Análise espacial de desigualdades intra-urbanas da saúde no Rio de Janeiro - Introdução de um índice de desigualdade

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One of the most striking examples [of health inequalities] is the systematic differences in health between different socioeconomic groups. This social pattern of disease is pervasive. No law of nature decrees that the children of poor families should die at a higher rate than that of children born into rich families.

UrbanHEART
Background: Inequality vs. Inequity

A difference in health that is systematic, socially produced (and, therefore, modifiable) and unfair is an inequity in health.¹

Background: 'Geographical Space’ as Social Determinant of Health

- city is place of enormous concentration of disparity
- urban spatial structuring is determined by political, ideological, social and market-oriented patterns
- allocation of population and population health within cities follows rules of functional internal organization

*see David Harvey “Right to the City”*
Intra-urban approach

- small scale geographical unit
- definition of key (local) urban health topics
- selection of socially sensitive indicators

*as disaggregated as possible (avoid clustering of ICD codes or spatial units)*
### Excurse: UrbanHEART Indicator

<table>
<thead>
<tr>
<th>#</th>
<th>HEALTH CARE OUTCOME</th>
<th>CORE INDICATOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Summary indicator</td>
<td>Infant mortality</td>
</tr>
<tr>
<td>2.</td>
<td>Disease-specific indicator</td>
<td>Diabetes</td>
</tr>
<tr>
<td>3.</td>
<td>Disease-specific indicator</td>
<td>Tuberculosis</td>
</tr>
<tr>
<td>4.</td>
<td>Disease-specific indicator</td>
<td>Road traffic injuries</td>
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### SUMMARY INDICATORS

<table>
<thead>
<tr>
<th>#</th>
<th>INDICATOR</th>
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<tbody>
<tr>
<td>1.</td>
<td>Under-five mortality rate</td>
</tr>
<tr>
<td>2.</td>
<td>Maternal mortality ratio</td>
</tr>
<tr>
<td>3.</td>
<td>Life expectancy at birth</td>
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### DISEASE-SPECIFIC INDICATORS

<table>
<thead>
<tr>
<th>#</th>
<th>INDICATOR</th>
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<tbody>
<tr>
<td>4.</td>
<td>A. All cancer</td>
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<tr>
<td></td>
<td>B. Cardiovascular disease</td>
</tr>
<tr>
<td></td>
<td>C. Respiratory diseases</td>
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<td></td>
<td>D. HIV and AIDS</td>
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<td></td>
<td>E. Homicide rate</td>
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<td></td>
<td>F. Mental illness</td>
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</tbody>
</table>
Index of Urban Health Disparity

- one single metric to represent inequalities
- objective marker for setting goals, evaluating interventions and planning
- significance exclusively for local level
- constructed for small areas within an administrative jurisdiction

¹ Development of an Urban Health Index (unpublished), Institute of Public Health, Georgia State University
Excurse: HDI Methodology

• constructed from
  - life expectancy at birth
  - measures of schooling
  - gross national income per capita

• The resulting value is a proportion between 0.0 and 1.0
Step 1 – Standardization of single indicator

- transformation of actual values into dimensionless proportion between 0 and 1

\[ I^S = \frac{I - \min^*(I)}{\max(I) - \min^*(I)}, \]

\( I^S \) is the standardized indicator

\( I \) is the observation in the small area

\( \max \) is the maximum value

\( \min \) is the minimum value
• **Step 2** - combination of indicators through calculation of geometric mean

• result is overall urban health index

• based on work by Atkinson

\[
\text{Geometric mean } \quad G = \left( \prod_{i=1}^{n} I_i^S \right)^{1/n}
\]
• **Step 3** – create rank order of the index value and design a graph
1. The RATIO of the extremes

• The ratio of the mean of the upper 10% to the mean of the lower 10% of the distribution as marker of overall disparity

2. The slope of the midsection

• steep slope suggests heterogenous group; flat slope suggests relative uniformity in the central segment of the data
• Using OLS linear regression; calculating the slope through the points defining the middle 80% of the distribution
Results Urban Health Index

Rio de Janeiro 2002-2010
Unit of analysis

- Individual geo-coded data vs. artificial administrative boundaries
- Census tract < bairro < districto administrativo < area de planejamento

Data source

- IBGE Census data
- National Datasus and Municipal Tabnet
- (SIM, SINAN, SINASC, SIH/ SIA, SIAB)
Key urban health topics & main indicators

a) infectious disease: Tuberculosis
   HIV
b) NCD: Ischaemic Heart Disease,
   Diabetes
   Breast and Cervix Cancer
c) external health: Homicide
   Traffic accidents
d) Infant health: Infant Mortality
## Generation of Mortality Rates

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<td>98.41</td>
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<td>79.39</td>
<td>79.25</td>
<td>78.29</td>
</tr>
</tbody>
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→ Small number problem
Sample size I

![Graph showing the relationship between Diabetes Mortality Rate 2010 per 100,000 inhabitants and Population size of analysed unit. The graph displays a scatter plot with data points representing different populations and their associated mortality rates.]
Sample size II

![Graph showing the relationship between population size and standard error of diabetes mortality rate. The x-axis represents the population size of the analyzed unit, ranging from 0 to 250,000, and the y-axis represents the standard error of diabetes mortality rate, ranging from 0.0 to 60.0.]
How to control for Small Number Problem?

a) exclusion of neighborhoods
   - due to population size (Standard Error)
   - due to 0-health event count (reliability)

b) 5-years weight

*instability remains challenging
*alternative: Bayesian approach?
Definition cut-off minimum population size
5-years weight to control for fluctuation
\((0.1*0.2*0.4*0.2*0.1)\)
Ranked distribution of Index Values in 142 neighborhoods of Rio de Janeiro Municipality, 2010

<table>
<thead>
<tr>
<th>Index</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Disparity Ratio</td>
<td>1.51</td>
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<tr>
<td>Disparity Slope</td>
<td>0.21</td>
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<tr>
<td>SE (MR)</td>
<td>7.94</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Index Values</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.77</td>
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<tr>
<td>Std Dev</td>
<td>0.08</td>
</tr>
<tr>
<td>Min</td>
<td>0.46</td>
</tr>
<tr>
<td>Max</td>
<td>0.95</td>
</tr>
<tr>
<td>Range</td>
<td>0.49</td>
</tr>
<tr>
<td>Median</td>
<td>0.78</td>
</tr>
<tr>
<td>10th Pctl</td>
<td>0.66</td>
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<tr>
<td>90th Pctl</td>
<td>0.87</td>
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</table>
Map displaying Urban Health Index in 142 neighborhoods of Rio de Janeiro Municipality, 2010
Ranked distribution of Index Values in Rio de Janeiro Municipality, 2002 and 2010
Disparity Slope and Ratio UHI in Rio de Janeiro Municipality, 2002-2012
Map displaying UHI in Rio de Janeiro Municipality, 2002 and 2010
Further Application

a) Rio’s urban transformation process (Rio2016) and its impact on health equity
   - Morar Carioca, PAC
   - UPP
   - extension *Programa Saúde da Família*
Informal Settlement Upgrading Municipal Plan - MORAR CARIOCA

Priority Criteria

Road system:
- Avenida Brasil
- Linha Azul
- Linhas Vermelhas
- Subway
- Projected road (Transcarioca)
- Projected road (Transmar)
- Projected road (Transbrasil)
- Corredor Tijuca-Barra da Tijuca
- Corredor Lagoa-Barra da Tijuca
- Corredor Maracanã-Engenho
- Corredor Engenho-Dos-Dez

Priority action in slums:
1. Slums neighboring Olympic facilities, access roads and security poligons
2. Slums within Olympic Clusters and security poligons with potential to grow
3. Slums with limited target (low priority) no action at this time.
Rio2016 – becoming a Global City

source: Felipe Menegaz,
Extension Family Health Program
Further Application

a) Rio’s urban transformation process (Rio2016) and its impact on health equity
   - Morar Carioca, PAC
   - UPP
   - extension Programa Saúde da Família

b) health and market-value of urban territory
   - correlation of health index with indicators like e.g. distance from centre, real estate, etc.
Intra-urban analysis - Pitfalls

• access & availability to health data
• sensibility & promptness to react towards urban transformation processes
• small number problem solved by Bayesian approach?
• age standardization necessary?
• level of analysis – how to include micro-level unit (e.g. Cantagalo within Ipanema)
• inclusion of Gran-Rio agglomeration
Obrigado

In collaboration with
WHO Kobe Center
Georgia State University
Fiocruz-ICIT
Institut of Public Health Heidelberg

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Age Adjustment – SMR vs. CMF

SMR: standard but internal bias
CMF: reliable for direct comparison but high SE

### Conclusion
- both, SMR as CMF, have high SE for small spatial areas
- cautious use of age-adjustment technique (only if necessary)