Income inequality, socioeconomic segregation and premature mortality in Brazil

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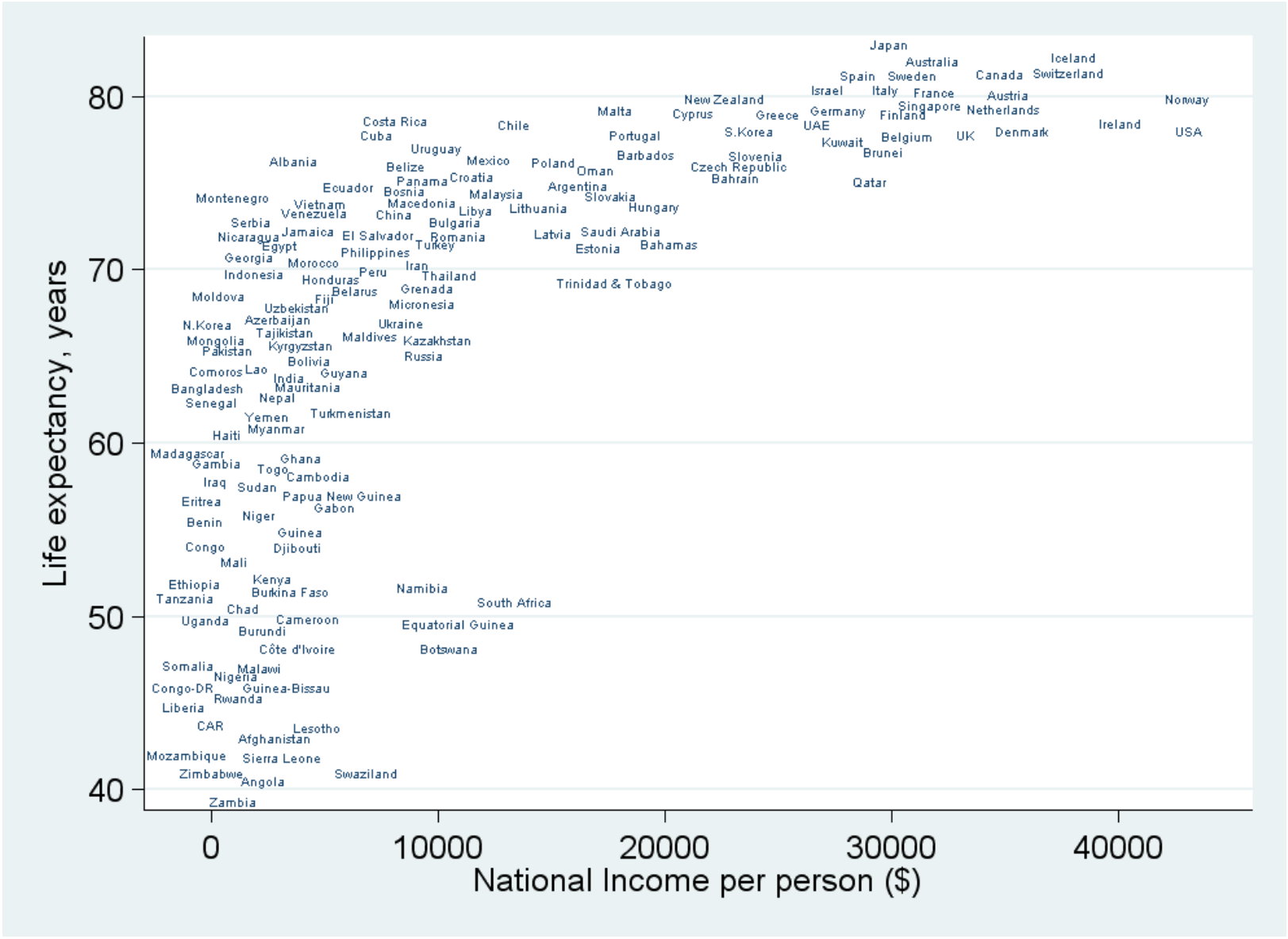
E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL

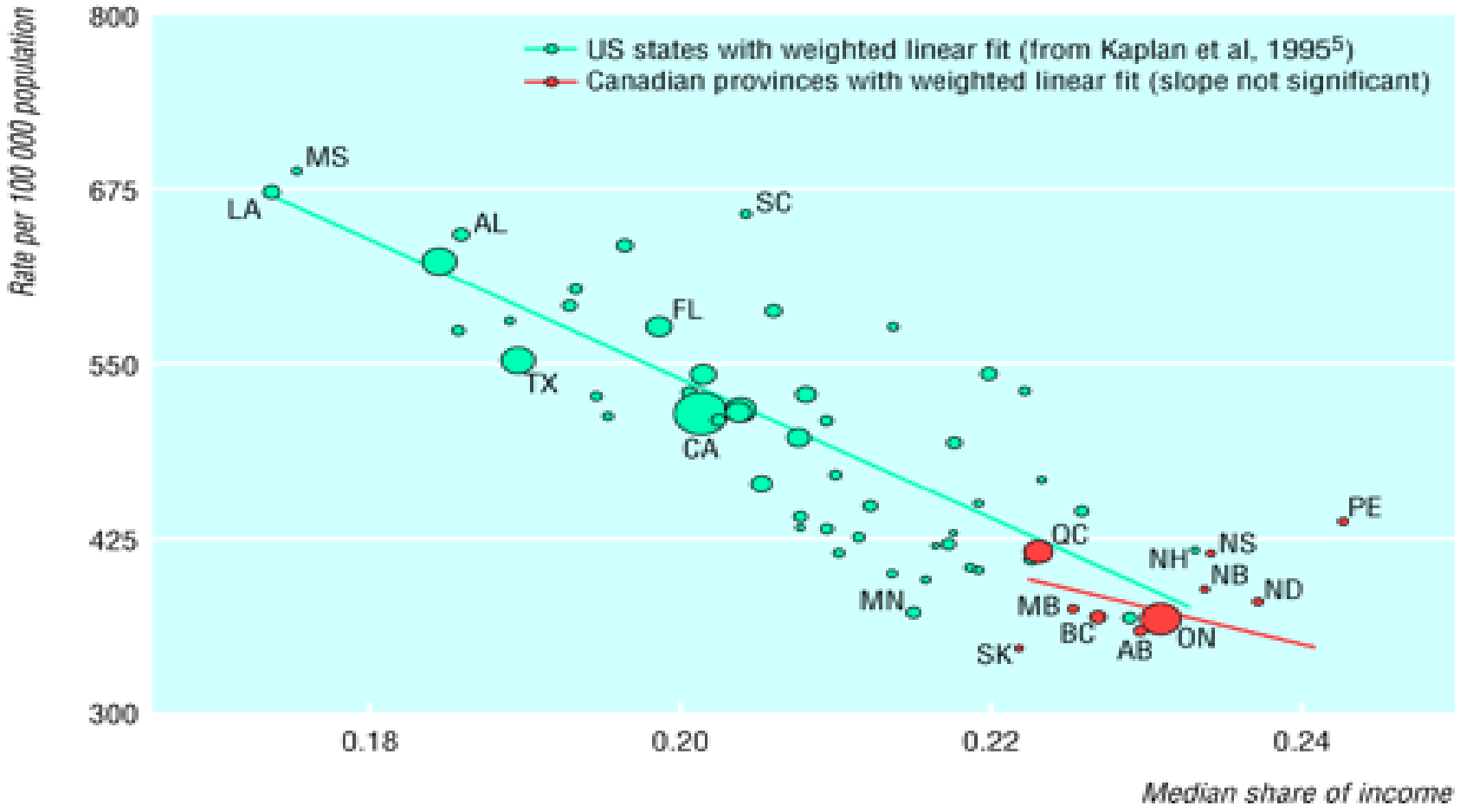
An ESRC pathfinder project

Income per head and life-expectancy: rich & poor countries



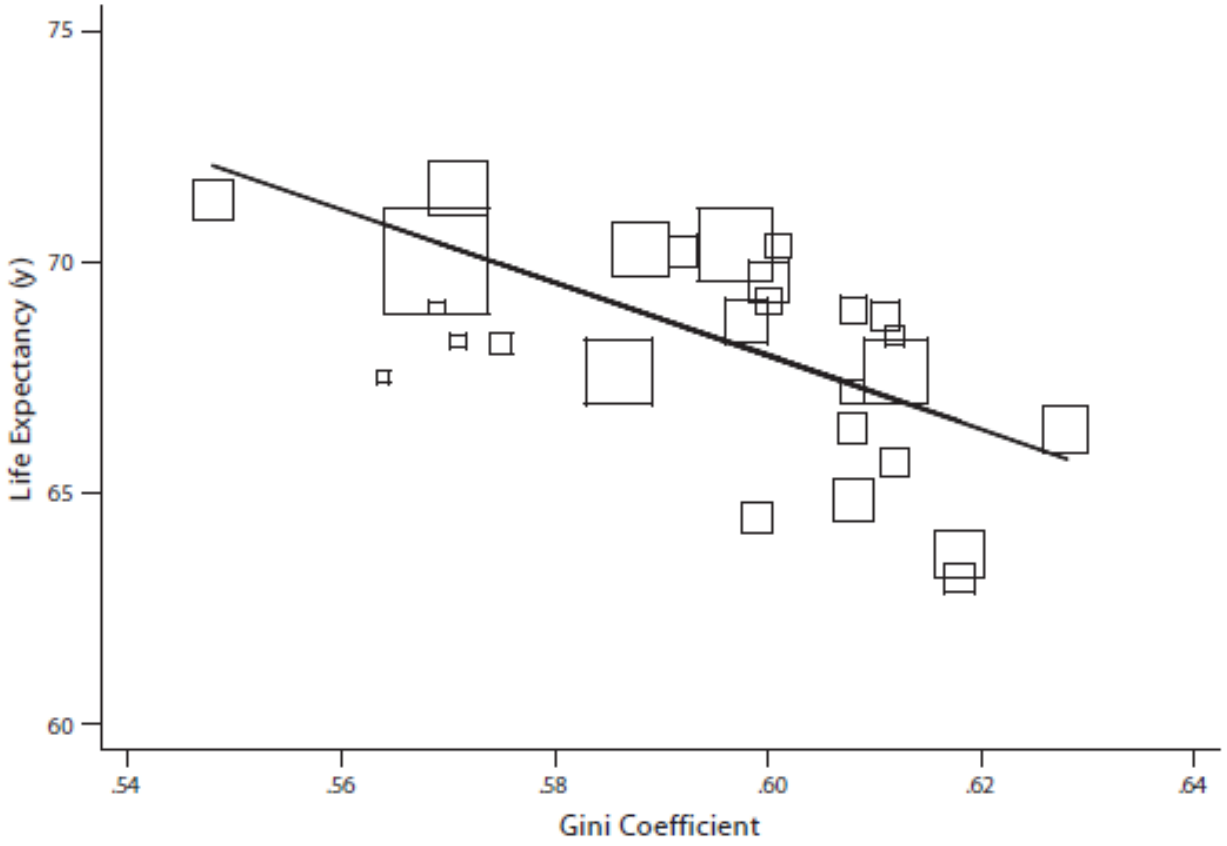
Source: Wilkinson & Pickett, The Spirit Level (2009)

Male mortality (25-64 yrs) and income inequality in US states and Canadian provinces.



Source: Ross NA, Wolfson MC, Dunn JR, Berthelot JM, Kaplan GA, Lynch JW. *British Medical Journal* 2000;320:898-902

Life expectancy and income inequality: Brazil, 2000



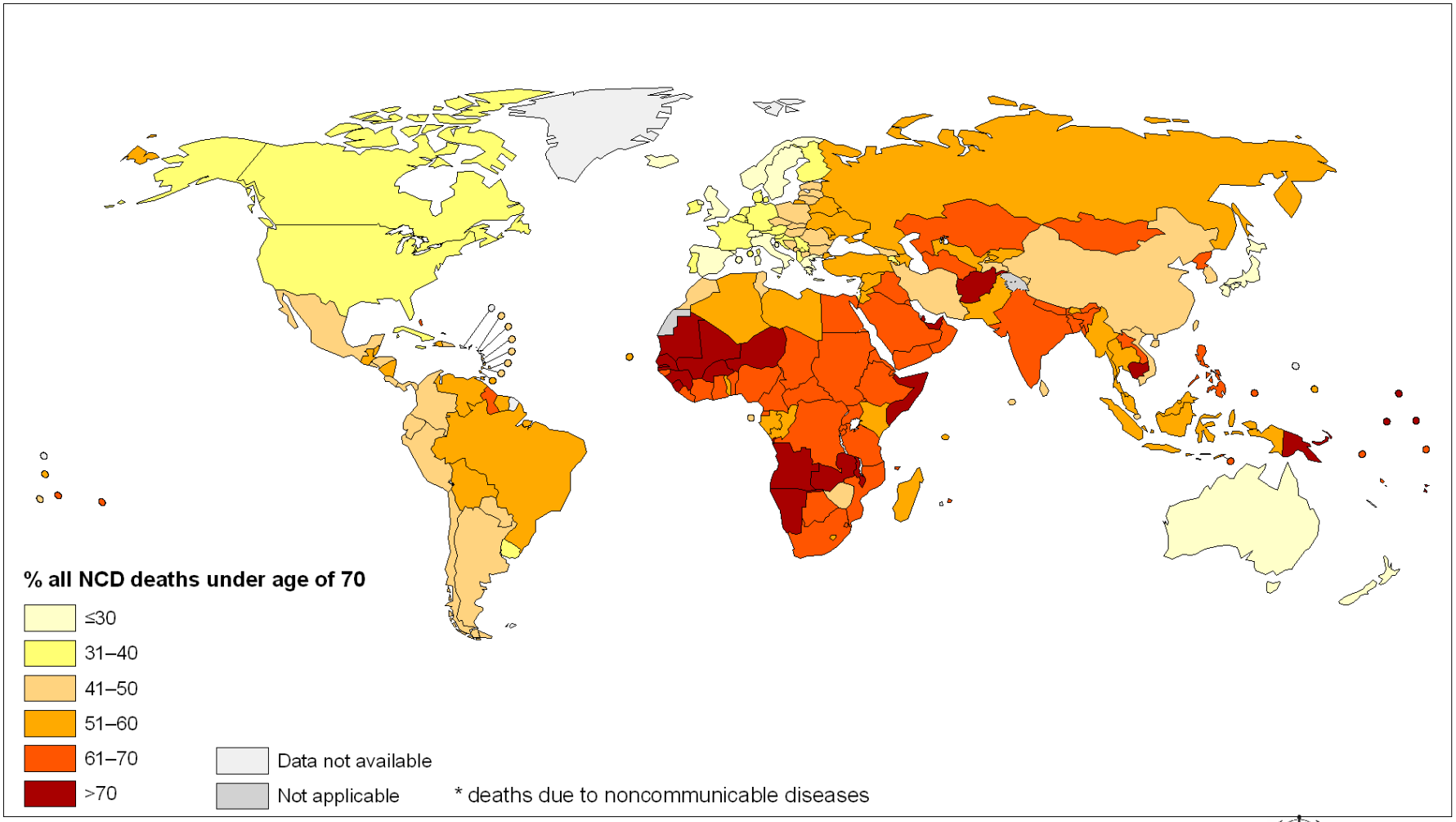
Note. Each square represents a state and is proportional to the size of its population.

(**Premature) Ageing, Inequalities and Development**

Increasing spatial inequality in poverty and income
- urbanisation and concentration of economic activity
- spatial concentration of affluence reproduces privileges of the rich
- spatial concentration of poverty results in segregation, involuntary clustering in ghettos

Effects on population health and premature mortality/morbidity?
“Triple health jeopardy: being poor in a poor neighbourhood that is spatially isolated from life-enhancing opportunities…” Nancy A Ross

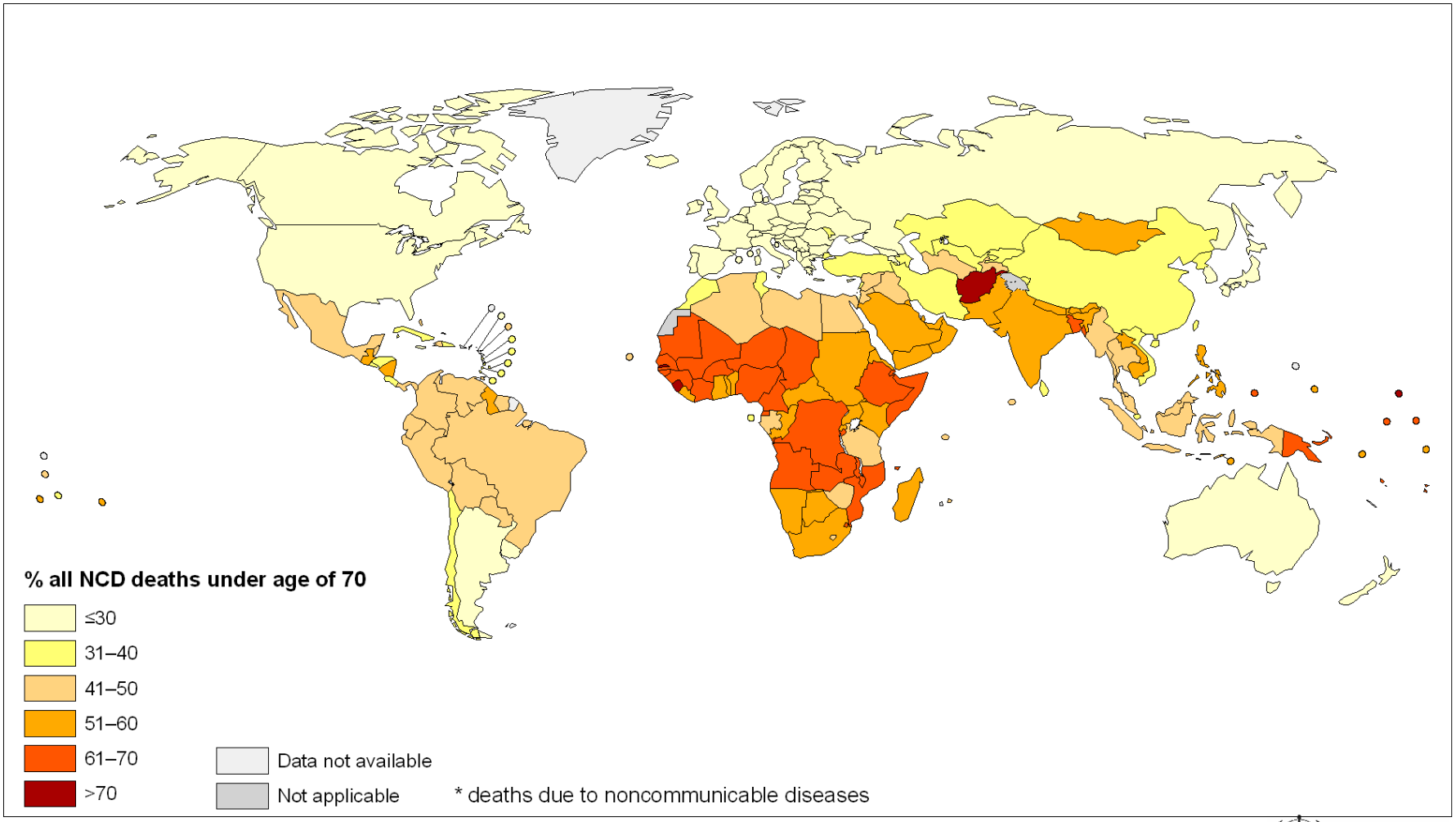
Percentage of all NCD deaths* occuring under age of 70
Males, 2008



Data Source: World Health Organization
Map Production: Public Health Information and Geographic Information Systems (GIS)
World Health Organization

World Health Organization

Percentage of all NCD deaths* occuring under age of 70
Females, 2008



Data Source: World Health Organization
Map Production: Public Health Information and Geographic Information Systems (GIS)
World Health Organization

World Health Organization

STATE OF THE WORLD'S CITIES 2010/2011
BRIDGING THE URBAN DIVIDE

UN HABITAT

Spatial poverty trap

- Severe job restriction
- Gender disparities
- Worsening living conditions
- Social exclusion and marginalisation
- Lack of social interaction
- High incidence of crime

EXPOSURE/ISOLATION DIMENSION

SPATIAL EXPOSURE INDEX

$$\breve{P}^{*}_{(m,\,n)} = \sum_{j=1}^{J} \frac{N_{jm}}{N_m} \left(\frac{\breve{L}_{jn}}{\breve{L}_j} \right)$$

Average proportion of group n in the localities of each member of group m

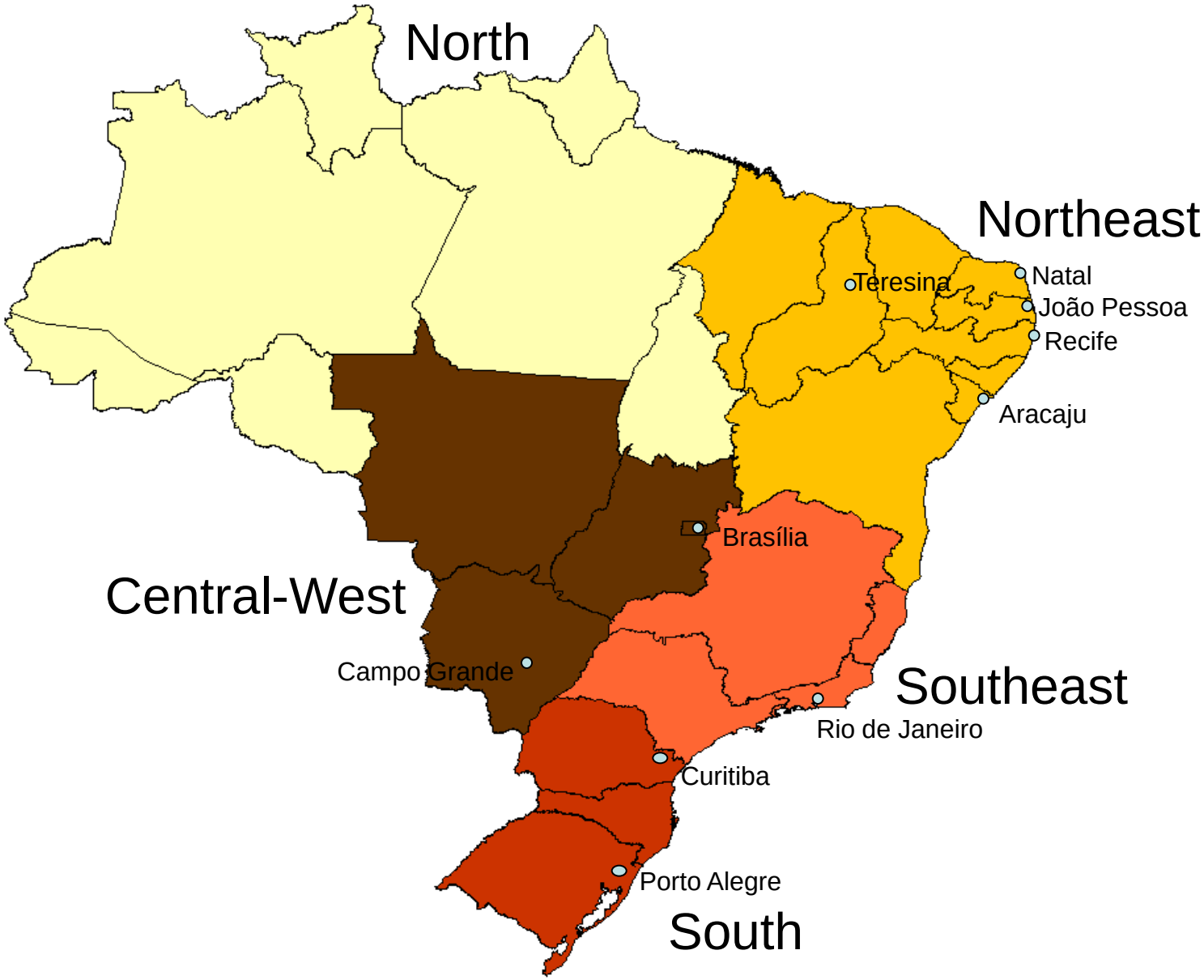
SPATIAL ISOLATION INDEX

$$\breve{Q}_m = \sum_{j=1}^{J} \frac{N_{jm}}{N_m} \left(\frac{\breve{L}_{jm}}{\breve{L}_j} \right)$$

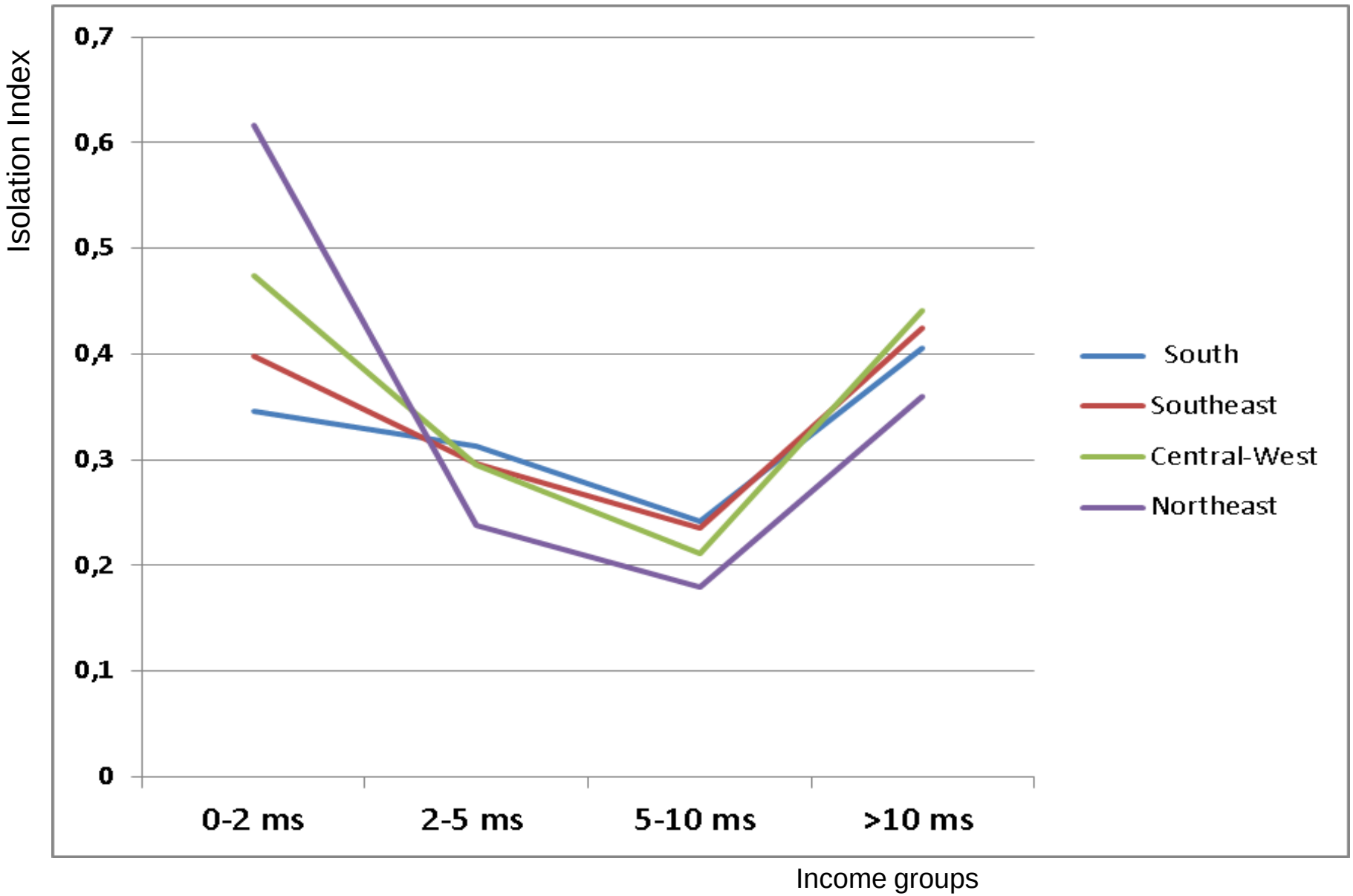
Average proportion of group m in the local environments of each member of group m (spatial exposure of group m to itself)

Feitosa, F. F.; Câmara, G.;Monteiro, A. M. V.; Koschitzki, T.; Silva, M. P. S., Global and local spatial indices of urban segregation. International Journal of Geographical Information Science; Mar2007, Vol. 21 Issue 3, p299-323,

Brazilian regions, states and selected cities



Spatial Isolation Index




72°W
60°
48°
36°
Georgetown
Paramaribo
Venezuela
Guyana
Suriname
French Guiana
Colombia
Boa Vista
Atlantic Ocean
Macapá
Negro R.
0°
Amazon R.
Belém
Manaus
São Luís
Amazon R.
Tocantins r.
Fortaleza
Teresina
Brazil
Natal
João Pessoa
Araguaia R.
Rio Branco
Pôrto Velho
Miracema do Norte
Recife
Maceió
Tocantins R.
São Francisco R.
Aracaju
Peru
Xingu R.
12°S
Salvador
Ucayali R.
Bolivia
Cuiabá
Brasilia
Paraguai R.
La Paz
Goiânia
Paranaíba R.
Belo Horizonte
Sucre
Campo Grande
Grande R.
Vitória
Pacific Ocean
Paraguay
Paraná R.
Rio de Janeiro
São Paulo
Chile
Asunción
Curitiba
24°
Argentina
Florianópolis
Pôrto Alegre
Paraná R.
Uruguay
0
750 km
0
500 mi
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Multilevel Poisson Model of premature CVD mortality rate with random slopes of income by city

$$\text{Premature\_CVD\_Mortality\_Rate}_{nordem2,\ City} \sim \text{Poisson}(\pi_{nordem2,\ City})$$

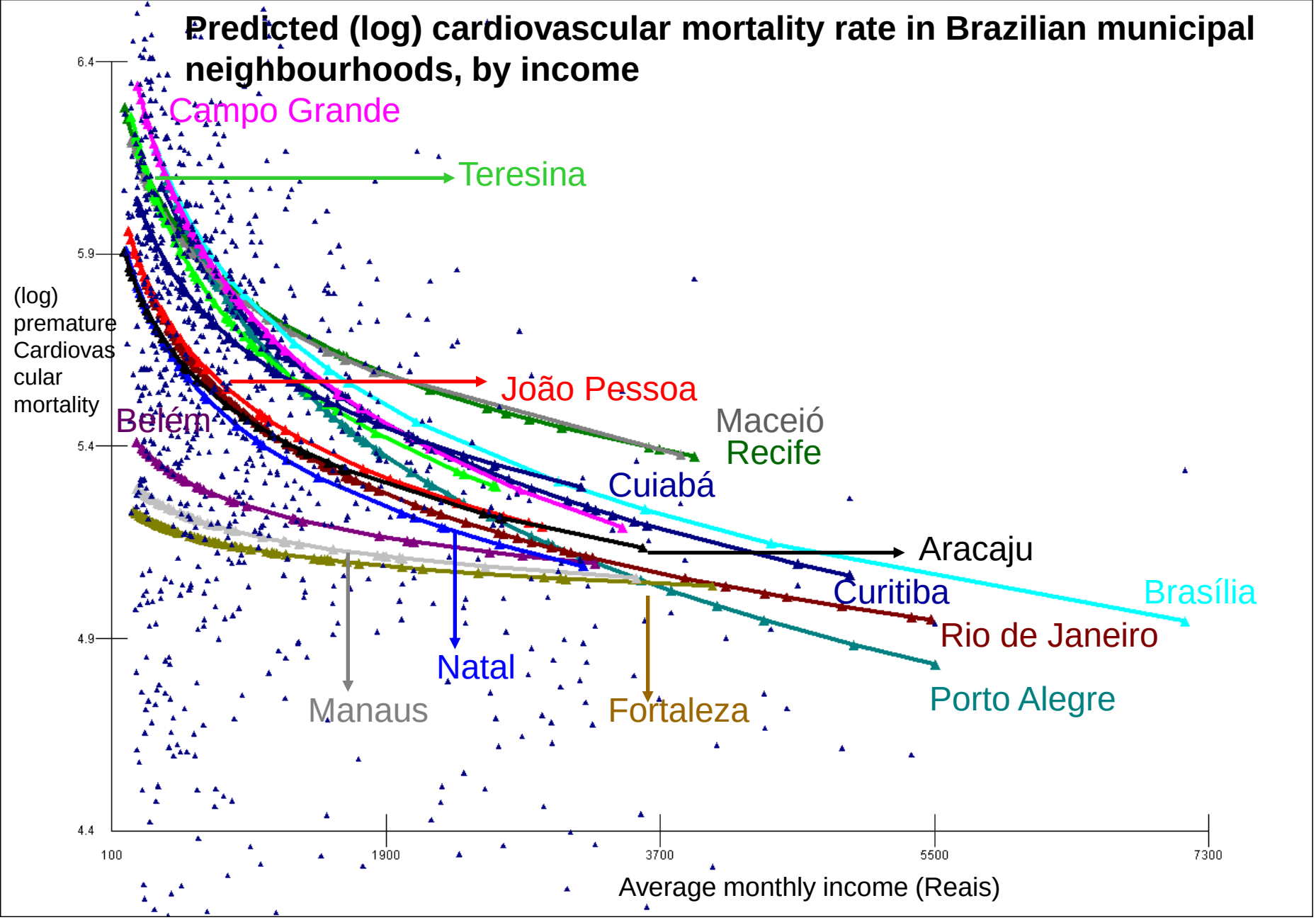
$$\log(\pi_{nordem2,\ City}) = \beta_{0City}\text{cons} + \beta_{1\,City}(\text{income-gm})$$

$$\beta_{0City} = \beta_0 + u_{0City}$$

$$\beta_{1City} = \beta_1 + u_{1City}$$

$$\begin{bmatrix} u_{0City} \\ u_{1City} \end{bmatrix} \sim \text{N}(0,\ \Omega_u) \ :\ \Omega_u = \begin{bmatrix} \sigma^2_{u0} & \\ \sigma_{u01} & \sigma^2_{u1} \end{bmatrix}$$

$$\text{var}(\text{Premature\_CVD\_Mortality\_Rate}_{nordem2,\ City} | \pi_{nordem2,\ City}) = \alpha\pi_{nordem2,\ City}$$


Predicted (log) cardiovascular mortality rate in Brazilian municipal neighbourhoods, by income
Campo Grande
Teresina
João Pessoa
Belém
Maceió
Recife
Cuiabá
Aracaju
Curitiba
Brasília
Rio de Janeiro
Natal
Porto Alegre
Manaus
Fortaleza
(log) premature Cardiovascular mortality
6.4
5.9
5.4
4.9
4.4
100
1900
3700
5500
7300
Average monthly income (Reais)

Multilevel Poisson Model of premature CVD mortality rate with random slopes of income and interaction with spatial isolation of poverty index

$$\text{Premature\_CVD\_Mortality\_Rate}_{nordem2,\ City} \sim \text{Poisson}(\pi_{nordem2,\ City})$$

$$\log(\pi_{nordem2,\ City}) = \beta_{0City}\text{cons} + \beta_{1\,City}\text{income} + \beta_2\text{isolated\_poor\_1}_{nordem2,\ City} + \beta_3\text{income.isolated\_poor\_1}_{nordem2,\ City}$$

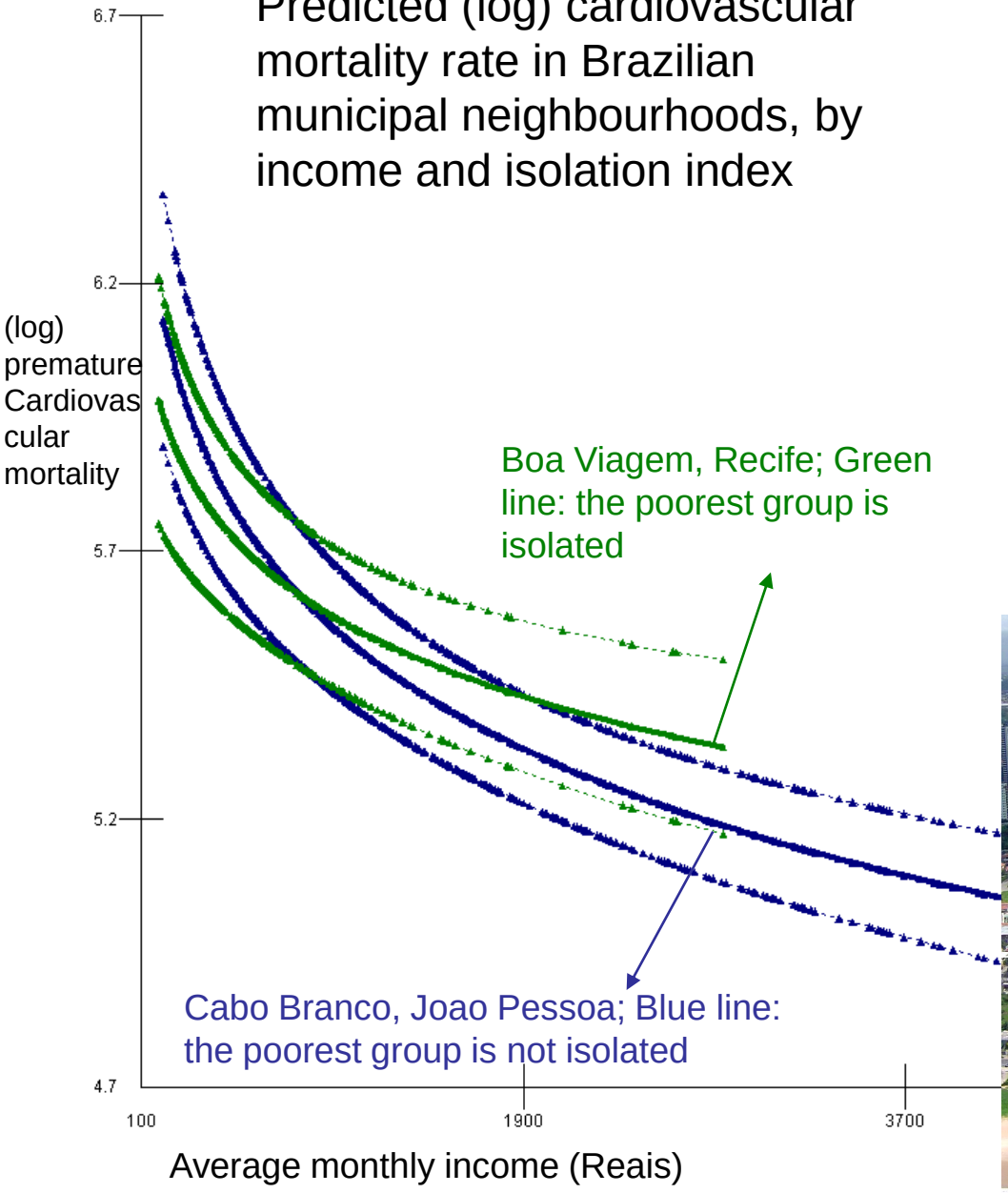
$$\beta_{0City} = \beta_0 + u_{0City}$$

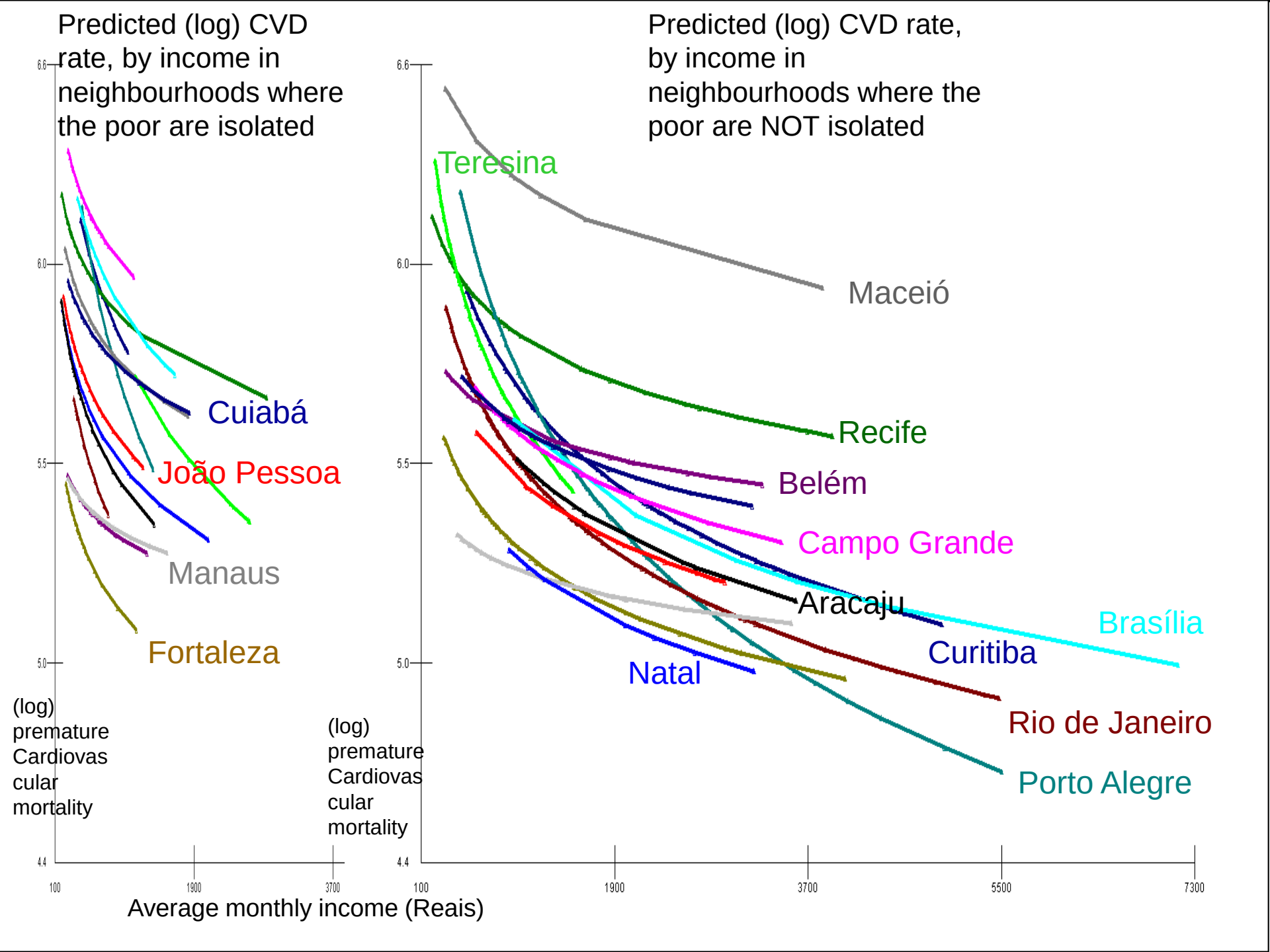
$$\beta_{1City} = \beta_1 + u_{1City}$$

$$\begin{bmatrix} u_{0City} \\ u_{1City} \end{bmatrix} \sim \text{N}(0,\ \Omega_u) \ :\ \Omega_u = \begin{bmatrix} \sigma^2_{u0} & \\ \sigma_{u01} & \sigma^2_{u1} \end{bmatrix}$$

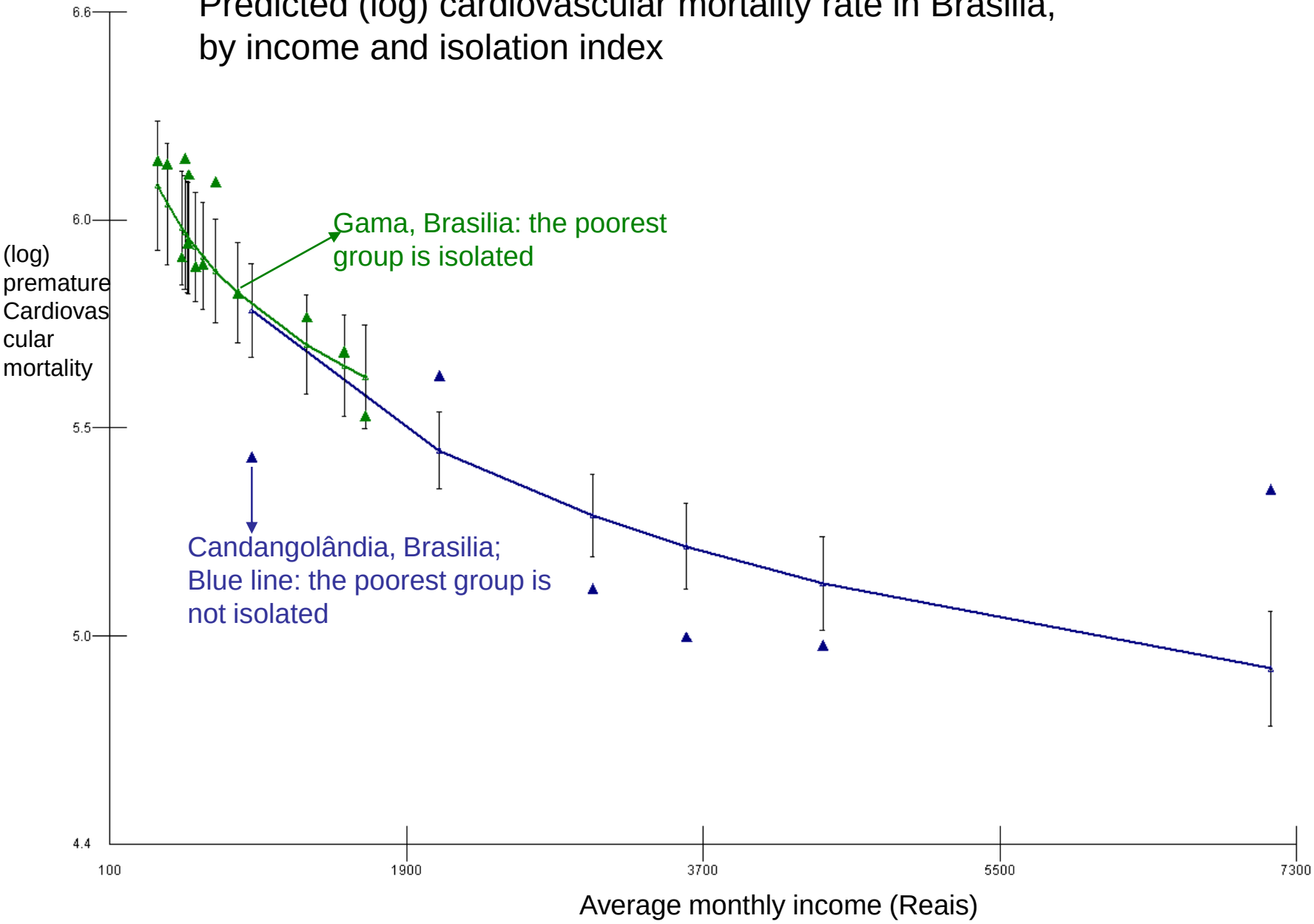
$$\text{var}(\text{Premature\_CVD\_Mortality\_Rate}_{nordem2,\ City} | \pi_{nordem2,\ City}) = \alpha\pi_{nordem2,\ City}$$

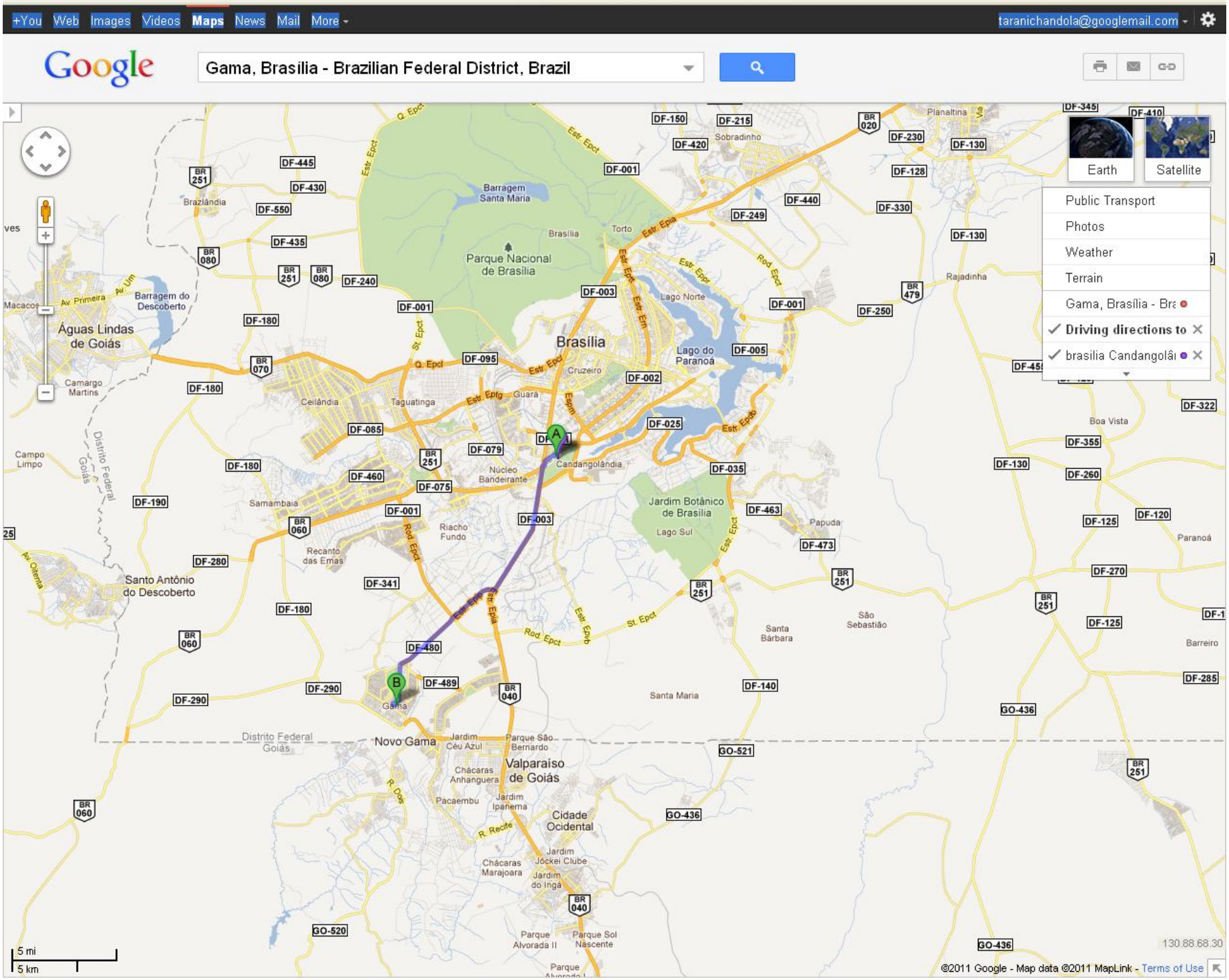
Predicted (log) cardiovascular mortality rate in Brazilian municipal neighbourhoods, by income and isolation index




Predicted (log) CVD rate, by income in neighbourhoods where the poor are isolated
Predicted (log) CVD rate, by income in neighbourhoods where the poor are NOT isolated
Teresina
Maceió
Recife
Belém
Campo Grande
Aracaju
Brasília
Curitiba
Rio de Janeiro
Porto Alegre
Natal
Cuiabá
João Pessoa
Manaus
Fortaleza
(log) premature Cardiovascular mortality
(log) premature Cardiovascular mortality
6.6
6.0
5.5
5.0
4.4
100
1900
3700
5500
7300
Average monthly income (Reais)

Predicted (log) cardiovascular mortality rate in Brasilia, by income and isolation index

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Lago Norte
Lago do Paranoá
Cruzeiro
Candangolândia
Núcleo Bandeirante
Guará
Taguatinga
Ceilândia
Águas Lindas de Goiás
Barragem do Descoberto
Samambaia
Riacho Fundo
Recanto das Emas
Santo Antônio do Descoberto
Jardim Botânico de Brasília
Lago Sul
Gama
Novo Gama
Valparaíso de Goiás
Cidade Ocidental
Santa Maria
Santa Bárbara
São Sebastião
Papuda
Sobradinho
Planaltina
Rajadinha
Boa Vista
Paranoá
Barreiro
Distrito Federal
Goiás
5 mi
5 km
130.88.68.30
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Predicted (log) cardiovascular mortality rate in Brazilian municipal neighbourhoods, by income and exposure index

6.2
5.8
5.4

(log) premature Cardiovascular mortality

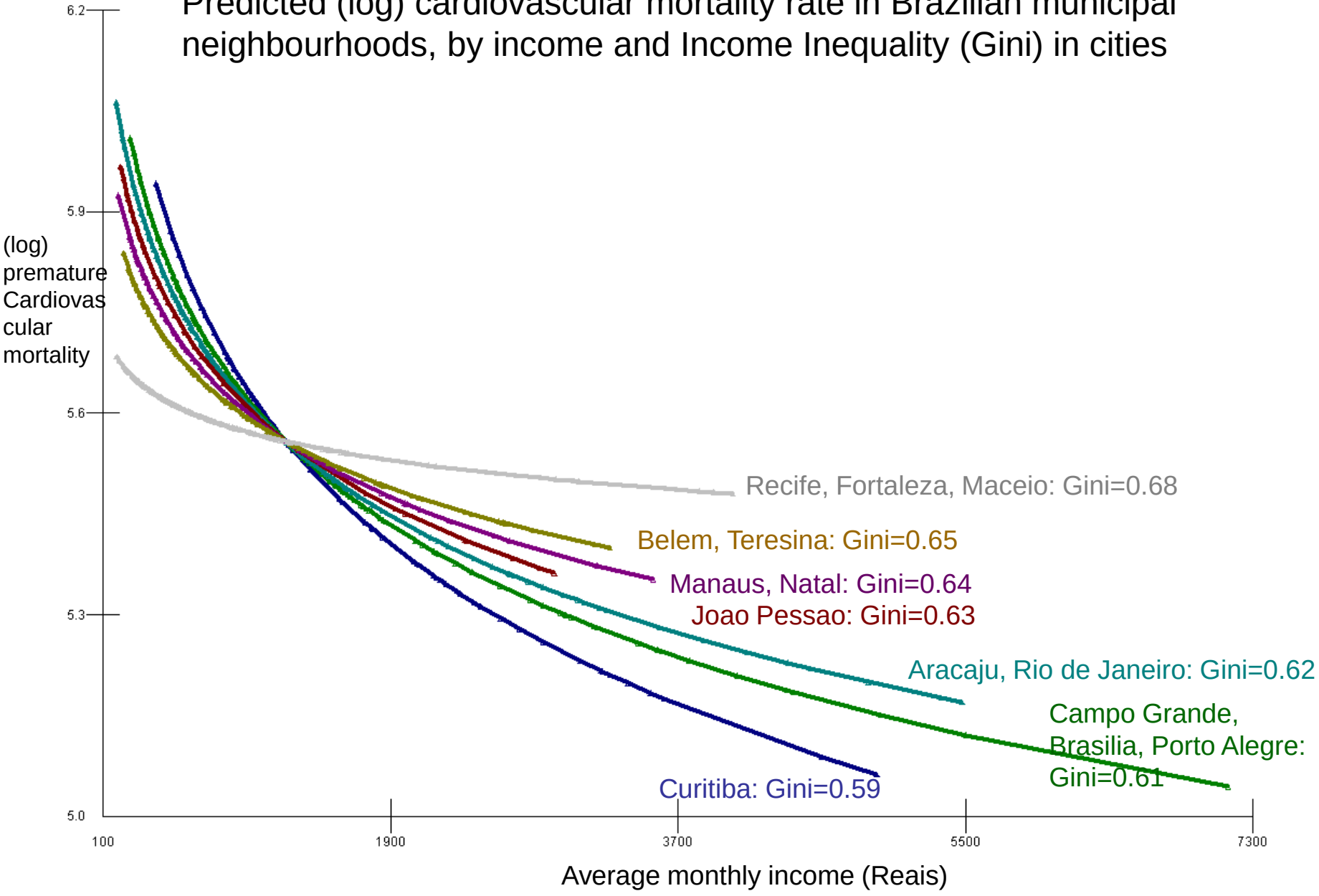
Sao Conrado, Rio de Janeiro; Blue line: the wealthiest group is isolated

Lagoa, Rio de Janeiro; Green line: the wealthiest group is exposed to the next wealthiest group

3700
5500
7300

Average monthly income (Reais)

Predicted (log) cardiovascular mortality rate in Brazilian municipal neighbourhoods, by income and Income Inequality (Gini) in cities



Summary

- Neighbourhoods in Brazil with higher average incomes have lower premature cardiovascular mortality

- Interactions with:
    Isolation index for poorest and richest groups
    Income inequality

-“Triple health jeopardy”- revisited?
    Being poor, in a socieconomically and spatially segregated neighbourhood that is developing

- Socioeconomic segregation and income inequality appears to be associated with decreased population health and increased premature ageing in richer neighbourhoods

- Implications for urban development and slum resettlement in other developing countries

Boa Viagem, Recife

Cabo Branco, Joao Pessoa

Candelária, Natal

Lagoa Nova, Natal

Sao Conrado, Rio de Janeiro

Lagoa, Rio de Janeiro