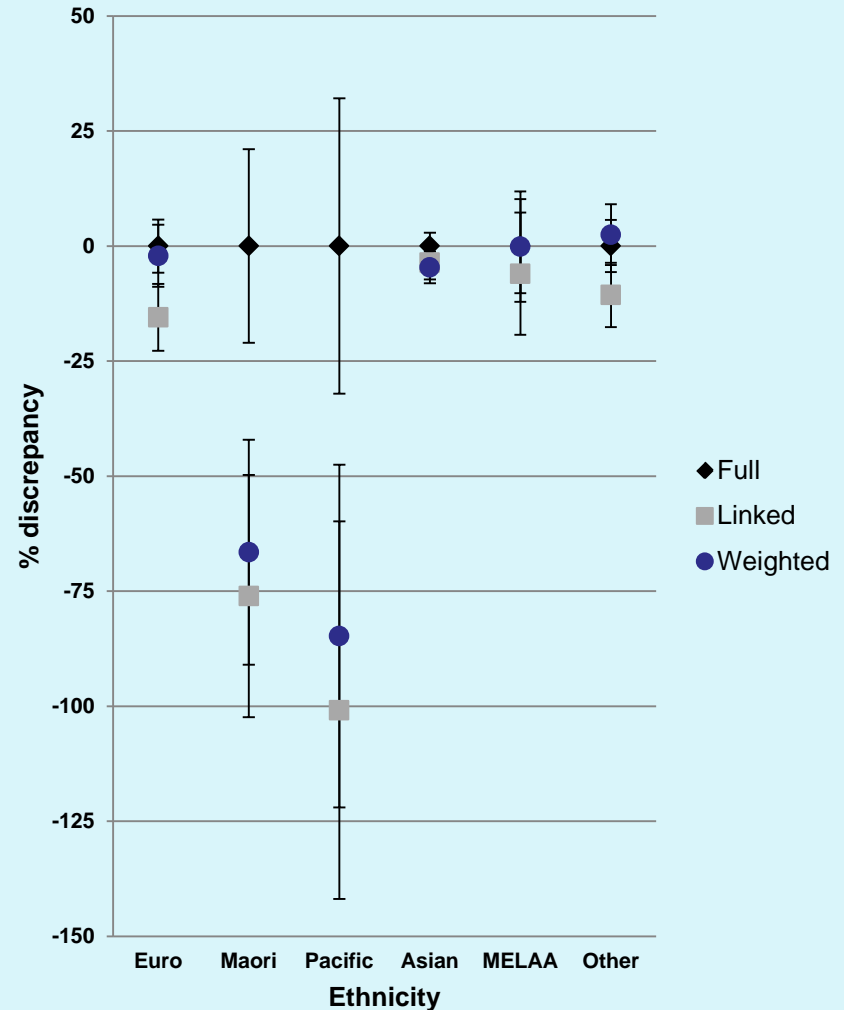
	Full	Linked	Weighted
None	--	--	--
School	\$8,000	\$8,000	\$7,900
Trade	\$10,000	\$10,000	\$10,000
Univ	\$26,900	\$27,500	\$26,700



Linkage Bias

-Can we adjust for it?

	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

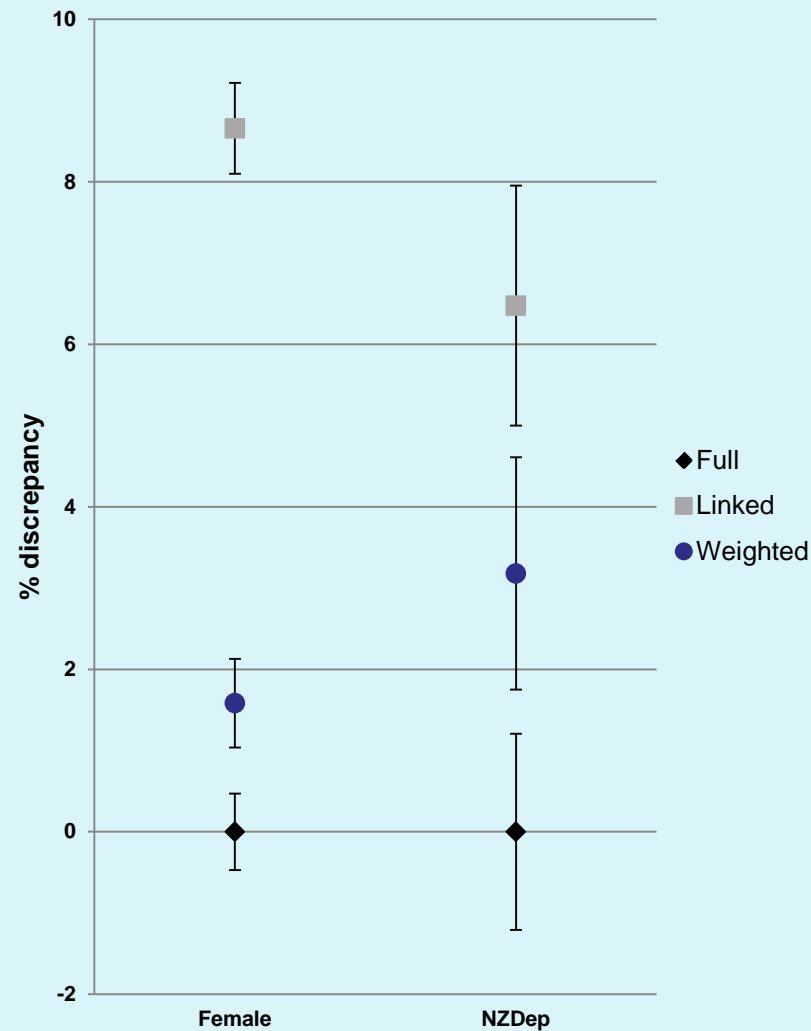


Linkage Bias

-Can we adjust for it?



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



- ❑ 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 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.