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The Association between Oral Health and Income Inequality, According to Income Levels, in Brazil 2002

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Introduction

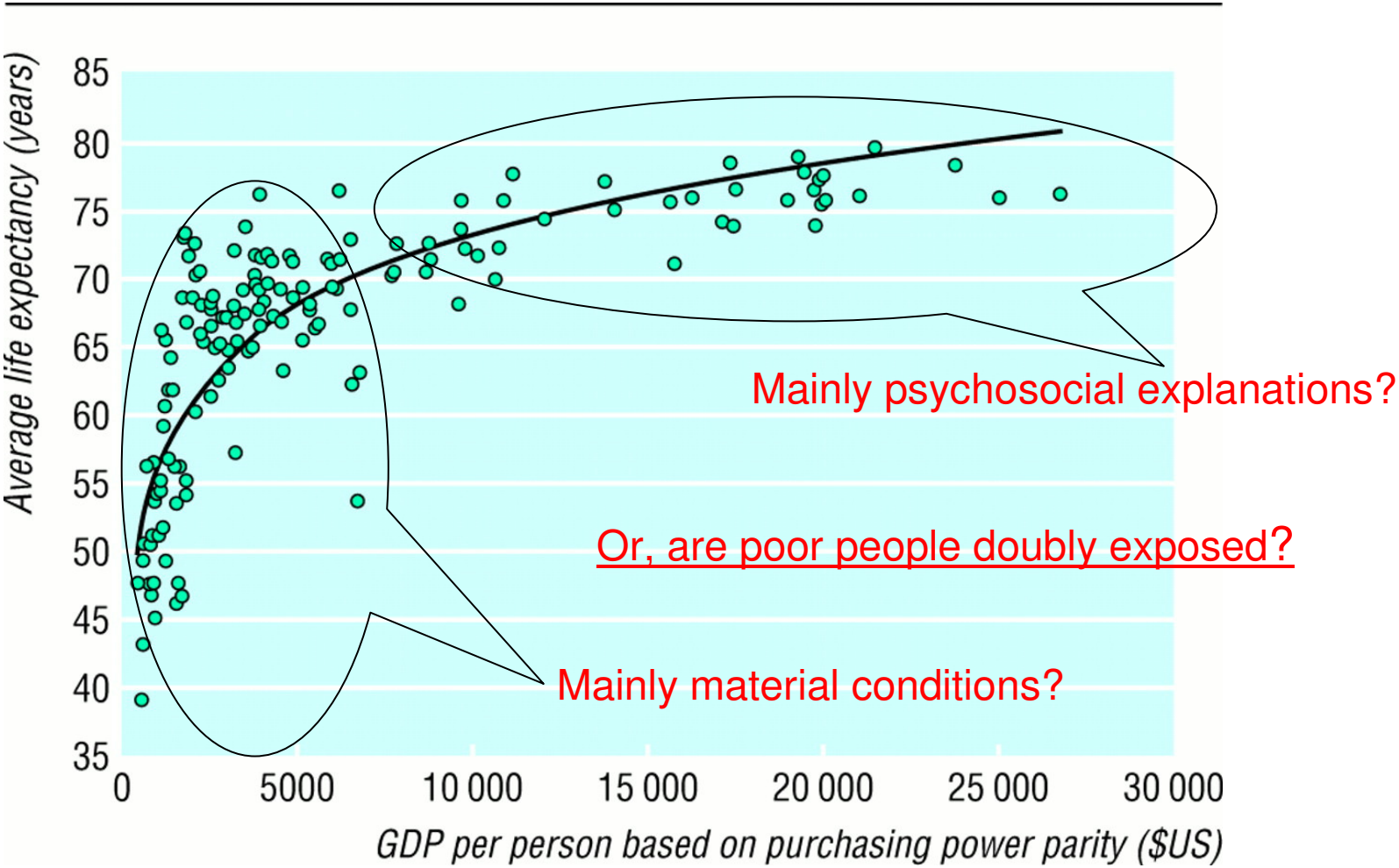
- Why may Income Inequality be a determinant of health?
  - weak ecological association between income and health among rich countries;
  - strong association between individual social position and health despite good living conditions,
  - strong ecological association between income inequality and health.

Wilkinson R. Unhealthy Societies (1996).
Wilkinson R. BMJ (1992).

Introduction

- Suggested pathways
  - Social comparisons (hierarchy)
  - Neomaterial (lifecourse material conditions and public policies)
  - Social capital
  - Statistical Artifact

Kawachi I, Kennedy BP. HSR (1999)
Lynch J. BMJ (2000)



Lynch, J. W et al. BMJ 2000;320:1200-1204

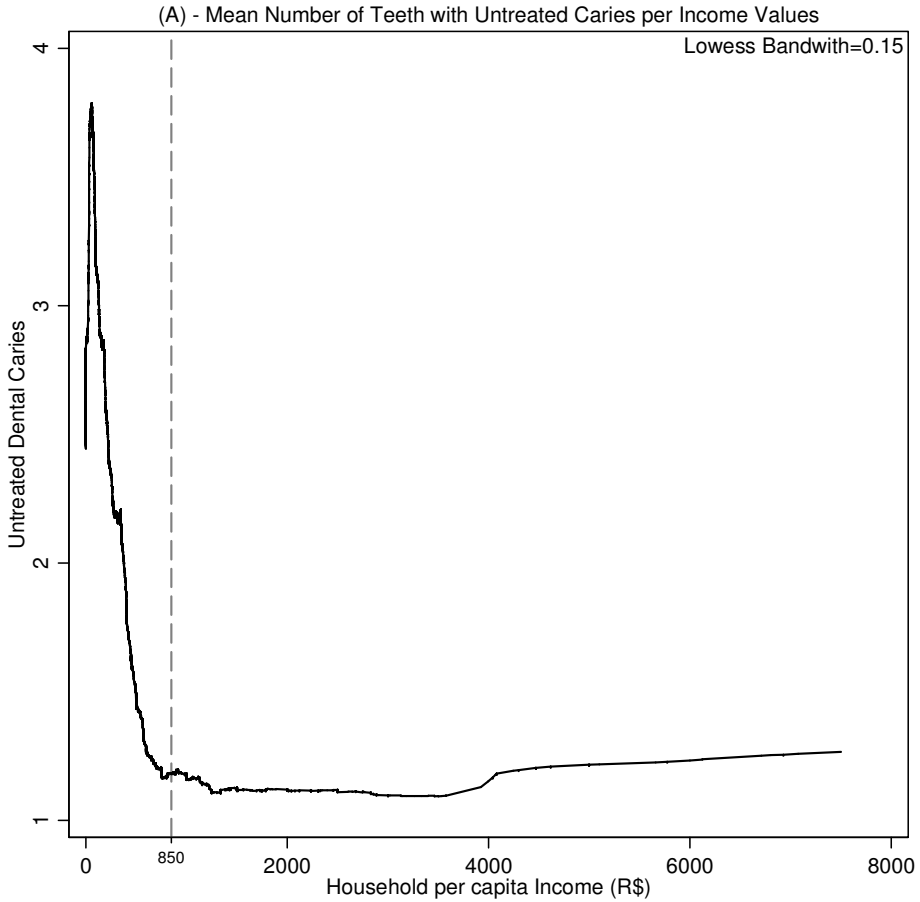
Objectives

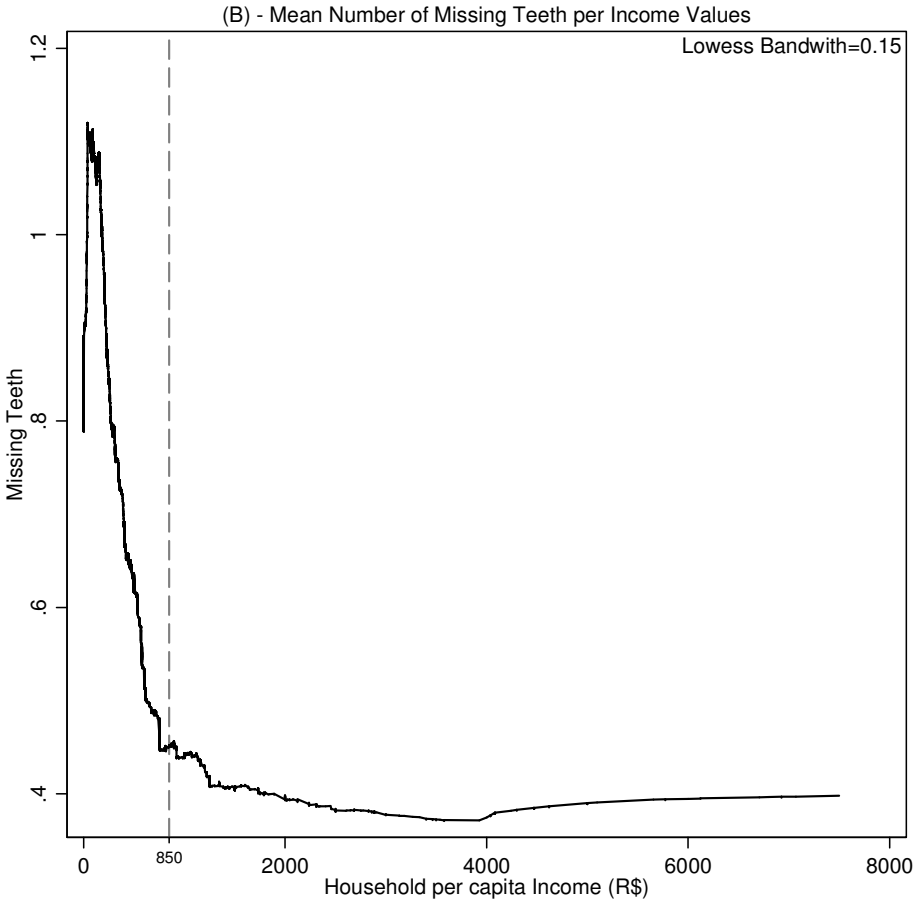
- to evaluate the association between income inequality and oral health in Brazil;
- to assess the role of alternative models that could explain this association;
- to assess whether income levels modify the income inequality effect.

Methods:

- Sampling
  - SBBrasil oral health survey 2002-2003 + SB expansion from RS and SP
  - 140,000 individuals nested in 330 municipalities
- Exposures
  - Income inequality (gini index)
  - Equivalised household income
- Outcomes
  - Binary: having at least one missing tooth (15-19 year old)
  - Binary: Being edentouolus (35-44 year-old)
  - Counting: Number of dental carious teeth (both age groups)
- Interaction measure
  - Dichotomized gini (at its median)
  - Equivalised household income dichotomized at R$850
  - Additive interaction: Rothman's Synergy Index
- Statistical procedure
  - Multilevel Logistic/Poisson regression with random intercept

Methods: setting the cut-off point





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Main Results and Discussion

Table 1 – Comparison of Odds and Rate Ratio (95% CI), explained variance (R2), variance partitioning coefficient (VPC) and the number of coefficients in various multilevel models – 15-19 year-olds, number of missing teeth and number of teeth with untreated caries.

Models* for the 15-19 year-old group	Gini† Odds Ratio (95% CI)	R^2 (%)	VPC (%)	Coefficients in regression (n)
Missing Teeth (P>0)				
Crude	1.25 (1.09 - 1.44)	0.47	14.35	2
Model 1 (Confounding)	1.20 (1.07 - 1.35)	10.36	9.60	6
Model 2 (M1+Income Dichot)	1.21 (1.07 - 1.36)	11.14	9.38	7
Model 3 (M1+Income)	1.19 (1.06 - 1.34)	11.55	9.44	7
Model 4 (M1+Ranking)	1,19 (1.06 - 1.34)	10.81	9.71	7
Model 5 (M1+Socioeconomic)	1.13 (1.01 - 1.27)	11.91	9.31	14
Model 6 (M1+Social Capital)	1.20 (1.06 - 1.34)	10.37	9.60	7
Model 7 (M1+Health Services)	1.28 (1.13 - 1.45)	19.31	9.50	12
Model 8 (M1+M5+M6+M7)	1.19 (1.05 - 1.35)	21.93	9.36	21
Untreated Caries	Rate Ratio (95% CI)			
Crude	1.26 (1.14 - 1.40)	0.54	8.39	2
Model 1 (Confounding)	1.24 (1.14 - 1.36)	3.21	6.19	6
Model 2 (M1+Income Dichot)	1.25 (1.15 - 1.37)	4.09	6.28	7
Model 3 (M1+Income)	1.24 (1.13 - 1.35)	4.23	6.17	7
Model 4 (M1+Ranking)	1.25 (1.14 - 1.36)	4.19	6.24	7
Model 5 (M1+Socioeconomic)	1.13 (1.04 - 1.24)	6.53	5.84	14
Model 6 (M1+Social Capital)	1.20 (1.10 - 1.32)	3.44	5.99	7
Model 7 (M1+Health Services)	1.22 (1.12 - 1.33)	4.19	5.50	12
Model 8 (M1+M5+M6+M7)	1.12 (1.08 - 1.22)	7.45	5.28	21

† Coefficients represent a change of 10 in the Gini scale (0-100)

Table 1 – Comparison of Odds and Rate Ratio (95% CI), explained variance (R2), variance partitioning coefficient (VPC) and the number of coefficients in various multilevel models – 35-44 year-olds, number of missing teeth and number of teeth with untreated caries.

Models for the 35-44 year-old group	Gini† Odds Ratio (95% CI)	R^2 (%)	VPC (%)	Coefficients in regression (n)
Edentulism (P=32)				
Crude	1.00 (0.87 - 1.15)	>0.00	9.90	2
Model 1 (Confounding)	0.98 (0.85 - 1.12)	12.36	9.16	6
Model 2 (M1+Income Dichot)	0.97 (0.84 - 1.12)	13.48	9.53	7
Model 3 (M1+Income)	0.95 (0.83 – 1.10)	14.70	9.59	7
Model 4 (M1+Ranking)	0.94 (0.81 – 1.08)	14.41	9.68	7
Model 5 (M1+Socioeconomic)	0.98 (0.85 - 1.12)	16.78	8.65	14
Model 6 (M1+Social Capital)	1.00 (0.86 - 1.14)	12.37	9.18	7
Model 7 (M1+Health Services)	0.94 (0.81 - 1.09)	26.21	9.24	12
Model 8 (M1+M5+M6+M7)	1.01 (0.87 - 1.17)	27.49	9.07	21
Untreated Caries	Rate Ratio (95% CI)			
Crude	1.30 (1.18 - 1.42)	0.71	6.67	2
Model 1 (Confounding)	1.28 (1.18 - 1.40)	2.49	5.18	6
Model 2 (M1+Income Dichot)	1.29 (1.19 - 1.41)	4.43	5.16	7
Model 3 (M1+Income)	1.26 (1.16 - 1.37)	6.07	4.57	7
Model 4 (M1+Ranking)	1.30 (1.19 - 1.41)	5.39	5.53	7
Model 5 (M1+Socioeconomic)	1.17 (1.08 - 1.27)	8.53	4.83	14
Model 6 (M1+Social Capital)	1.26 (1.16 - 1.37)	2.61	5.10	7
Model 7 (M1+Health Services)	1.26 (1.16 - 1.37)	4.98	4.44	12
Model 8 (M1+M5+M6+M7)	1.16 (1.06 - 1.26)	9.95	4.37	21

† Coefficients represent a change of 10 in the Gini scale (0-100)

Table 2 – Synergy Index for additive interaction of median Gini and dichotomized Individual Income, in multilevel regression models for two dental outcomes in young in Brazil.

		Gini<0.56	Gini>0.56	Synergy Index (95% CI)	R^2 (%)	VPC (%)
		Odds Ratio (95% CI)				
At least one missing tooth	Individual Income>850	1	1.45 (0.98 - 2.15)			
	Individual Income<850	2.59 (2.00 - 3.35)	3.79 (2.77 - 5.18)	1.37 (0.83 - 2.25)	19.72	14.37
Edentulism	Individual Income>850	1	0.89 (0.50 - 1.59)			
	Individual Income<850	1.28 (0.90 - 1.81)	1.41 (0.96 - 2.06)	2.49 (0.05 – 122.9)	26.58	8.73
		Rate Ratio (95% CI)				
Untreated Caries (15-19 year-old)	Individual Income>850	1	1.38 (1.05 - 1.83)			
	Individual Income<850	2.16 (1.77 – 2.63)	2.50 (1.98 – 3.12)	0.97 (0.88 – 1.08)	4.99	5.51
Untreated Caries (35-44 year-old)	Individual Income>850	1	1.46 (1.27 - 1.68)			
	Individual Income<850	2.49 (2.30 - 2.68)	3.03 (2.68 – 3.43)	1.05 (0.92-1.15)	5.82	5.17

Discussion

- The residual effect of Gini in our study could be due to unmeasured or badly measured characteristics of one of the proposed mechanisms, as we have no reason to believe that it could stand for a new mechanism.

- In our study the inclusion of health care variables increased, instead of decreased, the Gini effect, showing that they may not lay in the pathway.

Discussion

- The fact that social ranking did not rule out the Gini effect means that it may not opperate only through comparison mechanisms.
- A strong assumption when using Gini is that the membership and the comparison groups are the same (Pedersen, 2004).
- In our case, people would belong and compare themselves to all others in the same municipality.

Discussion

- Lack of interaction in our study means that income inequality and low income have independent effects (not competing or synergistic mechanisms).
- Therefore, poor people living in high income inequality areas are exposed to a double burden of risk.

Conclusions

- Greater municipal income inequality was associated with worse oral health even after controlling for individual level variables.
- Gini showed no additive effect with income as a departure from additivity, suggesting that it had a similar detrimental effect among lower and higher income groups.
- Lack of association of income inequality with a long latency outcome (edentulism) suggests that further research should consider the effect according to different lag times