



Affluent neighborhoods protect tooth retention among adults with low income

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Effect of place on health

- Compositional explanations (individual level) attributed effect of place on health solely to characteristics of residents
- Contextual explanations (area level) have emerged
 - High crime rates associated with adverse health outcomes¹
 - Social capital (trust, reciprocity, civic mindedness) confers a protective effect²

¹ Curry A, et al. Pathways to depression: The impact of neighborhood violent crime on inner-city residents in Baltimore, Maryland, USA. *Soc Sci Med.* 2008 [Epub ahead of print]

² Scheffler RM, et al. Community-level social capital and recurrence of acute coronary syndrome. *Soc Sci Med.* 2008;66:1603-13.

Hierarchically structured (multilevel) data

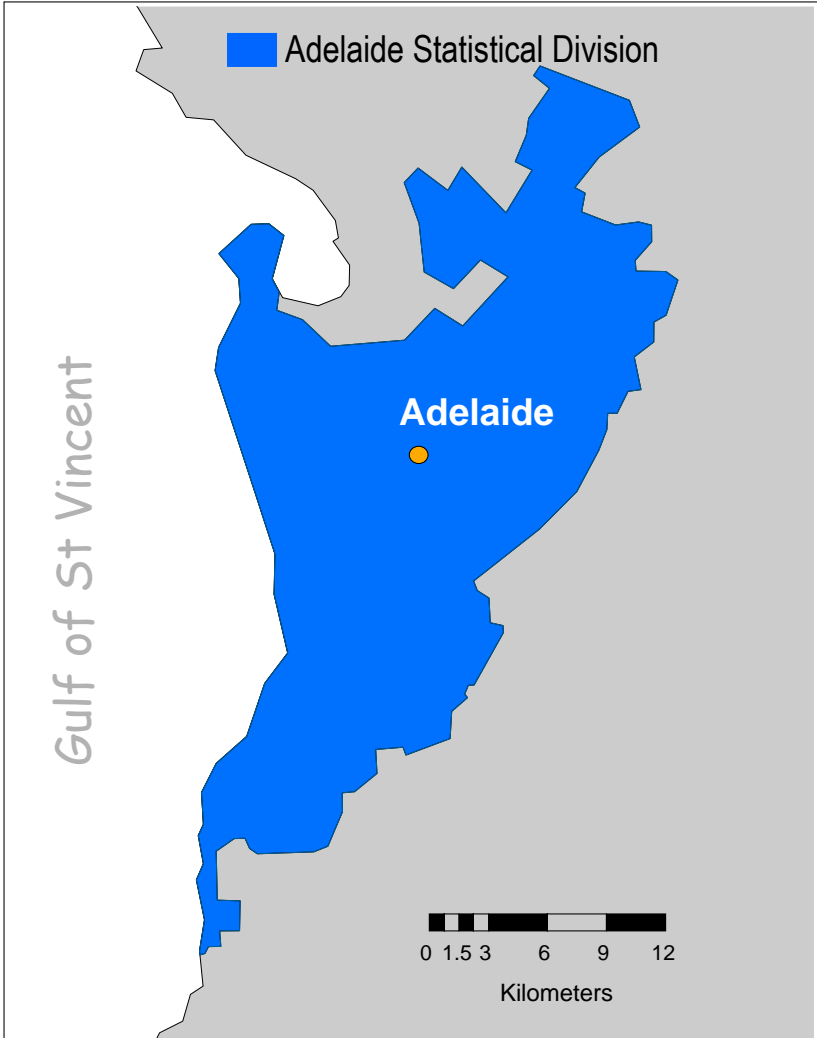
- Emergence of multilevel statistical techniques
- Rapid escalation in studies of place and health since 1999
- Net contextual effect of area on many aspects of health ¹
- Most studies examine main effects and interactions *within* each level
- Is there a *cross-level* interaction?

¹Reva, et al. Toward the next generation of research into small area effects on health: a synthesis of multilevel investigations published since July 1998. *J Epidemiol Community Health*. 2007; 61:853-61.

Aim and hypothesis

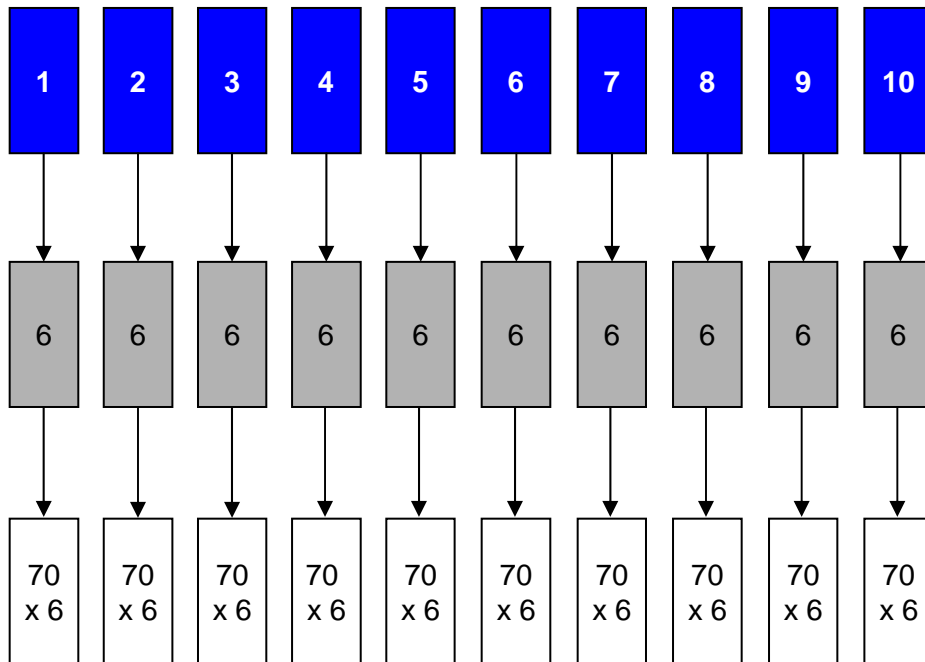
- To investigate the presence of a cross-level interaction between neighborhood socioeconomic position and individual household income on tooth retention
- *Low income is more hazardous for tooth retention in poor neighborhoods than in affluent neighborhoods*

Adelaide Small Area Dental Study



Study design and sampling

Cross sectional population-based observational study of individuals nested in residential areas



113 contiguous postcode areas stratified into area-based socioeconomic deciles ¹

Six postcodes sampled per decile with probability proportionate to size (n=60)

35 males and 35 females aged 43-57 years sampled per postcode (n=4,200) ²

¹ Australian Bureau of Statistics 2003. Information Paper Census of Population and Housing Socio-Economic Indexes for Areas, Australia 2001. ABS Cat no.2039.0

² Cohen MP. Determining sample sizes for surveys with data analyzed by hierarchical linear models. *J Official Stat.* 1998; 14:267-275.

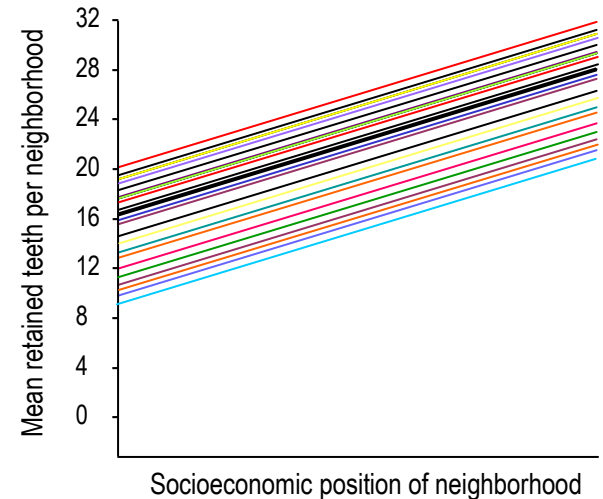
Key variables

- Dependent variable: Self reported number of teeth
- Compositional variables:
 - Pretax total household income
≤\$20,799; \$20,800–36,399; \$36,400–51,999; \$52,000+ (ref)
 - Educational attainment
School; vocational; diploma; university degree (ref)
 - Covariates: age in years, sex
- Contextual variable:
 - Index of Relative Socio-Economic Disadvantage¹
– a composite score derived from twenty 2001 census variables divided into tertiles labelled “Poor”, “Intermediate” and “Affluent” (ref) neighborhoods

¹ Australian Bureau of Statistics (2003). Information Paper Census of Population and Housing Socio-Economic Indexes for Areas, Australia 2001. ABS Cat no.2039.0.

Analytic approach

- Two-level random intercept variance components models
 - Intercepts to vary, slopes remain fixed
- Iterative generalized least-squares
- Model 1: Random intercept term for neighborhoods and fixed effects for sex and age centered
- Model 2: + Main effects of fixed compositional socioeconomic predictors
- Model 3: + Main effects of neighborhood tertiles
- Model 4: + Dummy variables for (a) neighborhood socioeconomic tertiles; (b) household income categories; (c) their multiplicative interaction



Results: response

- 2,915 adults completed a questionnaire (response=69.4%)
- Analysis limited to those reporting number of teeth (n=2,860)
- 45.6% was male; mean age = 50.1 years
- 91.3% had lived at current address for 10 years or more
 - Mean length of residence at current address was 17.5 years and residence length varied by <1 year between neighborhood tertiles

Description of study participants including adjusted mean numbers of retained teeth per person

N=2,860		n	(%)	Mean teeth *
Educational attainment	University degree	571	(20.0)	26.5
	Diploma	313	(10.9)	26.3
	Vocational	651	(22.8)	24.7
	School	1,100	(38.5)	24.3
	Missing	225	(7.9)	24.3
Household income	\$52,000+	1,303	(45.6)	26.4
	\$36,400-51,999	501	(17.5)	24.9
	\$20,800-36,399	423	(14.8)	24.4
	<=\$20,799	358	(12.5)	22.4
	Missing, Don't know	275	(9.6)	24.3
Neighborhood socioeconomic position	Affluent	926	(32.4)	26.5
	Intermediate	964	(33.7)	25.3
	Poor	970	(33.9)	23.3

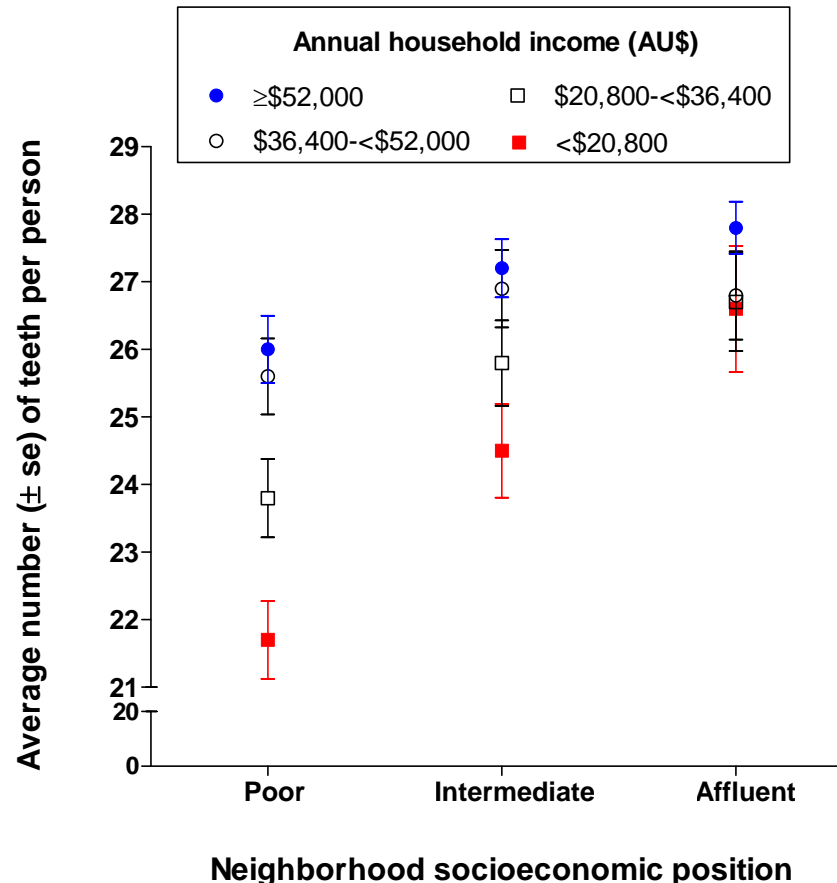
* Adjusted for age (centered), sex and postcode random effects

Variance components for individual- and area-level effects on number of teeth (main effects)

Individuals = 2,860 Areas =60		Model 1 Intercept, age, sex		Model 2 + Education, income		Model 3 + Neighborhood SEP	
Intercept		24.94		27.25		27.98	
		β	95% CI	β	95% CI	β	95% CI
Fixed effects							
Age (Centered)		-0.41	-0.46, -0.35	-0.37	-0.42, -0.31	-0.38	-0.43, -0.32
Sex (ref=Male)		0.70	0.23, 1.17	0.30	-0.18, 0.78	0.34	-0.13, 0.82
Education	University degree (ref)			--	--	--	--
	Diploma			0.04	-0.82, 0.90	0.06	-0.80, 0.92
	Vocational			-1.33	-2.07, -0.60	-1.25	-1.99, -0.52
	School			-1.53	-2.21, -0.85	-1.43	-2.11, -0.75
	Missing			-1.52	-2.51, -0.52	-1.42	-2.41, -0.43
Household income	\$52,000+ (ref)			--	--	--	--
	\$36,400–51,999			-1.22	-1.88, -0.56	-1.09	-1.75, -0.43
	\$20,800–36,399			-1.57	-2.28, -0.86	-1.41	-2.23, -0.70
	<=\$20,799			-3.80	-4.58, -3.03	-3.57	-4.35, -2.79
	Missing, Don't know			-1.74	-2.56, -0.91	-1.63	-2.46, -0.80
Neighborhood SEP	Affluent (ref)					--	--
	Intermediate					-0.58	-1.35, 0.19
	Poor					-1.97	-2.75, -1.18
Level 2 variance, (std error)		2.89 (0.68)		1.27 (0.38)		0.65 (0.27)	
Intra-class correlation (%)		6.77		3.18		1.68	

Cross-level interaction of tertiles of neighborhood socioeconomic position and individual's household income on predicted number of retained teeth

– adjusted for sex, age and education



Significant neighborhood socioeconomic x household income interaction (P=0.005)

Discussion

- Residence in affluent neighborhoods attenuated excess risk of tooth loss associated with low income
- In affluent neighborhoods rich and poor were statistically indistinguishable in terms of tooth retention
- Wealthier adults in poor neighborhoods lost little of their oral health advantage
- Yet low income adults in poor neighborhoods retained substantially fewer teeth
- Implies a heightened sensitivity to neighborhood effects among the poor, while the affluent were relatively impervious to neighborhood effects

Possible explanations

- Selection bias: poor people with few teeth choose to live in poor areas
- Concentrated disadvantage generates neighborhood disorder, mistrust, and social exclusion all of which are correlated with poor health ¹
 - Some support in the dental literature ^{2,3}
- Implications: planning to avoid concentrated disadvantage in neighborhoods?

¹ Cattell V. Poor people, poor places, and poor health: the mediating role of social networks and social capital. Soc Sci Med 2001; 52:1501-16.

² Watt RG. Emerging theories into the social determinants of health... Community Dent Oral Epidemiol 2002; 30:241-7.

³ Pattussi MP, et al. Neighborhood social capital and dental injuries in Brazilian adolescents. Am J Public Health 2006; 96:1462-8.

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