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Big data, small populations: unpacking health inequalities using linked data

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28 June 2018

CENTRE FOR BIG DATA RESEARCH IN HEALTH

Indigenous health gap

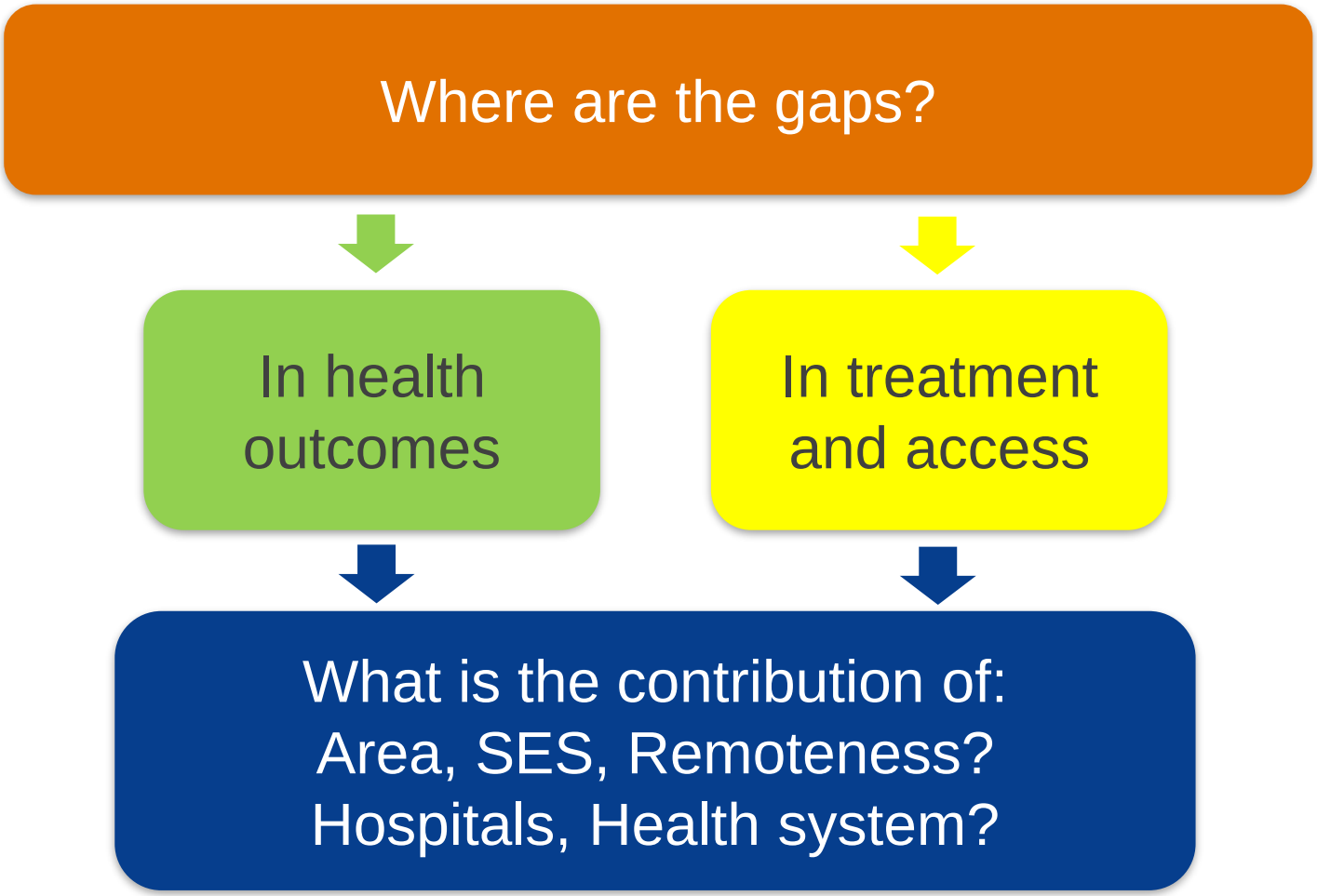
- Compared to other Australians, life expectancy is 10.6 years less for males and 9.5 years less for females
- Burden of disease (disability-adjusted life years, DALYs) is 2.3 times higher in Indigenous Australians
- Biggest contributors to this gap are:
  - cardiovascular diseases (19%)
  - mental and substance use disorders (14%)
  - injuries (14%)
  - respiratory diseases (10%)
  - cancer (9%)

AIHW (2014). *Mortality and life expectancy of Indigenous Australians: 2008 to 2012*.
AIHW (2016). *Australian Burden of Disease Study: Impact and causes of illness and death in Aboriginal and Torres Strait Islander people 2011*.

Summary

- Indigenous Health Outcomes Patient Evaluation (IHOPE)
  - Revascularisation following AMI
  - Road traffic injuries
  - Cataract surgery
- Seeding Success
  - Maternal age and offspring developmental vulnerability

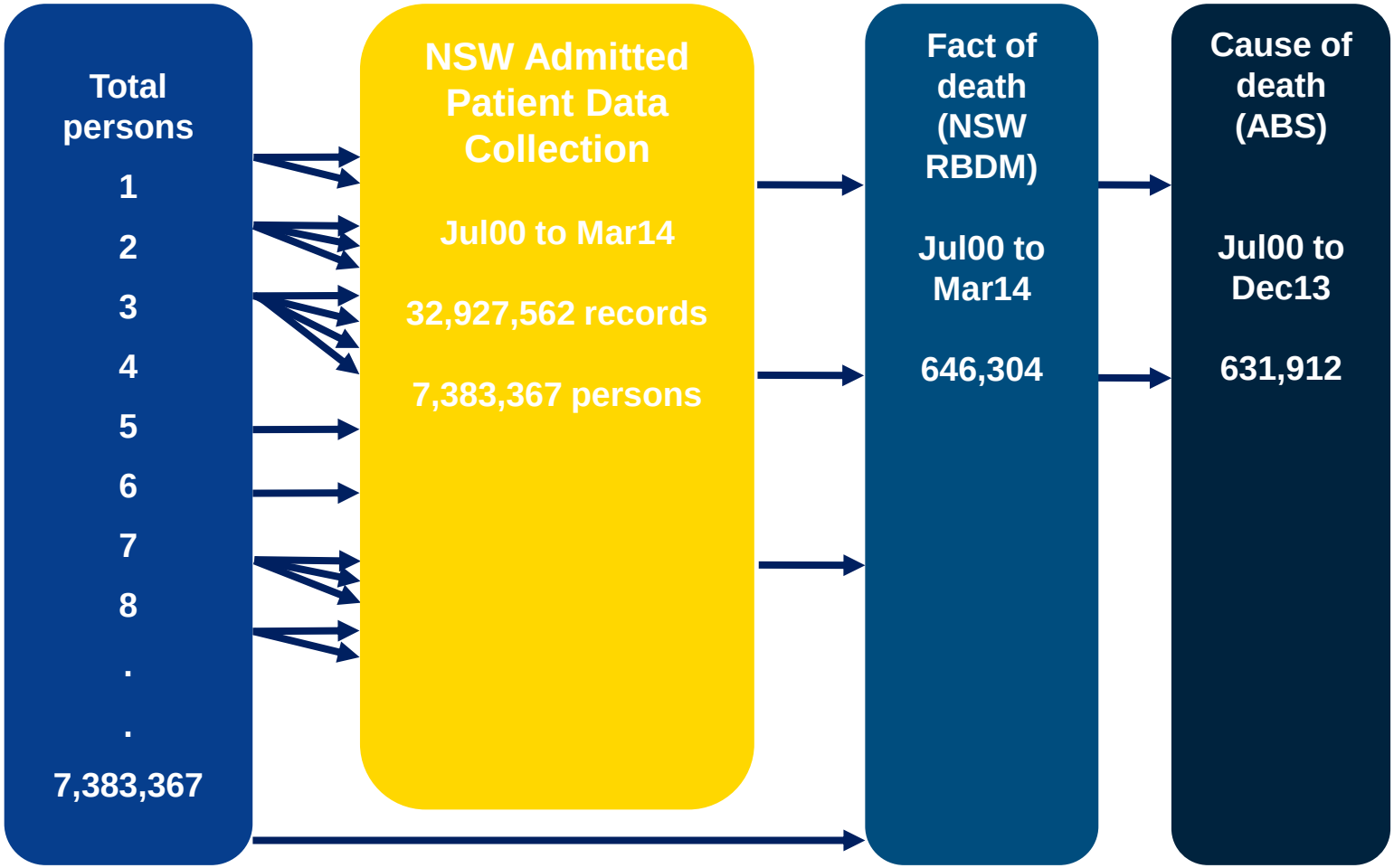
The IHOPE study



Research focus

- Acute myocardial infarction
- Road traffic injuries
- Unintentional injuries in children
- Cataract procedures
- Otitis media procedures in children
- Potentially preventable hospitalisations
- Breast conserving surgery

IHOPE data


Total persons
1
2
3
4
5
6
7
8
.
.
7,383,367
NSW Admitted Patient Data Collection
Jul00 to Mar14
32,927,562 records
7,383,367 persons
Fact of death (NSW RBDM)
Jul00 to Mar14
646,304
Cause of death (ABS)
Jul00 to Dec13
631,912

Characteristics of people admitted to hospital with AMI

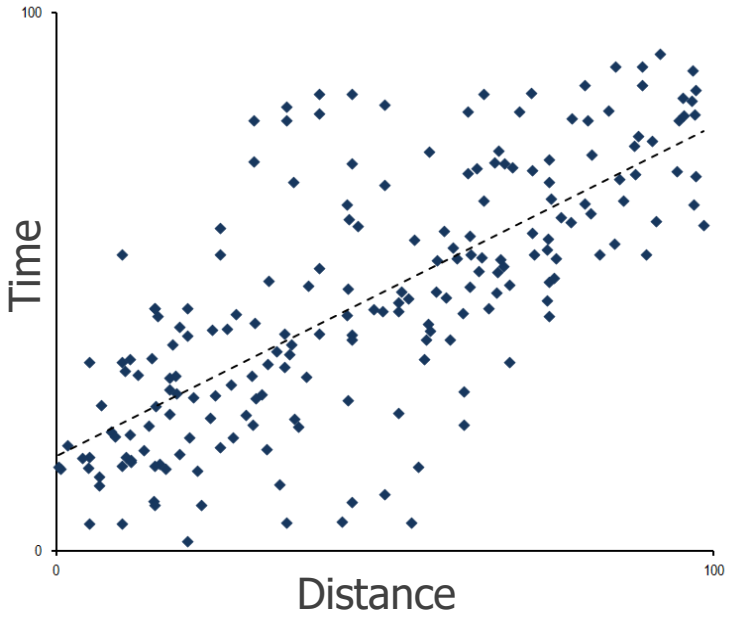
	Indigenous	Non-Indigenous
Average age (years)	54	66
Current smokers	51%	27%
Private health insurance	16%	45%
Live in most disadvantaged areas	48%	26%
First admitted to:		
- major city hospital	33%	67%
- hospital with specialist cardiac facilities	27%	44%

Multilevel modelling

- Models data that are clustered
  - e.g. live in same neighbourhood, go to the same hospital
- Individuals within clusters are more similar than those in other clusters because of shared exposures (often unmeasured)
- Clustering can impact on standard errors and parameter estimates if not taken into account
- Particular issue for Indigenous health research
  - ~40% of NSW Indigenous people live in major cities
  - ~70% of NSW non-Indigenous people live in major cities

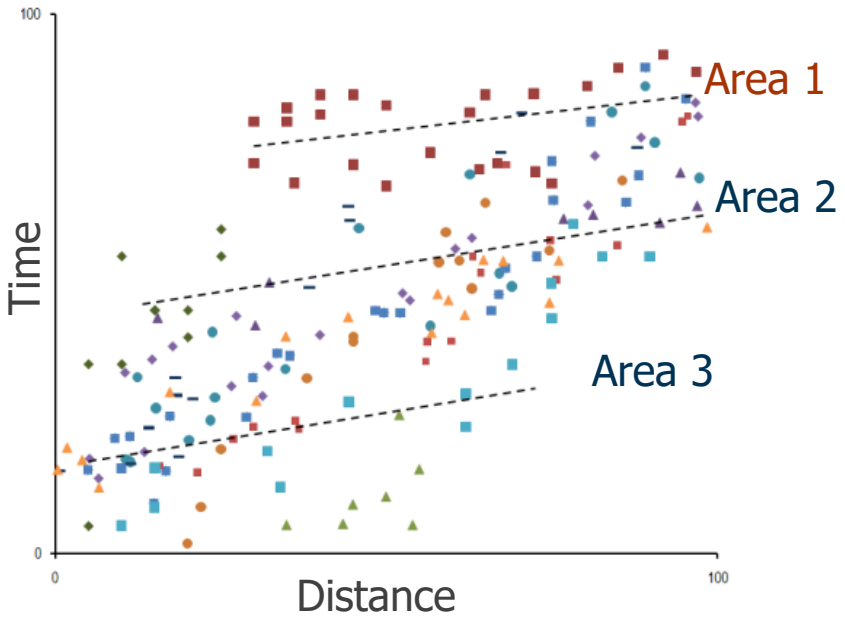
How is multilevel modelling different?

Single level regression model



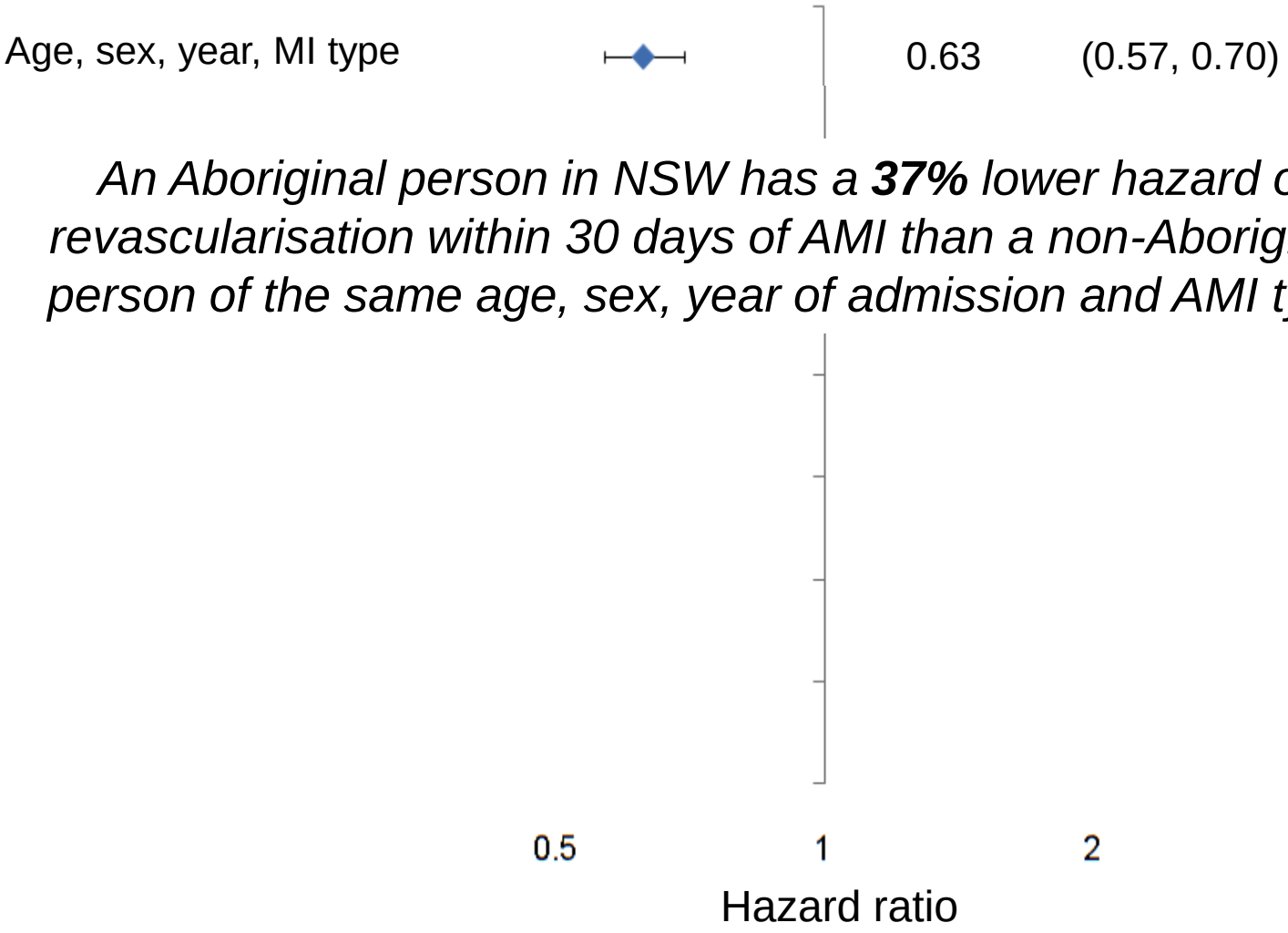
Fits an average association

Multilevel regression model (random intercept)



Strength of association may vary between areas

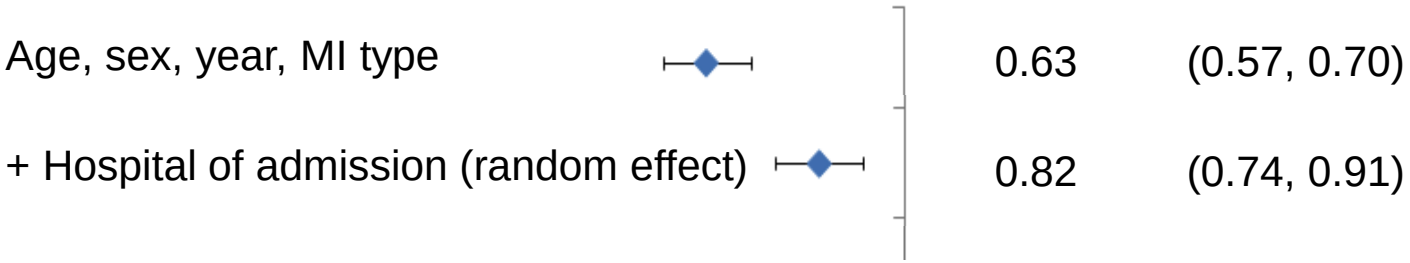
Revascularisation: “unpacking” the gap



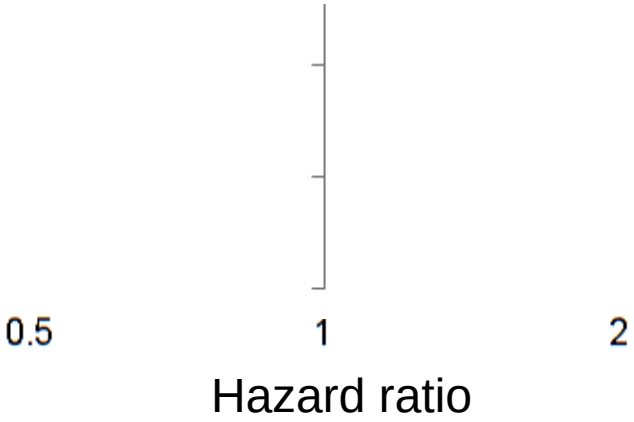
*An Aboriginal person in NSW has a **37%** lower hazard of revascularisation within 30 days of AMI than a non-Aboriginal person of the same age, sex, year of admission and AMI type*

Randall DA, Jorm LR, Lujic S, O’Loughlin AJ, Eades SJ, Leyland AH. *Circulation*. 2013 Feb 19;127(7):811–19.

Revascularisation: “unpacking” the gap

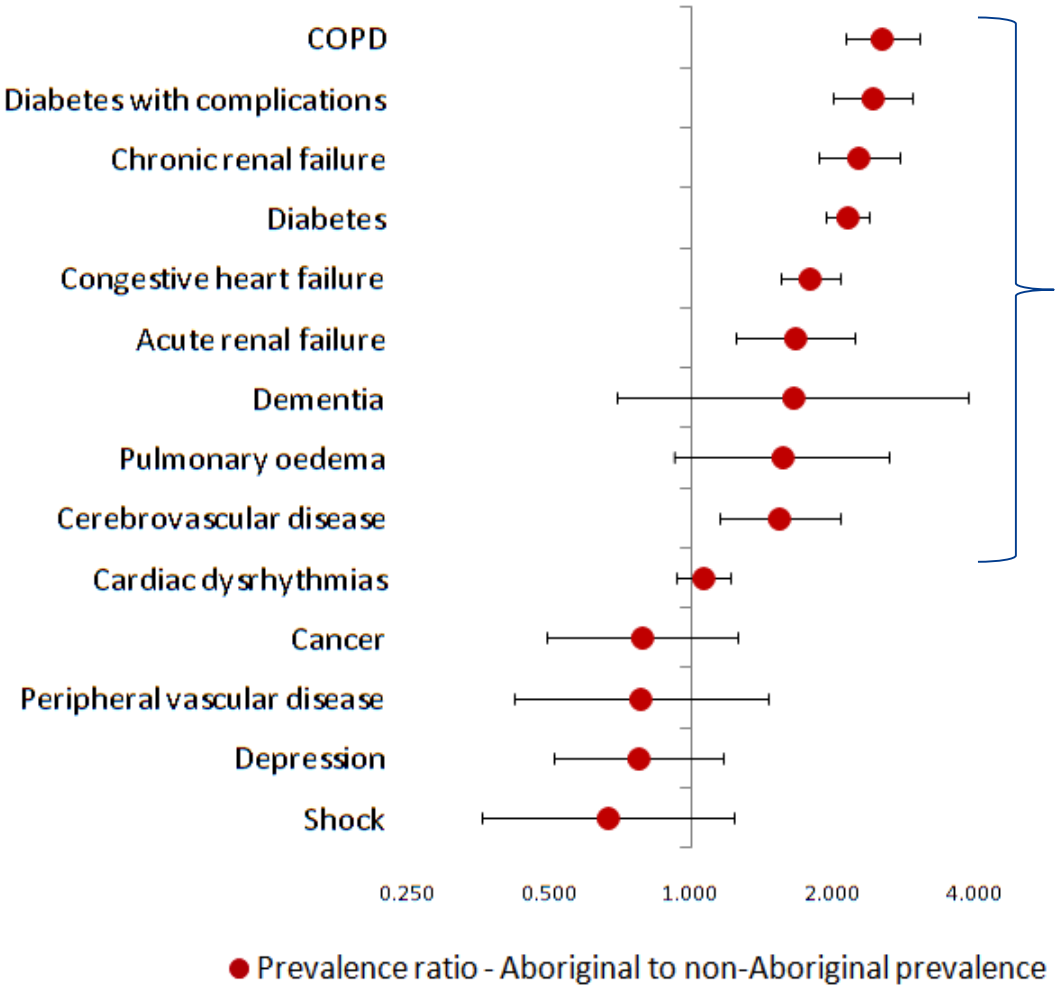


*Once we compare within hospitals, the disparity reduces - an Aboriginal person has a **18%** lower hazard of revascularisation than a non-Aboriginal person of the same age, sex, year of admission, AMI type, admitted to the same hospital*



Randall DA, Jorm LR, Lujic S, O’Loughlin AJ, Eades SJ, Leyland AH. *Circulation*. 2013 Feb 19;127(7):811–19.

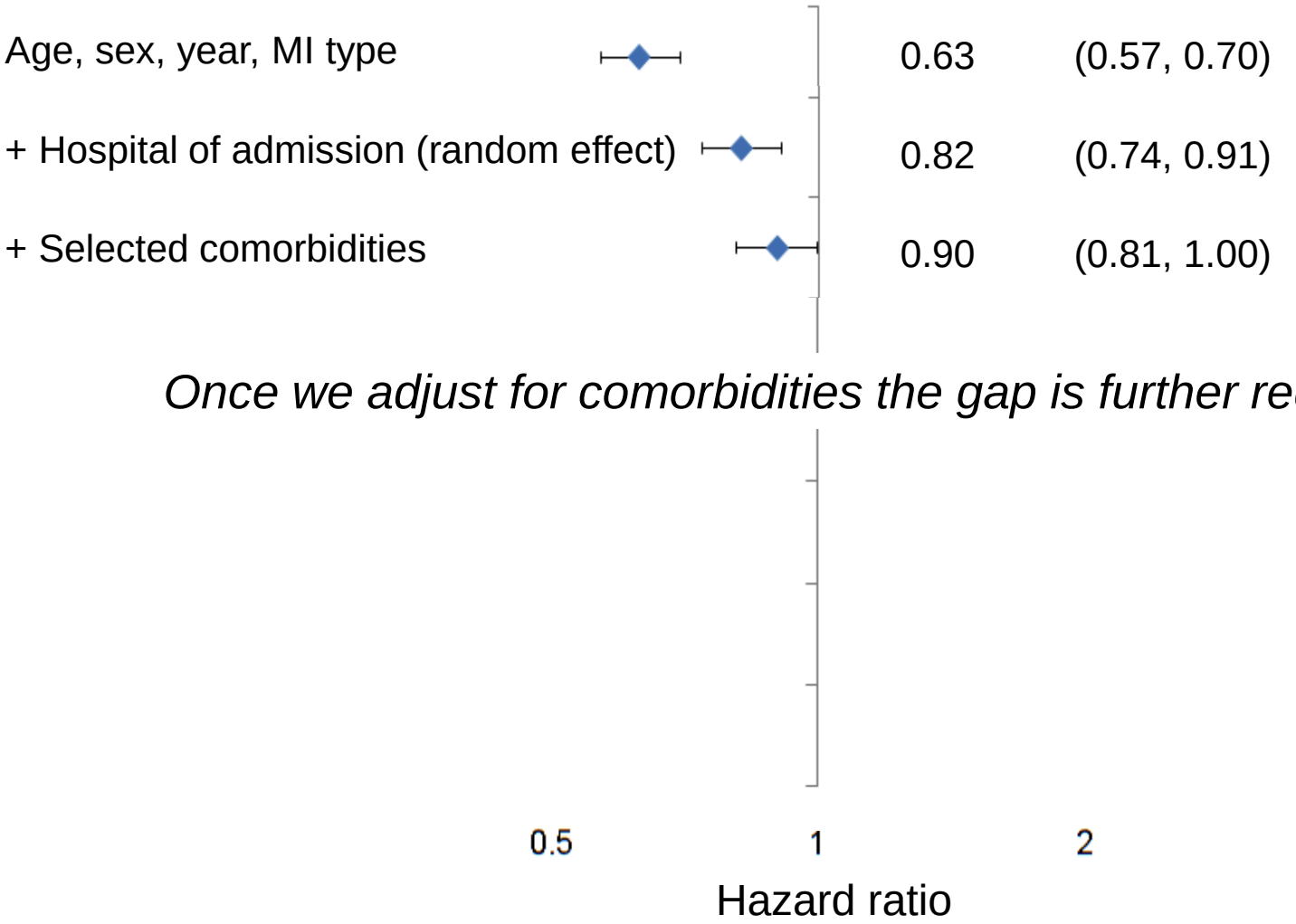
Comorbidity burden on admission



Aboriginal people have higher rates of these conditions recorded in hospital data than non-Aboriginal people

Randall DA, Jorm LR, Lujic S, O'Loughlin AJ, Eades SJ, Leyland AH. *Circulation*. 2013 Feb 19;127(7):811–19.

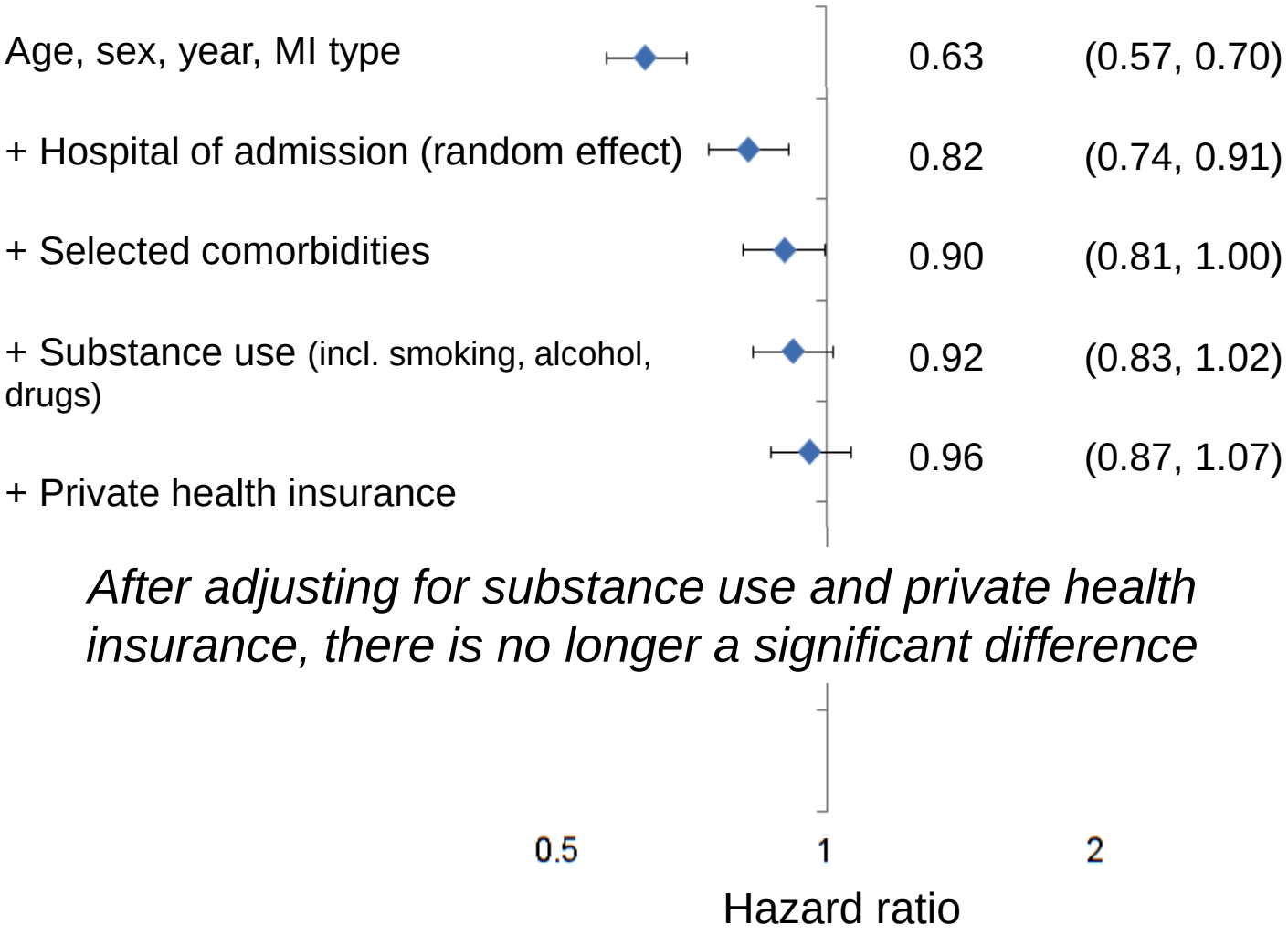
Revascularisation: “unpacking” the gap



Once we adjust for comorbidities the gap is further reduced

Randall DA, Jorm LR, Lujic S, O’Loughlin AJ, Eades SJ, Leyland AH. *Circulation*. 2013 Feb 19;127(7):811–19.

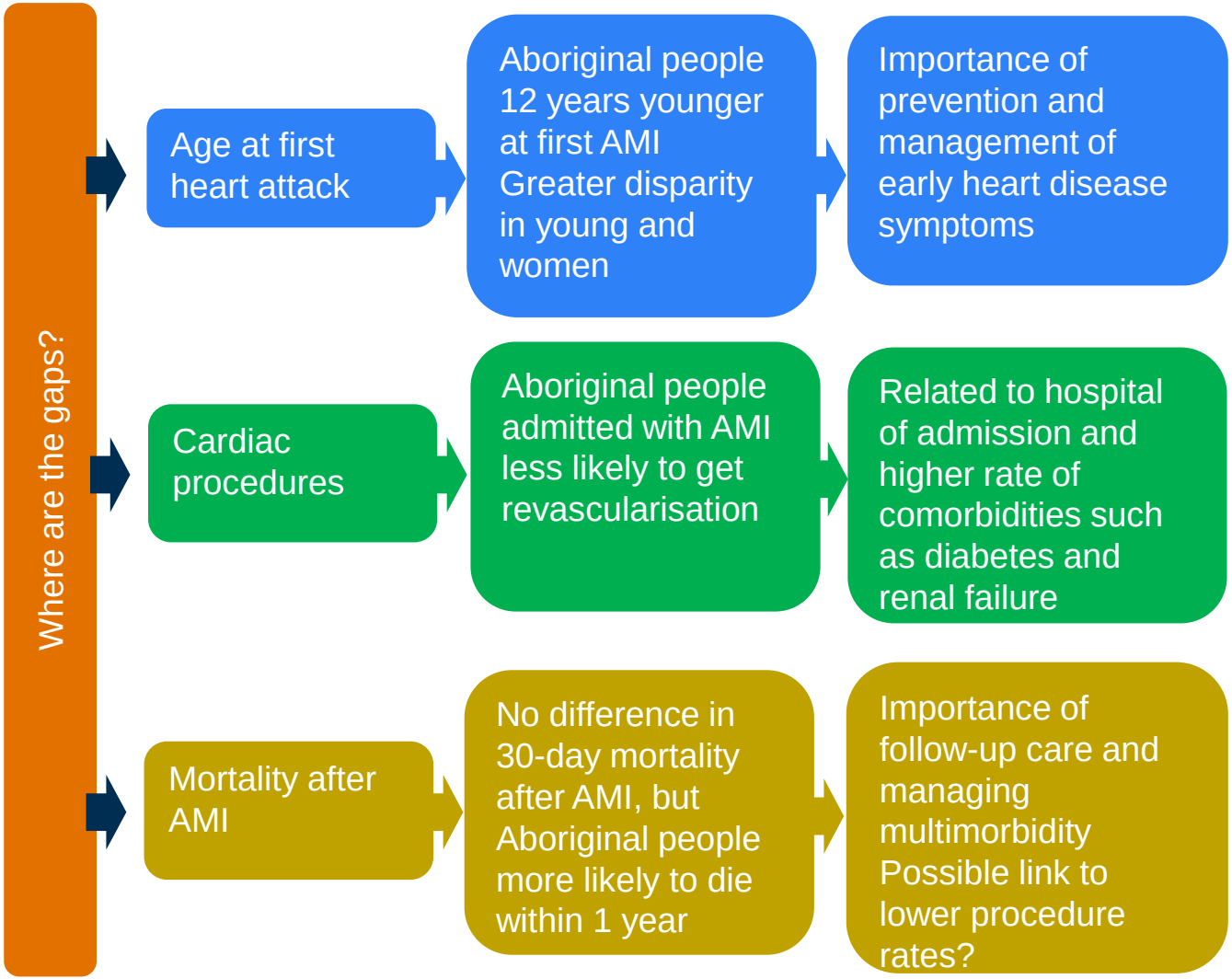
Revascularisation: “unpacking” the gap



After adjusting for substance use and private health insurance, there is no longer a significant difference

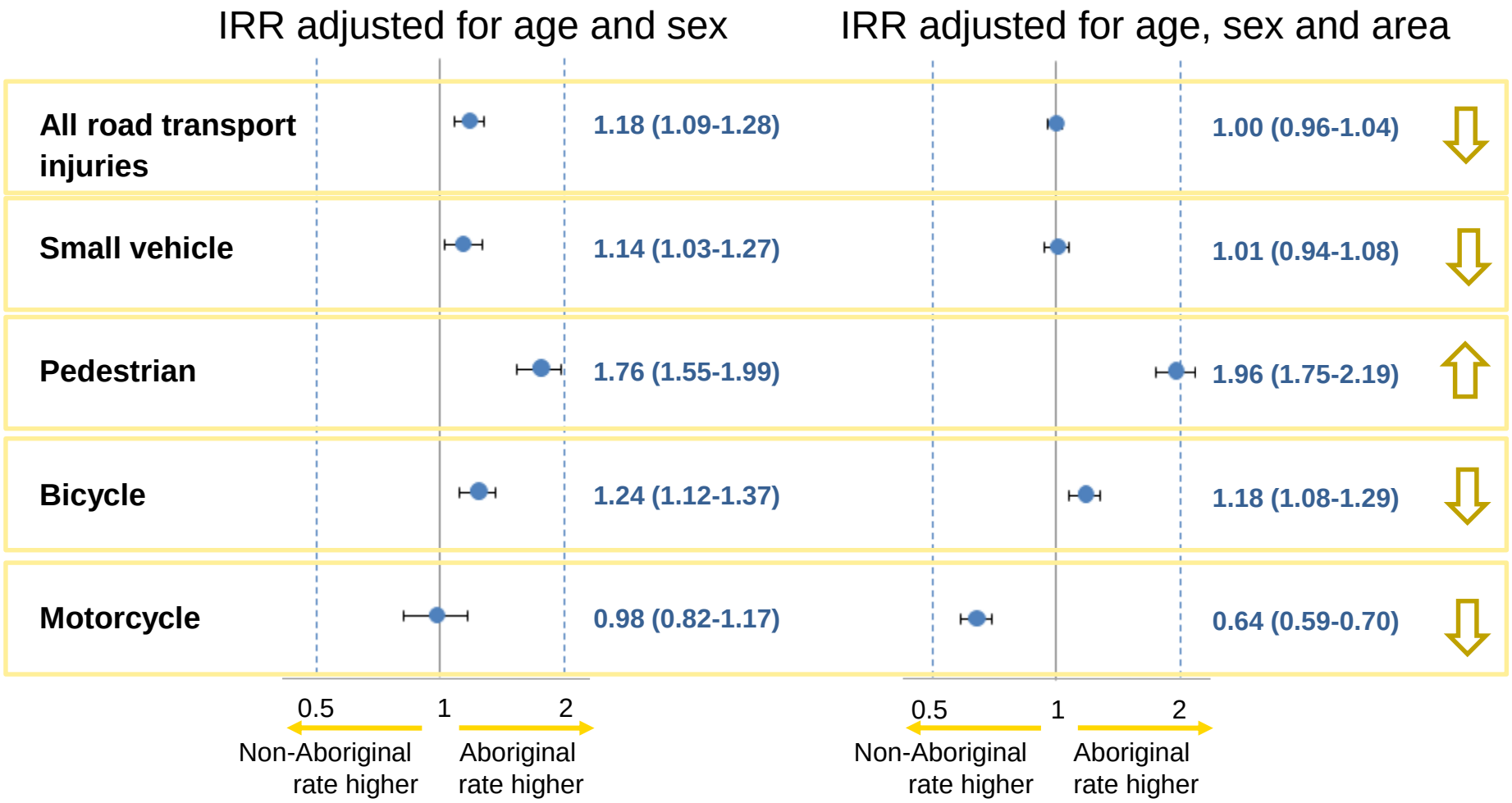
Randall DA, Jorm LR, Lujic S, O’Loughlin AJ, Eades SJ, Leyland AH. *Circulation*. 2013 Feb 19;127(7):811–19.

How can the findings inform policy?



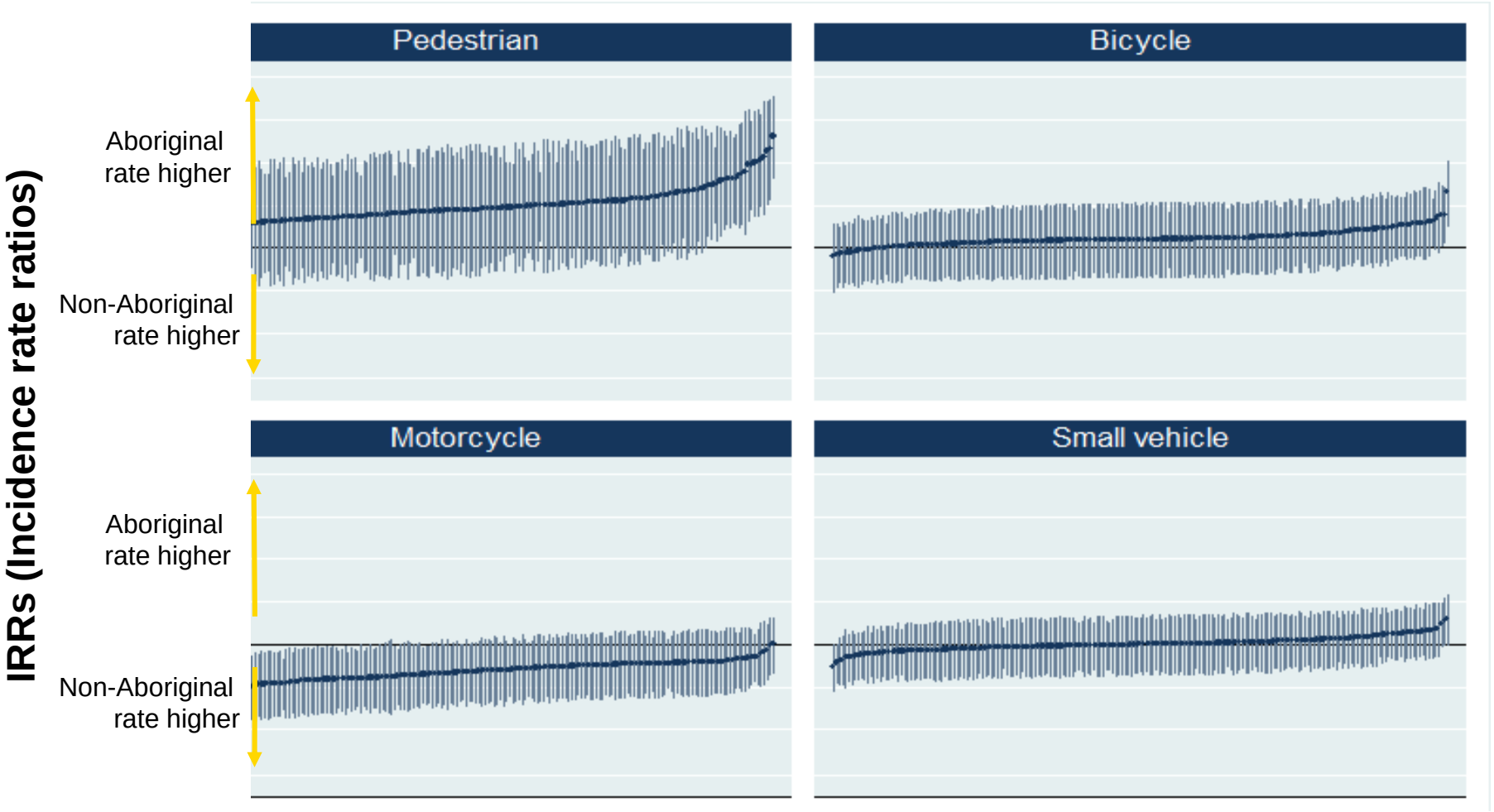
Randall DA, Jorm LR, Lujic S, O'Loughlin AJ, Eades SJ, Leyland AH. *Circulation*. 2013 Feb 19;127(7):811–19.

Is there a disparity in road transport injury?



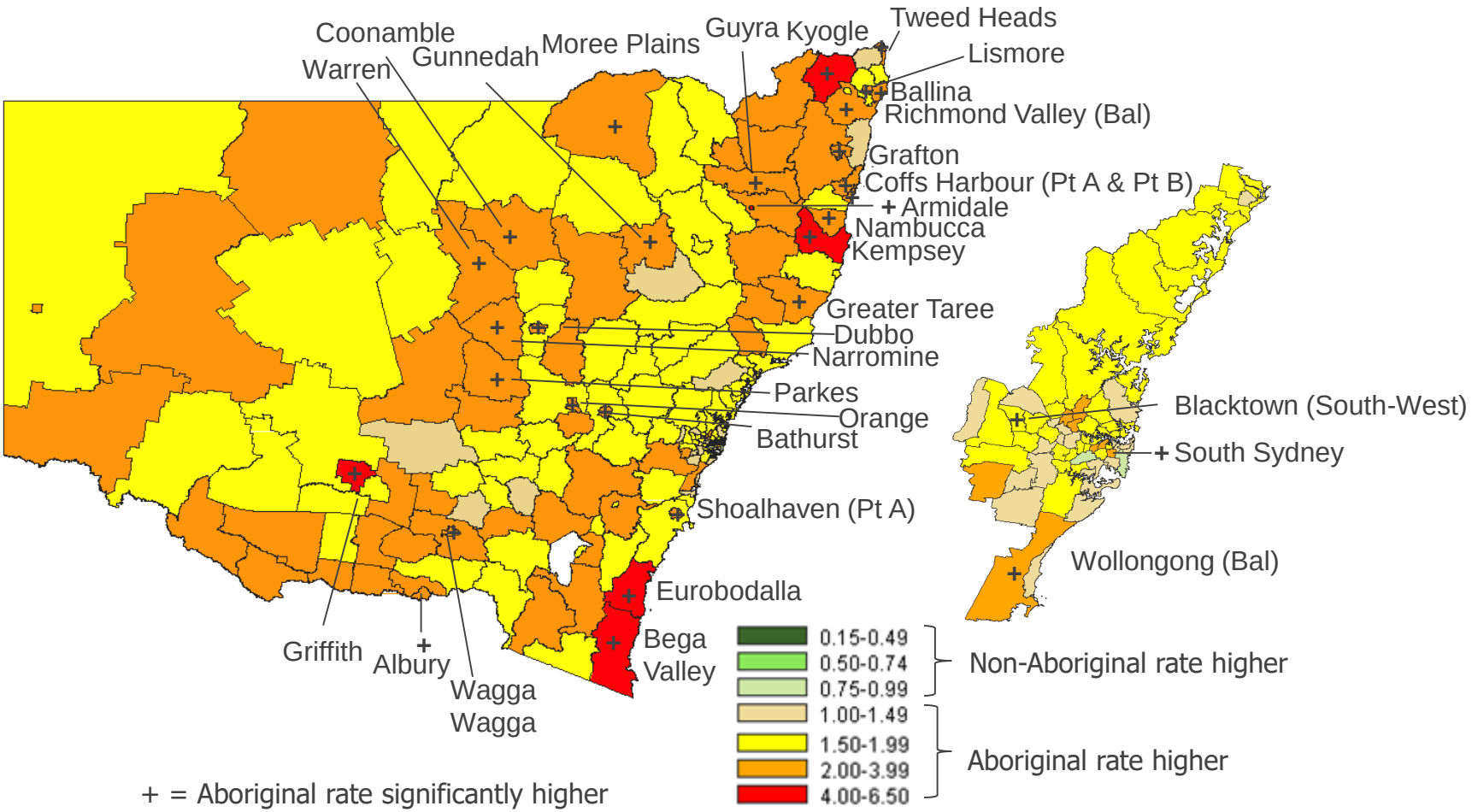
Falster MO, Randall DA, Lujic S, Ivers R, Leyland AH, Jorm LR.
Accid Anal Prev. 2013 May;54:32–8.

Disparities by area



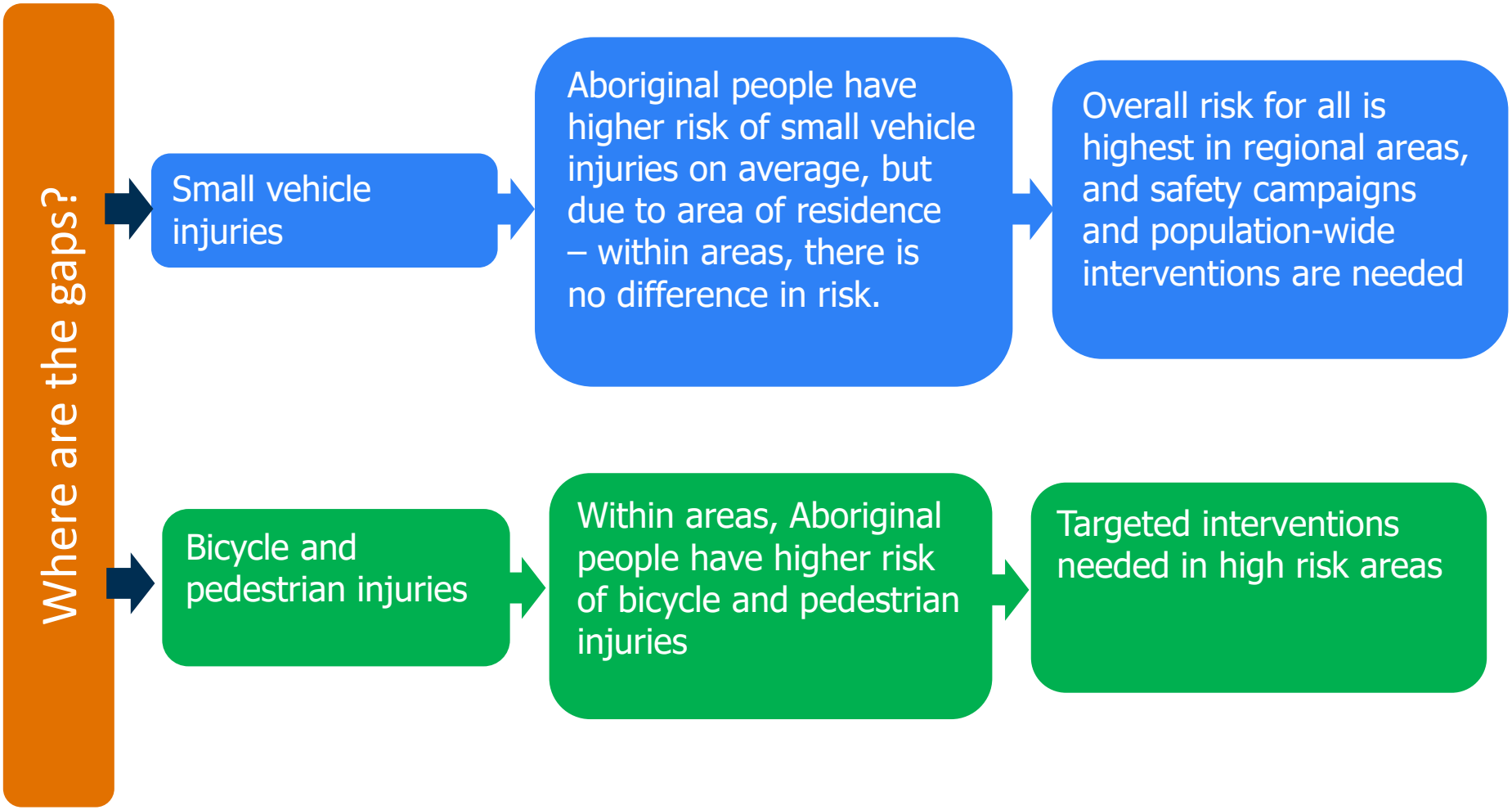
Falster MO, Randall DA, Lujic S, Ivers R, Leyland AH, Jorm LR. *Accid Anal Prev*. 2013 May;54:32–8.

Pedestrian injury rate ratio



Falster MO, Randall DA, Lujic S, Ivers R, Leyland AH, Jorm LR.
Accid Anal Prev. 2013 May;54:32–8.

Summary - Serious road traffic injuries



Falster MO, Randall DA, Lujic S, Ivers R, Leyland AH, Jorm LR. *Accid Anal Prev*. 2013 May;54:32–8.

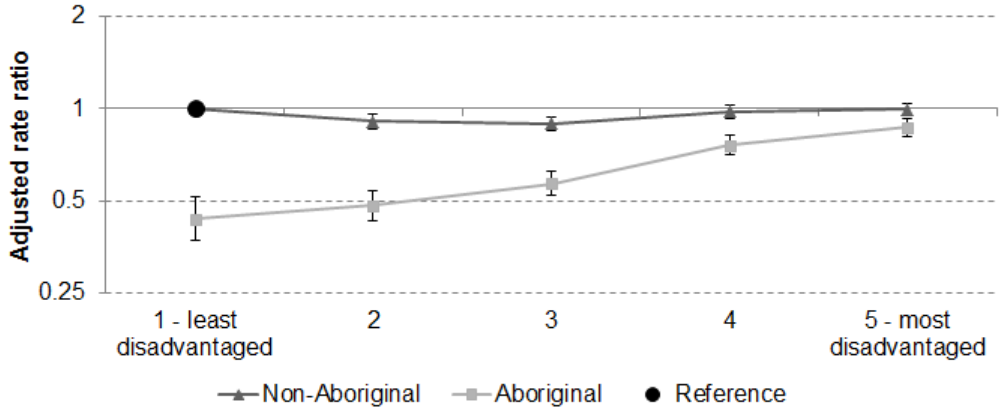
Cataract surgery

- Procedure rates in NSW 2001 to 2008:
  - 641 per 100,000 for Aboriginal people
  - 863 per 100,000 for non-Aboriginal people
  - Rate ratio of 0.74 (0.71–0.77)
- Despite evidence that Aboriginal people have a higher prevalence of cataracts

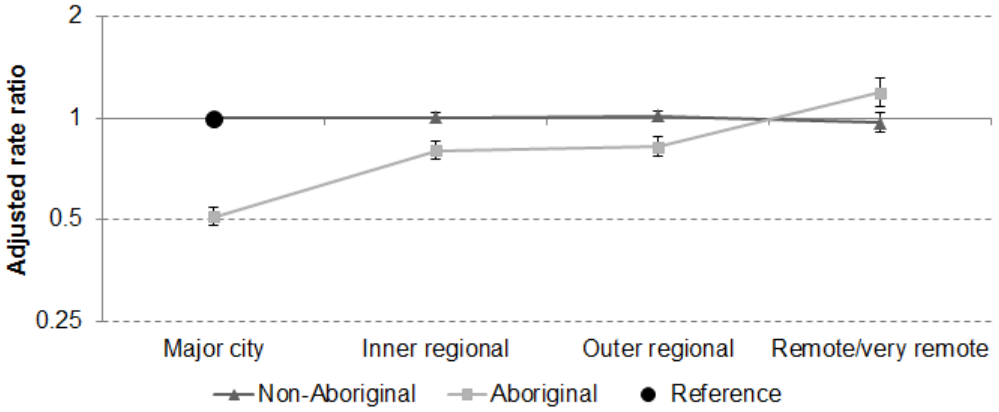
Randall DA, Reinten T, Maher L, Lujic S, Stewart J, Keay L, Leyland AH, Jorm LR. *Clin Exp Ophthalmol*. 2014 Sep–Oct;42(7):629–36.

Disparity in cataract surgery by SES and remoteness

Socio-economic status of area of residence



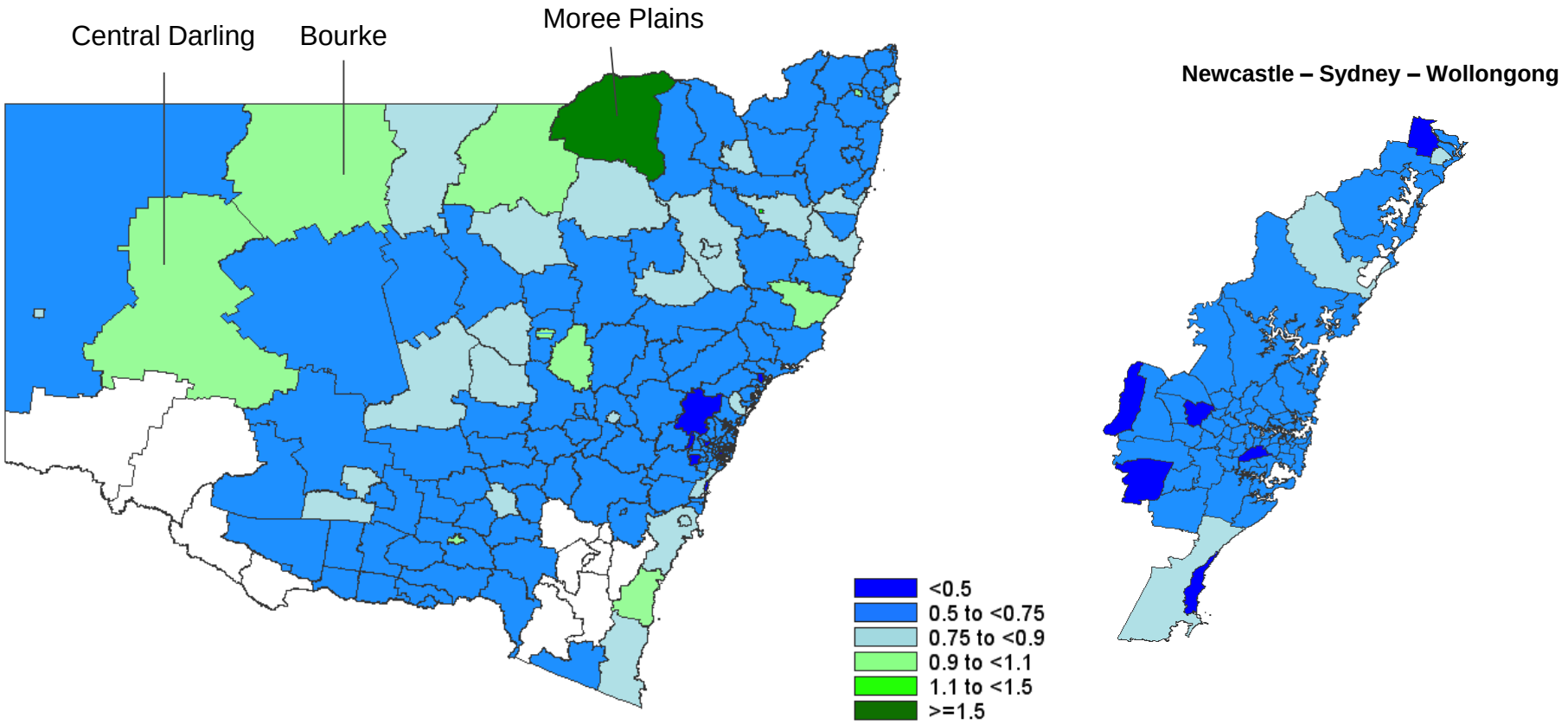
Remoteness of area of residence



Disparity is greatest in less disadvantaged and more urban areas

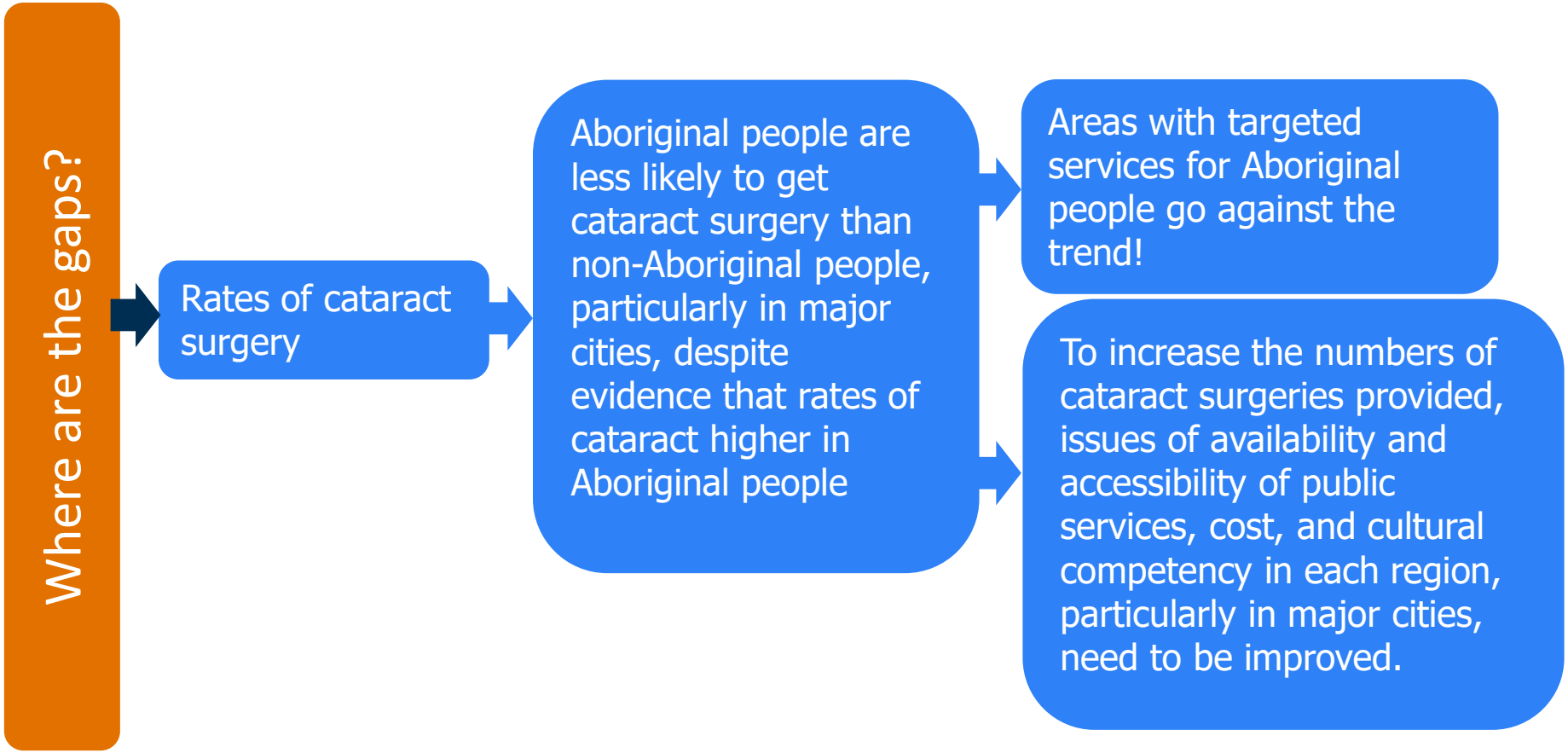
Randall DA, Reinten T, Maher L, Lujic S, Stewart J, Keay L, Leyland AH, Jorm LR. *Clin Exp Ophthalmol*. 2014 Sep–Oct;42(7):629–36.

Areas with higher rates of cataract surgery in Aboriginal people



Randall DA, Reinten T, Maher L, Lujic S, Stewart J, Keay L, Leyland AH, Jorm LR. *Clin Exp Ophthalmol*. 2014 Sep–Oct;42(7):629–36.

Summary – Cataract surgery rates



Randall DA, Reinten T, Maher L, Lujic S, Stewart J, Keay L, Leyland AH, Jorm LR. *Clin Exp Ophthalmol*. 2014 Sep–Oct;42(7):629–36.

The Seeding Success Study

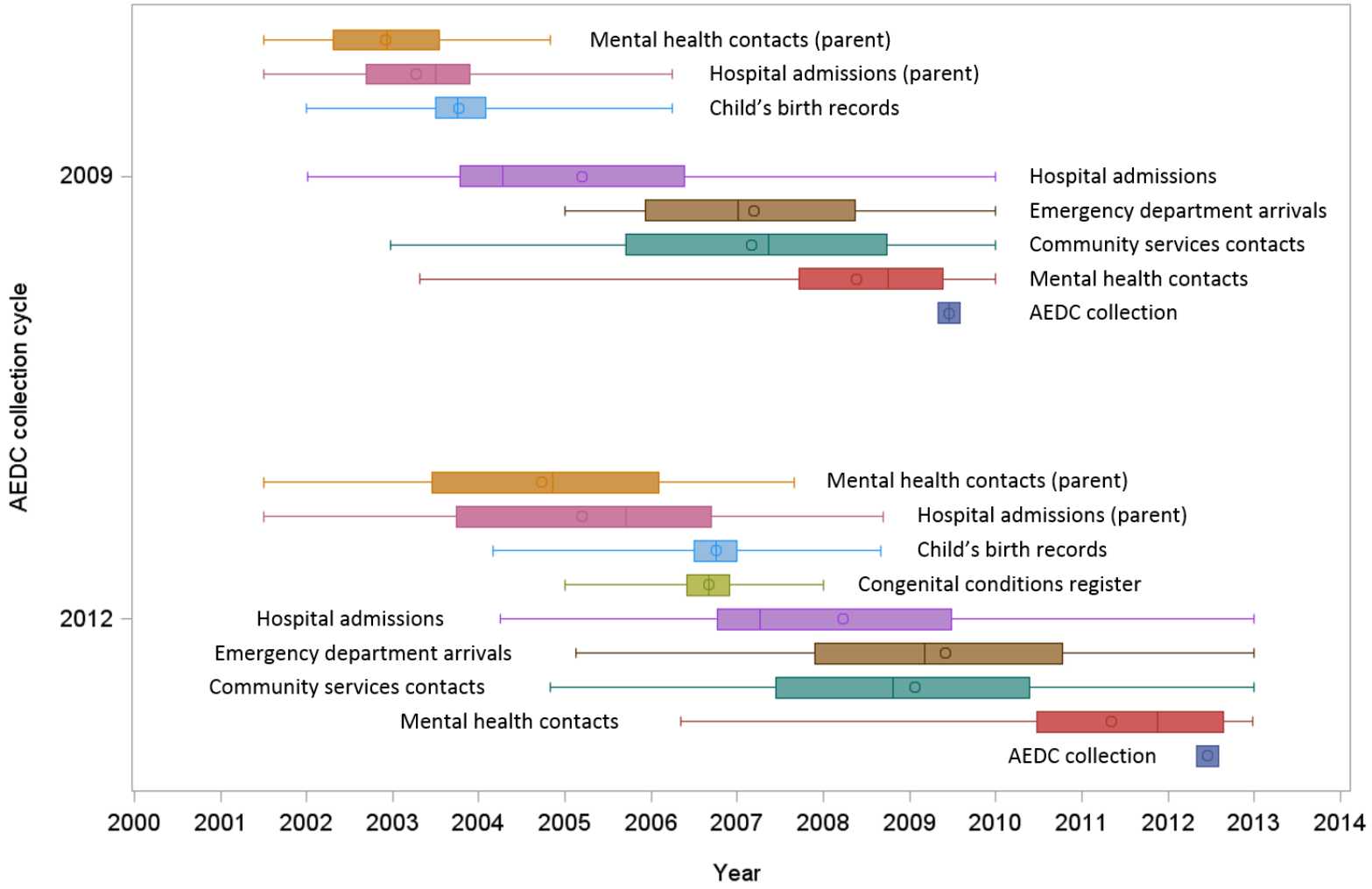
Born in NSW
(Birth registrations, perinatal records)

Started school 2009/12
(Australian Early Development Census)

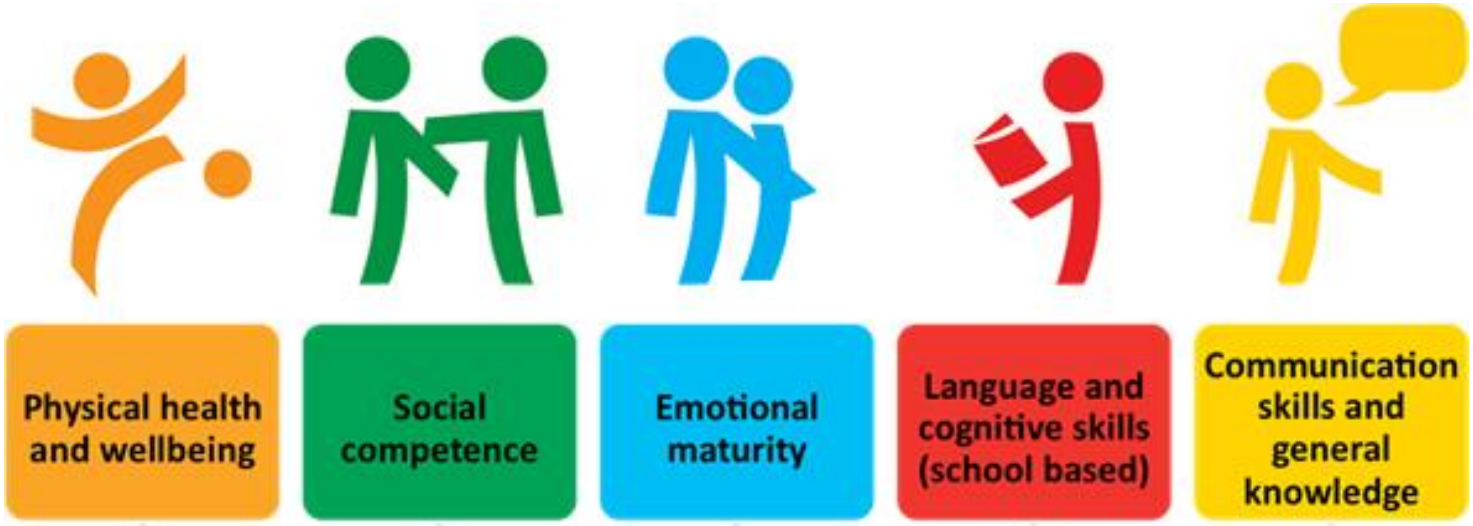
166,278 children

Falster K, Jorgensen M, Hanly M, Banks E, Brownell M, Eades S, Craven R, Goldfeld S, Randall D, Jorm L. *Int J Epidemiol*. 2017 Oct 1;46(5):1365–6.

What is currently in the data resource?



Primary outcome: child development at age five



Australian Early Development Census:

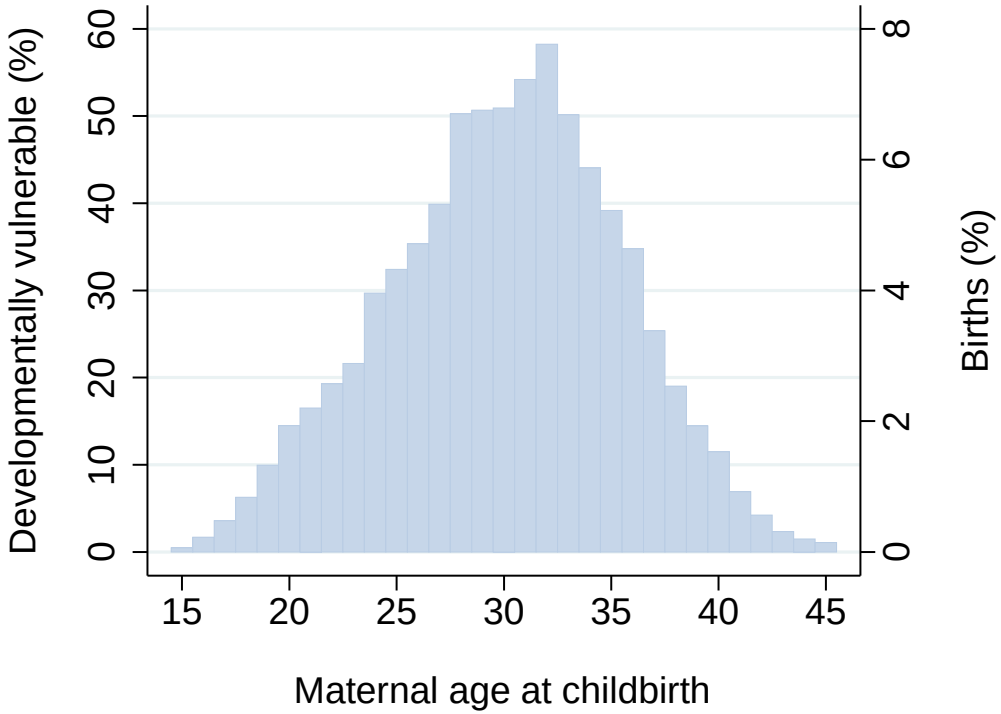
collected every three years nationally since 2009

Falster K, Jorgensen M, Hanly M, Banks E, Brownell M, Eades S, Craven R, Goldfeld S, Randall D, Jorm L. *Int J Epidemiol*. 2017 Oct 1;46(5):1365–6.

What is the risk of developmental vulnerability at age five by maternal age at childbirth in Aboriginal and non-Aboriginal children?

Falster K, Hanly M, Banks E, Lynch J, Chambers G, Brownell M, Eades S, Jorm L. *PLoS Med* 2018; 15(4): e1002558.

Births by maternal age at childbirth and Aboriginality



Legend: Light blue, non-Aboriginal births.

Falster K, Hanly M, Banks E, Lynch J, Chambers G, Brownell M, Eades S, Jorm L. *PLoS Med* 2018; 15(4): e1002558.

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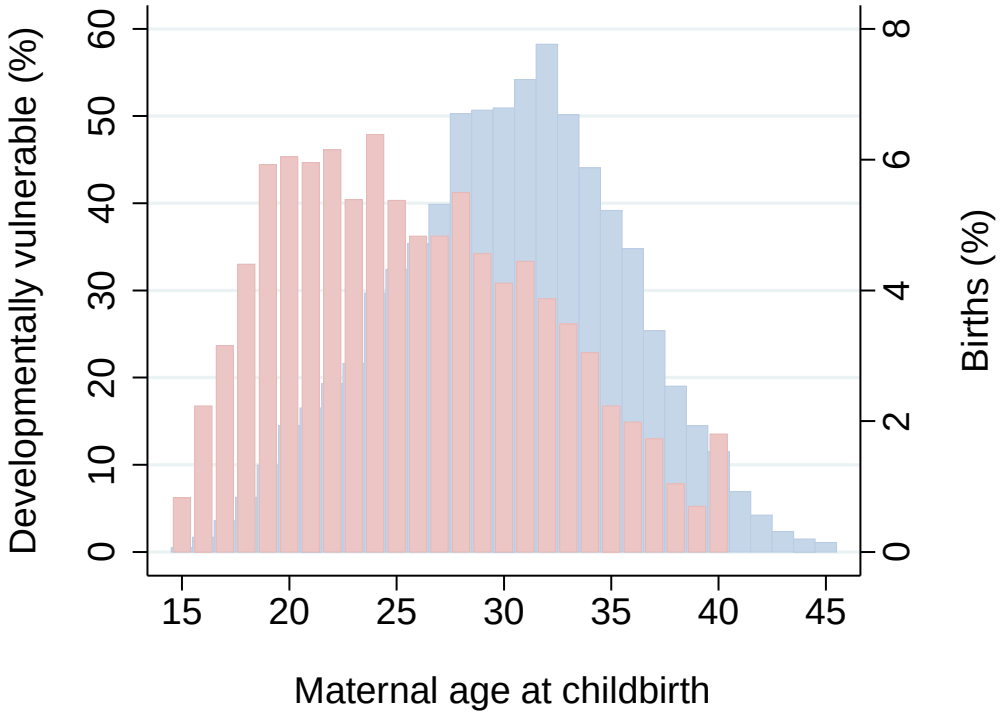
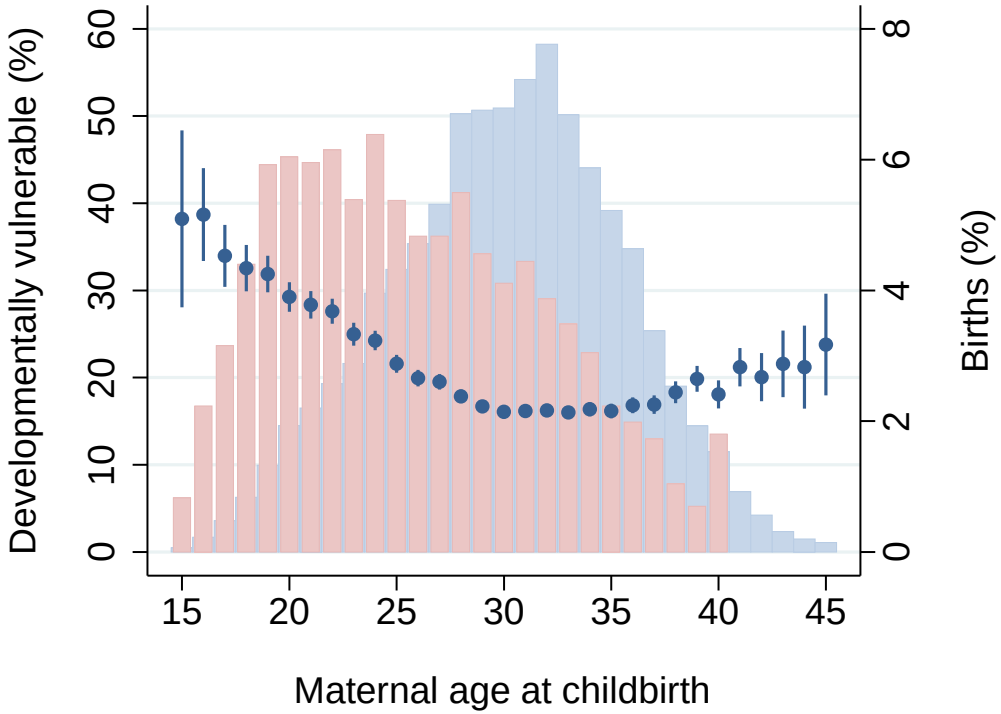


Legend: Light blue, non-Aboriginal births; light red, Aboriginal births.

Falster K, Hanly M, Banks E, Lynch J, Chambers G, Brownell M, Eades S, Jorm L. *PLoS Med* 2018; 15(4): e1002558.

Risk of vulnerability on one or more domains of child development by maternal age and Aboriginality



Legend: Light blue, non-Aboriginal births; light red, Aboriginal births; dark blue, vulnerability non-Aboriginal children.

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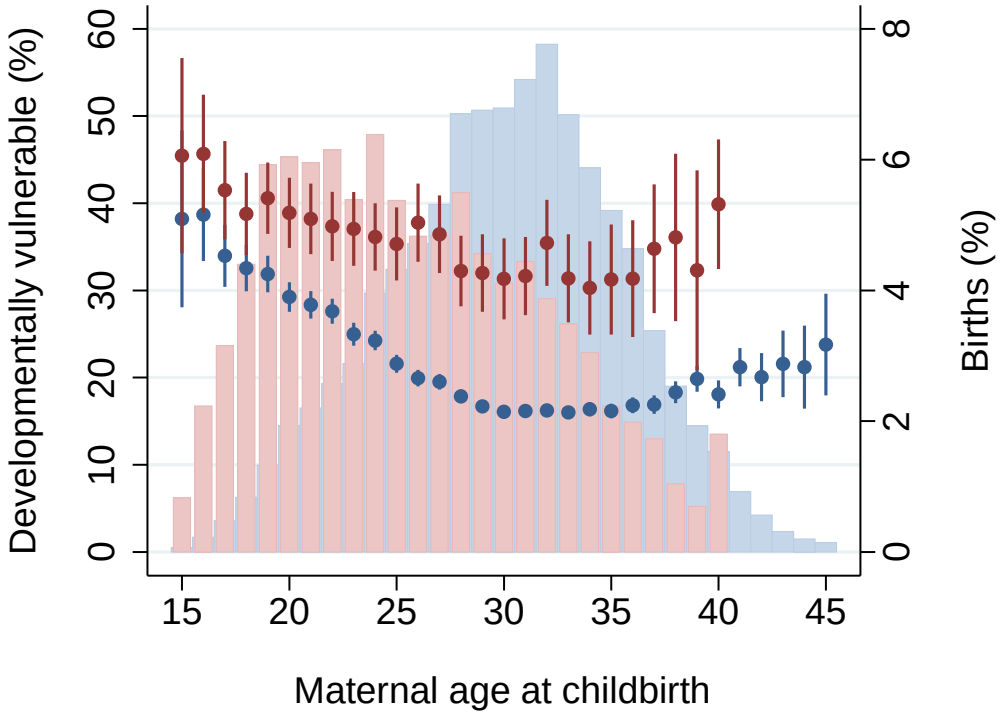


Legend: Light blue, non-Aboriginal births; light red, Aboriginal births; dark blue, vulnerability non-Aboriginal children; dark red, vulnerability Aboriginal children.

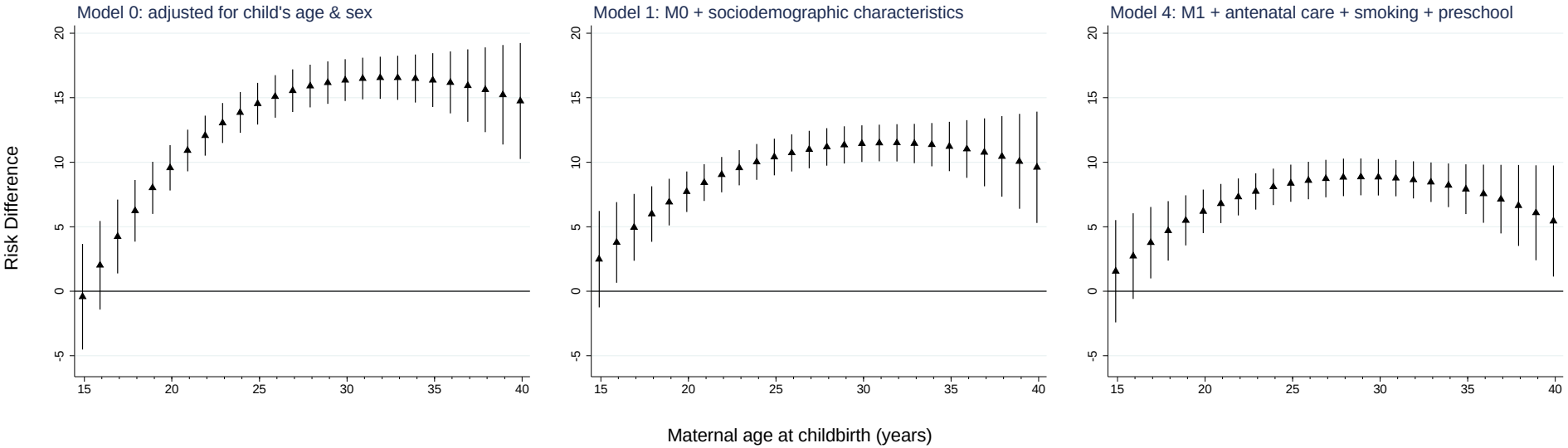
Falster K, Hanly M, Banks E, Lynch J, Chambers G, Brownell M, Eades S, Jorm L. *PLoS Med* 2018; 15(4): e1002558.

What is the magnitude of the inequality in child development outcomes across the maternal age range?

How much of the inequality can be explained by differences in demographic characteristics and modifiable early childhood exposures?

Falster K, Hanly M, Banks E, Lynch J, Chambers G, Brownell M, Eades S, Jorm L. *PLoS Med* 2018; 15(4): e1002558.

Aboriginal-to-non-Aboriginal risk difference by maternal age at childbirth



Falster K, Hanly M, Banks E, Lynch J, Chambers G, Brownell M, Eades S, Jorm L. *PLoS Med* 2018; 15(4): e1002558.

Summary of findings

- Aboriginal babies are born to younger mothers
- Children born to young mothers have highest risk, regardless of Aboriginality
- Aboriginal children have higher risk across the maternal age range
- Absolute inequality increases with increasing maternal age
- Differences in socio-demographic characteristics and modifiable exposures account for some of the inequality

Falster K, Hanly M, Banks E, Lynch J, Chambers G, Brownell M, Eades S, Jorm L. *PLoS Med* 2018; 15(4): e1002558.

Conclusions

- Whole-of-population linked routinely collected data methods have unique power to explore health disparities
  - "unpack" contributions of personal, geographic and service factors
  - identify targets for intervention
- It is essential that geography is taken into account in studies of health disparities
  - especially where there are significant urban-rural differences in the distribution of disadvantaged populations and health services
- The simplest of data linkages hugely increases the value of routinely collected data!