THE SALURBAL PROJECT: LIFE EXPECTANCY & MORTALITY PROFILES IN 363 CITIES OF LATIN AMERICA

Usama Bilal, MD MPH PhD
Assistant Professor
Urban Health Collaborative & Department of Epidemiology and Biostatistics
Drexel University Dornsife School of Public Health
ubilal@drexel.edu // @usama_bilal

Philipp Hessel, PhD
Associate Professor
Universidad de los Andes
School of Government
p.hessel@uniandes.edu.co // @philipp_hessel

LAC-URBAN HEALTH
Urban Health Network for Latin America and the Caribbean

DREXEL UNIVERSITY
Urban Health Collaborative
Dornsife School of Public Health

wellcome

Background

- Demographic transition = global mortality convergence towards a single mortality regime
- Substantial decreases in mortality & gains in life expectancy in Latin America (LA) since 1950´s
  - average life expectancy (LE)=76 years, GBD
- LA at later stages of epidemiological transition
- However:
  - Large heterogeneity between countries (Alvarez et al. 2020)
  - Stagnation of LE in several countries
  - Linked to increasing number of deaths from violence and accidents (Aburto et al. 2016)

Background

- Large inequalities in LE between rural and urban areas in high-income countries
- Open question on the existence of an urban mortality advantage (or penalty)
- Urbanisation of LA = 80%
  - Highest of any world region
- Yet, for cities in LA no comparative evidence on:
  - Differences in LE
  - Mortality patterns
  - City-level characteristics with LE and mortality

The SALURBAL Project

- Five years (April 2017 - March 2022)
- Funded by the Wellcome Trust.
- Implemented by Drexel University and international partners primarily based in Latin America.
- Part of the Wellcome Trust's "Our Planet, Our Health" global initiative.

➢ https://drexel.edu/lac/salurbal/overview/

Our Team: An International Network of Collaborators

Drexel University, Philadelphia, Pennsylvania, USA
National University of Lanus, Buenos Aires, Argentina
Federal University of Minas Gerais, Belo Horizonte, Brazil
Universidade de Sao Paulo, Sao Paulo, Brazil
Oswaldo Cruz Foundation, Salvador Bahia, Brazil
Oswaldo Cruz Foundation, Rio de Janeiro, Brazil
Universidad de Chile, Santiago, Chile
Pontífica Universidad Católica de Chile, Santiago, Chile
Universidad de los Andes, Bogotá, Colombia
Instituto Nacional de Salud Pública, Mexico City, Mexico
Universidad Peruana Cayetano Heredia, Lima, Peru
Institute of Nutrition of Central America and Panama (INCAP), Guatemala City, Guatemala
University of California at Berkeley, Berkeley, California, USA
Washington University in St Louis, St Louis, Missouri, USA

Vision

- Create evidence base needed to make Latin American cities (and other cities) healthier, environmentally sustainable and more equitable.

- Engage policy makers and the public in a new dialogue about urban health and urban sustainability and implications for societal action.

- Create a platform and network that will ensure continued learning and translation.

Our Goals and Process

Engage with policy makers and other regional and global stakeholders to determine specific policy-relevant research priorities

Evaluate health, environmental and equity impact of policies and interventions

Identify city and neighborhood drivers of health and health inequalities among and within cities

Employ systems-thinking and simulation models to evaluate urban-health-environment links and plausible policy impacts

Lessons from Latin America about what makes cities healthier, equitable and environmentally sustainable

Engage the scientific community, the public and policy makers to disseminate and translate findings

Other SALURBAL works in progress

- Distribution and determinants of **Infant Mortality** across Latin American Cities (Ana Ortigoza) Published Oct 2020 (JECH)
- Determinants and health consequences of **Air Pollution** in Latin American Cities (Nelson Gouveia)
- **Commuting patterns and mental health** in 11 Latin American Cities (Xize Wang) – Published Sept 2019
- Longitudinal Changes in the **Retail Food Environmen**t in Mexico and its Association with **Diabetes** (Carolina Perez Ferrer) – Published Oct 2020 (Health and Place)

A brief taste of SALURBAL results

How does life expectancy vary **between** Latin American Cities?

→

How do **mortality profiles** vary across Latin American Cities?

Bilal U, **Hessel P**, Perez-Ferrer C, Michael Y, Alfaro T, Tenorio-Mucha J, de Friche AA, Pina MF, Vives A, Quick H, Alazraqui M, Rodriguez D, Miranda JJ, Diez-Roux AV, and the SALURBAL study team.

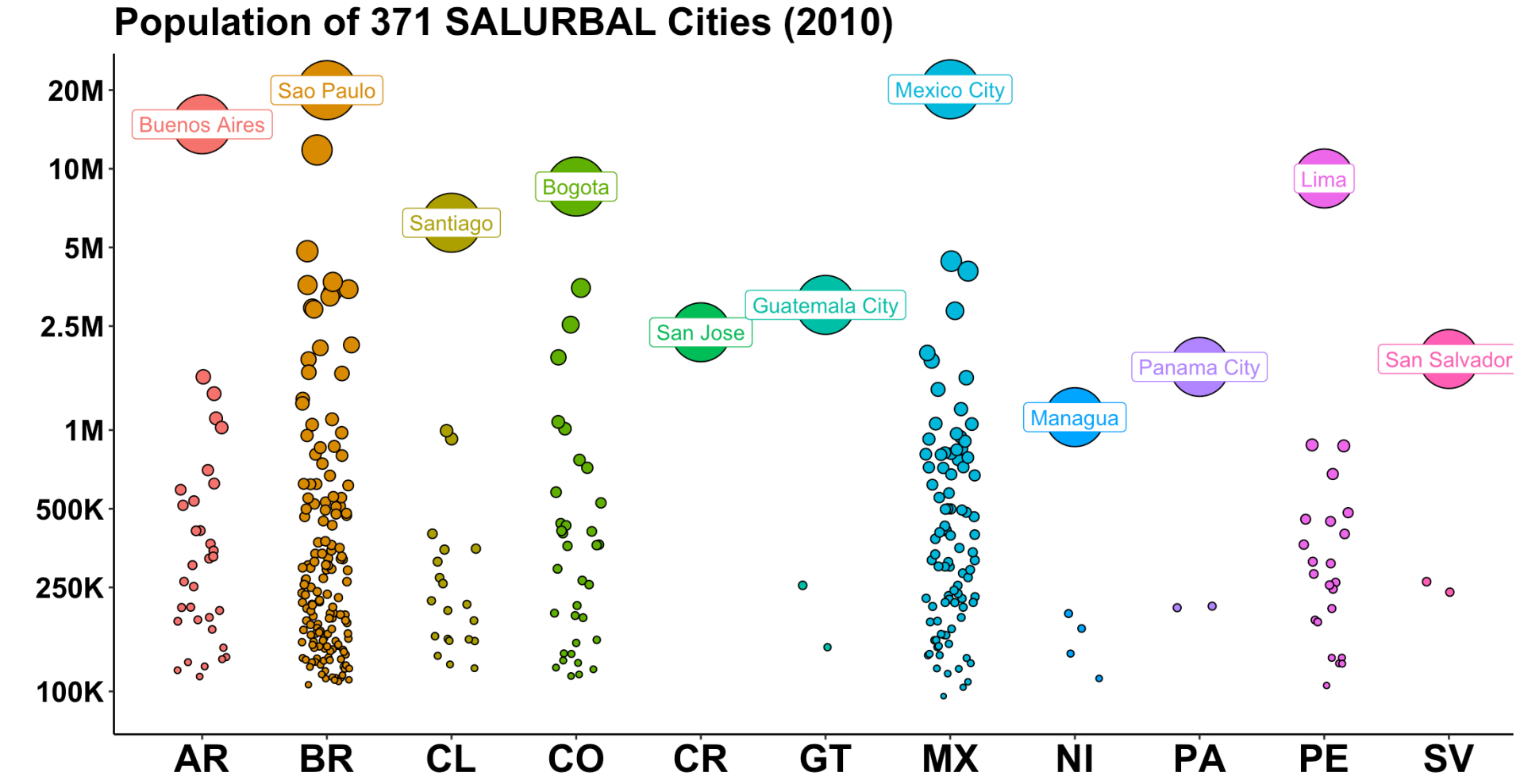
Life expectancy and mortality profiles are highly heterogeneous in 363 cities of Latin America: the SALURBAL project.

Nature Medicine 2020. *Accepted for publication*

Setting

- Setting:
  - Space: 363 cities in 9 LA countries
  - Time: 2012-2016 (except SV; 2010-2014)
  - Unit: City (agglomeration of administrative units that are covered by the built-up extent of the city)
- Data: all at city level
  - Mortality records with age, sex, cause of death
  - Population projections/estimations by age and sex
  - Social and built environment features

City Universe

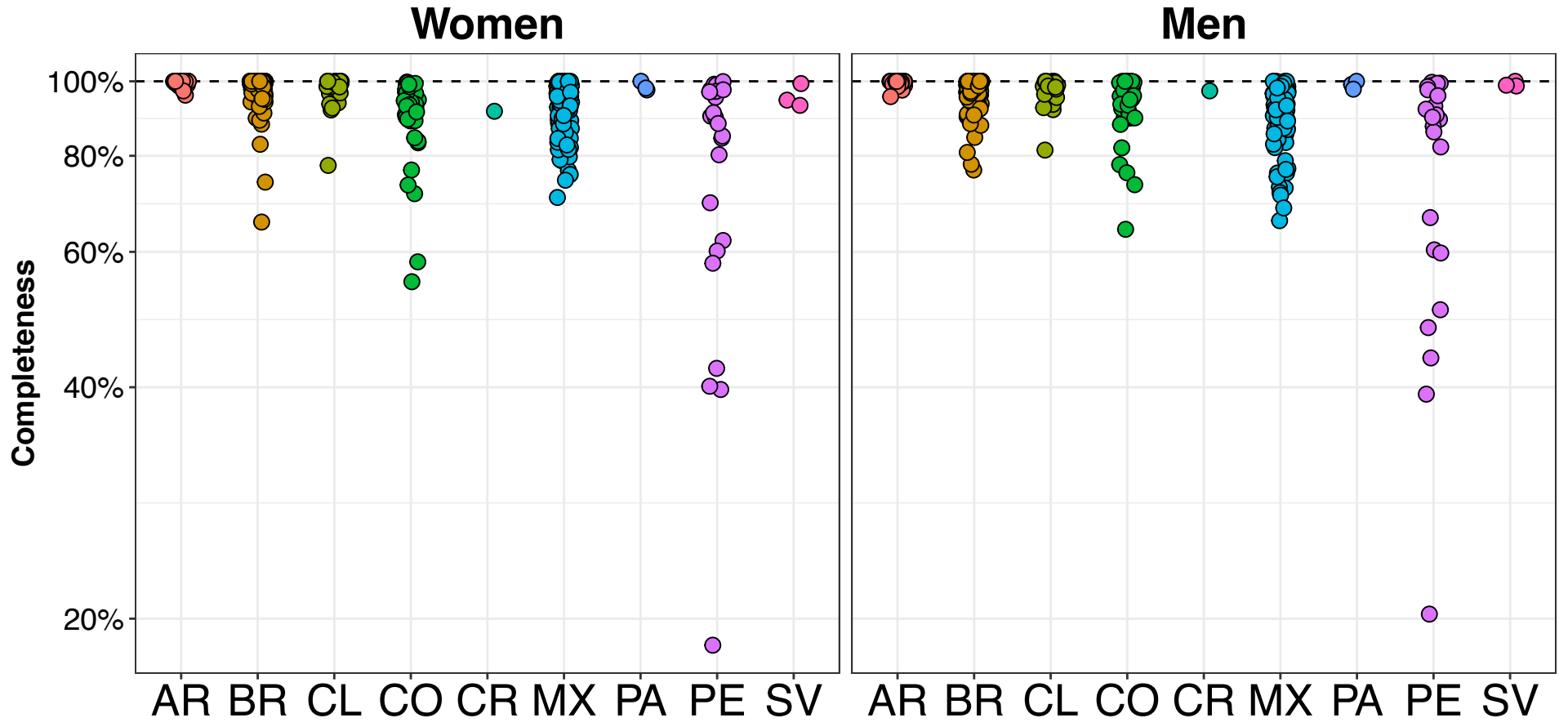


All 371 urban agglomerations with a population >=100,000 by 2010 in 11 Countries

Analysis: undercounting

- Incomplete coverage of death counts:
  - Especially in Peru (~60% natl coverage)
  - Other are heterogeneous: CO, PE, MX
- Estimated undercounting factors at the city level
  - Key issue: lack of net migration.
- 2 approaches:
  - Average methods that respond differentially to migration
    - GGB, SEG, GGB-SEG
  - Use age bands that are more robust to migration
    - Hill (30-65), Murray (50-75), DDM R Package (best fit)
- Total of 9 estimates (3 methods x 3 age bands)

Coverage estimates



Analysis: life expectancy

- Model based on Schmertmann & Gonzaga (Demography 2018)
  - Bayesian Poisson model, with random effects for age and city, stratified by sex
  - Obs. counts ~ Rate * Population * Coverage
  - Coverage is distributed beta, with shape based on the 9 estimates of undercounting
- Final output: 1000 estimates of life expectancy at birth (or other ages) by sex and city
- Descriptives: Median, 2.5th and 97.5% percentiles
- Regression: use 1000 estimates in 1000 linear models and pool coefficients

Analysis: mortality profiles

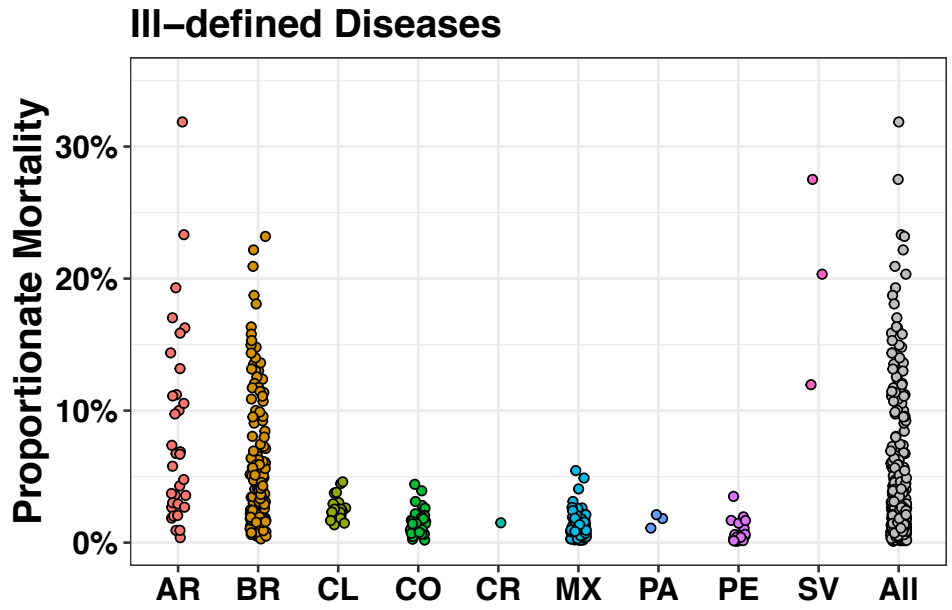
- Redistributed R chapter codes and Y10-Y34 codes, proportionally by age, sex, country, and year
- Estimated proportionate mortality

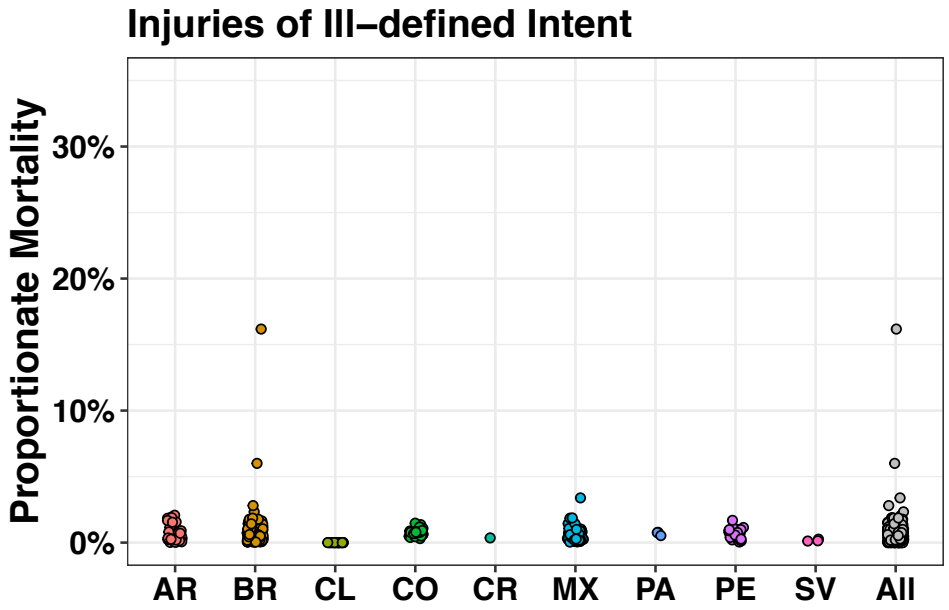
$$PM_{ij} = \frac{d_{ij}}{\sum_{i=1}^{5} d_{ij}}$$

(ith cause of death, jth city)

- Five large groupings:
  - Communicable, maternal, neonatal and nutritional (CMNN)
  - Cancer
  - Cardiovascular and other NCDs (CVD/NCDs)
  - Unintentional injuries
  - Intentional injuries
- Regression: negative binomial random effects model

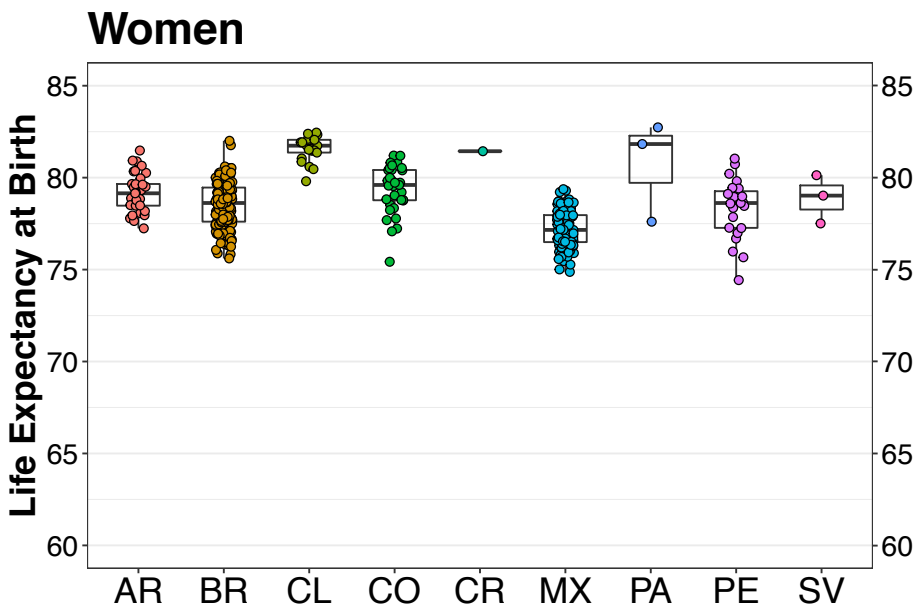
Redistribution of ill-defined codes

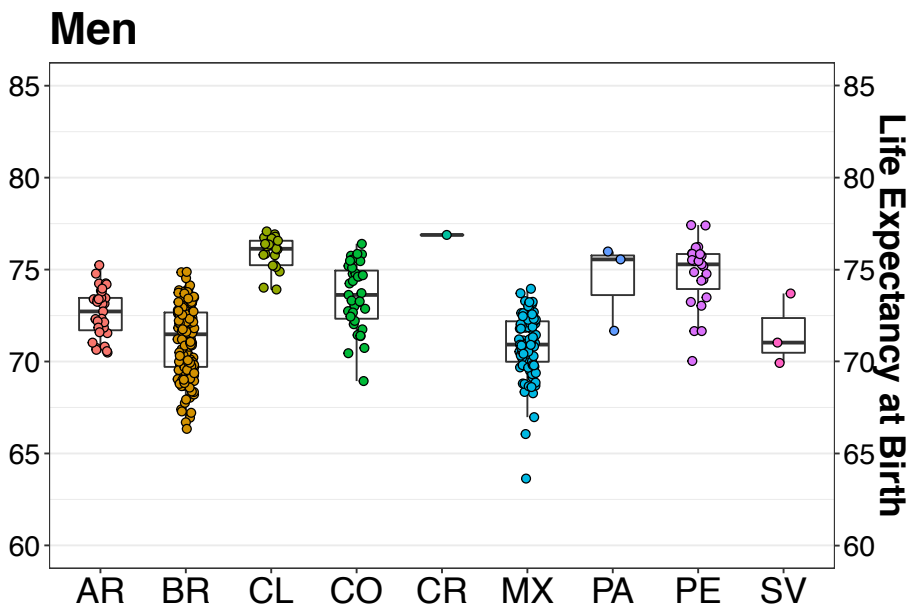




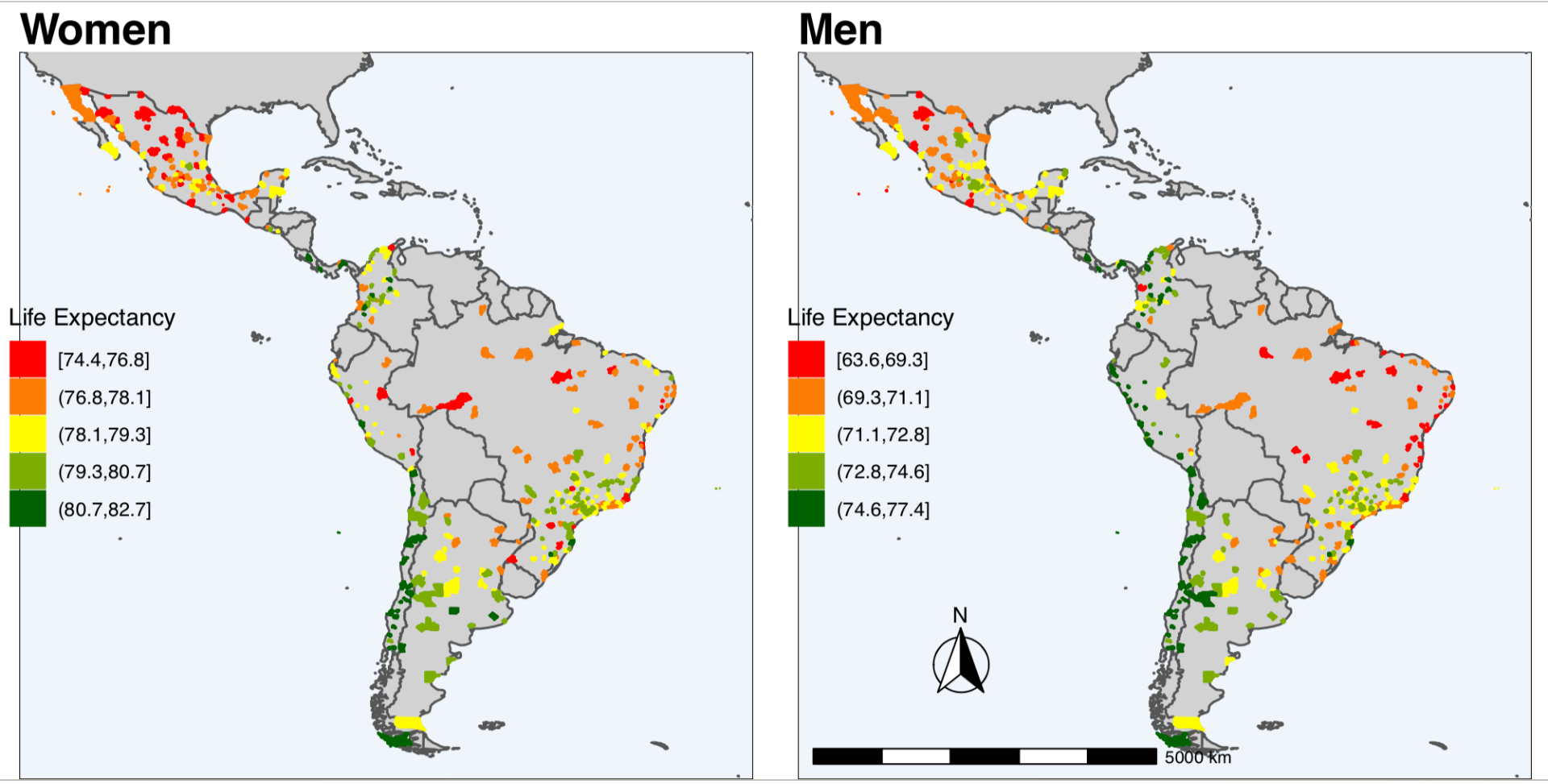
Results

How does life expectancy vary **across** Latin American Cities?

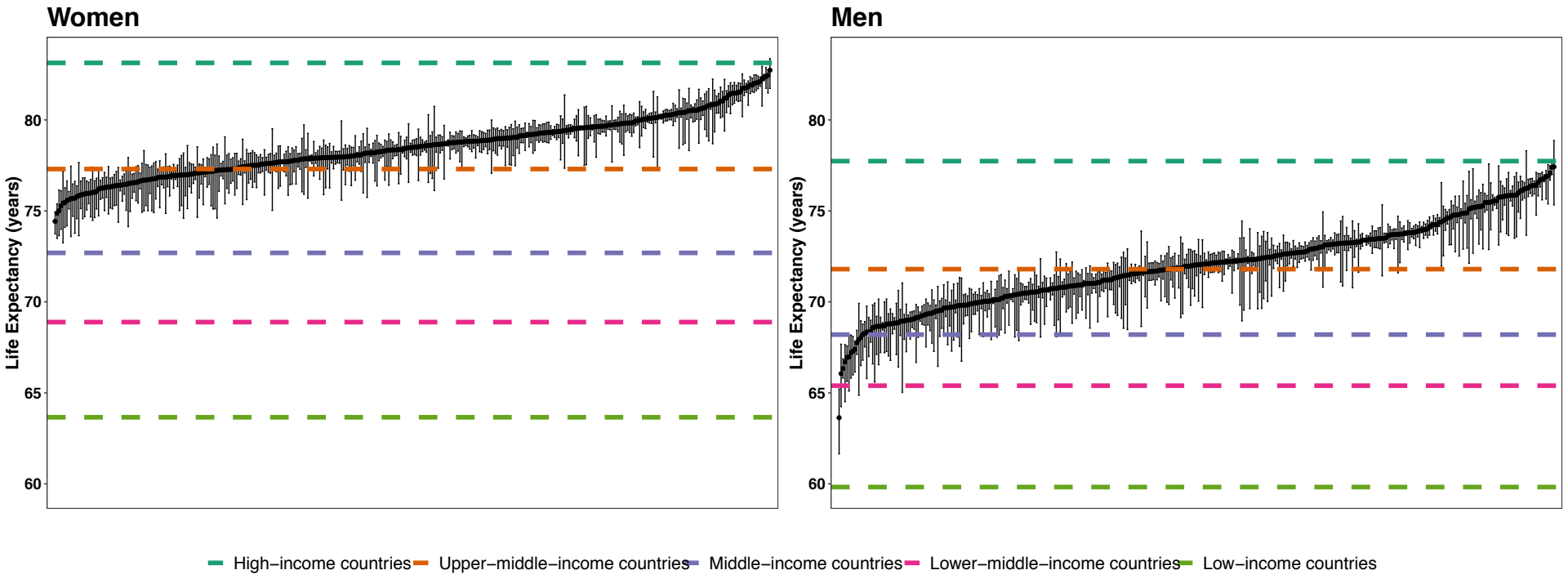




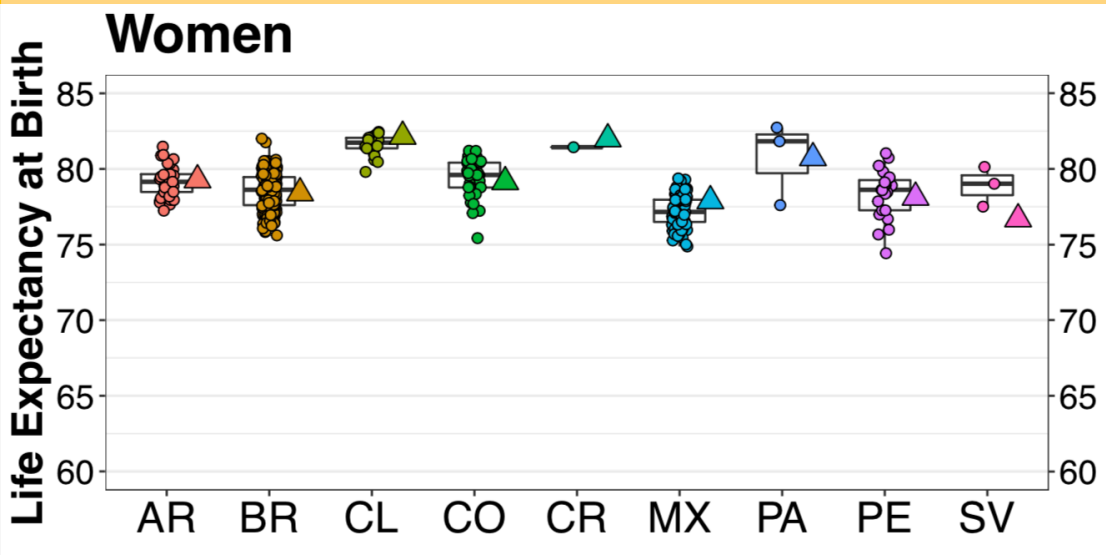
How does life expectancy vary **across** Latin American Cities?



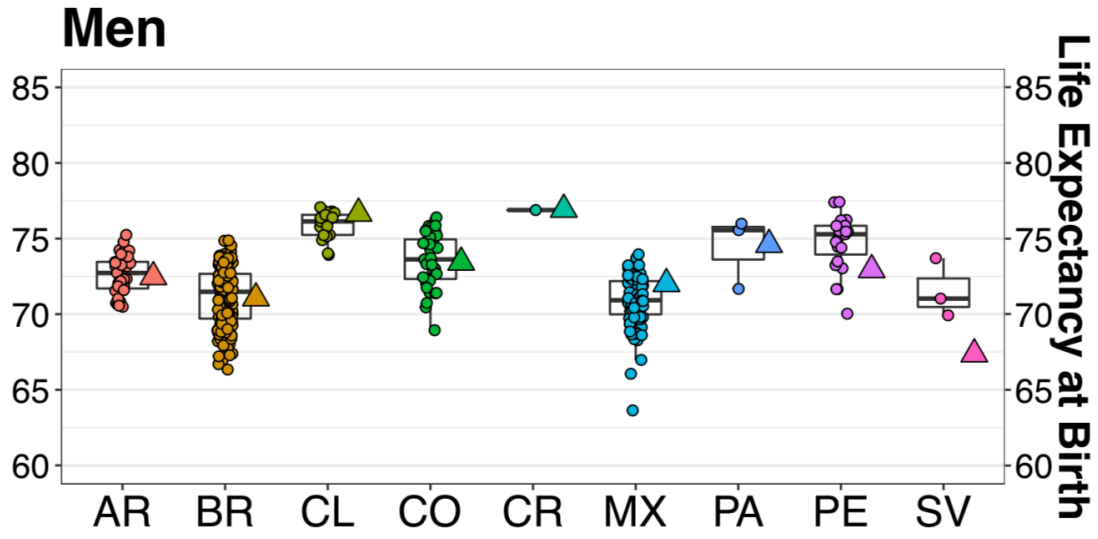
How does life expectancy vary **across** Latin American Cities?



How does life expectancy vary **across** Latin American Cities?



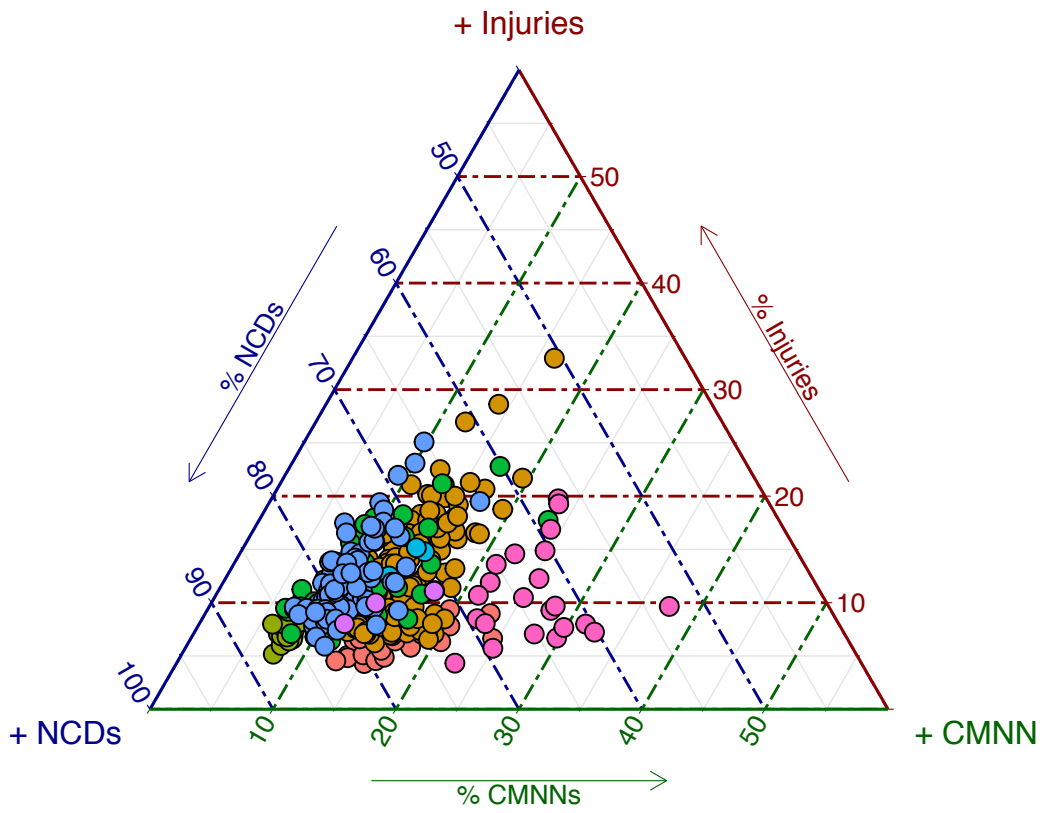
Triangles: country-level estimates of LEB (UNDP WPP for 2010-2015)



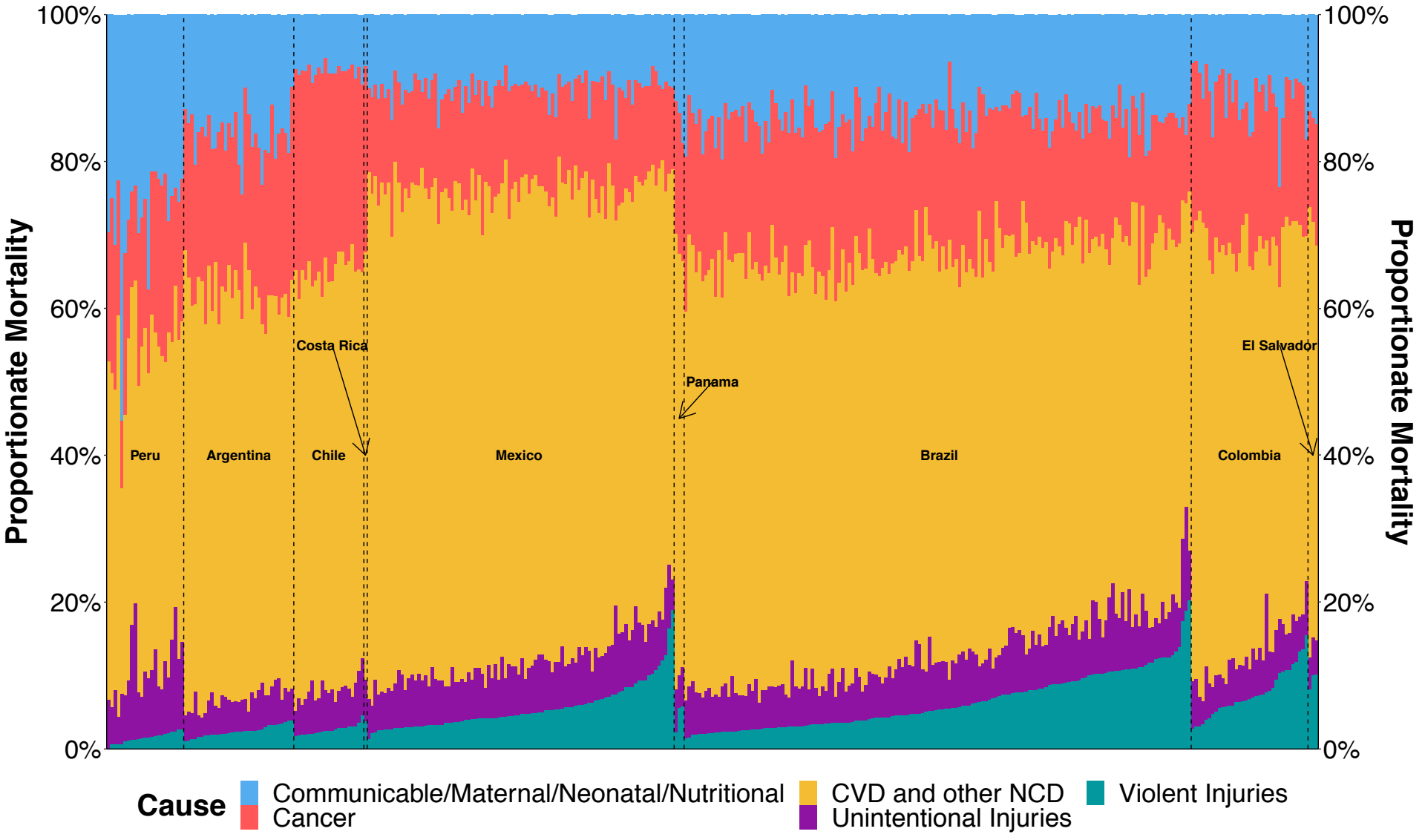
What factors are associated with life expectancy at birth in Latin American Cities?

Variable	Units	Men	Women
Population Size	Doubling	-0.08 [-0.19;0.03]	0 [-0.08;0.08]
Population Growth	4.7%	**0.42 [0.22;0.61]**	**0.22 [0.08;0.36]**
Population Density	4145 pop/km^2	-0.07 [-0.38;0.23]	-0.02 [-0.24;0.2]
Fragmentation	0.29 ptch/km^2	**0.28 [-0.02;0.57]**	**0.31 [0.1;0.52]**
Street Connectivity	6.42 int/km^2	-0.29 [-0.86;0.28]	0.04 [-0.37;0.45]
Social Env. Index	1 SD	**0.75 [0.53;0.97]**	**0.48 [0.32;0.64]**

How do mortality profiles vary across Latin American Cities?

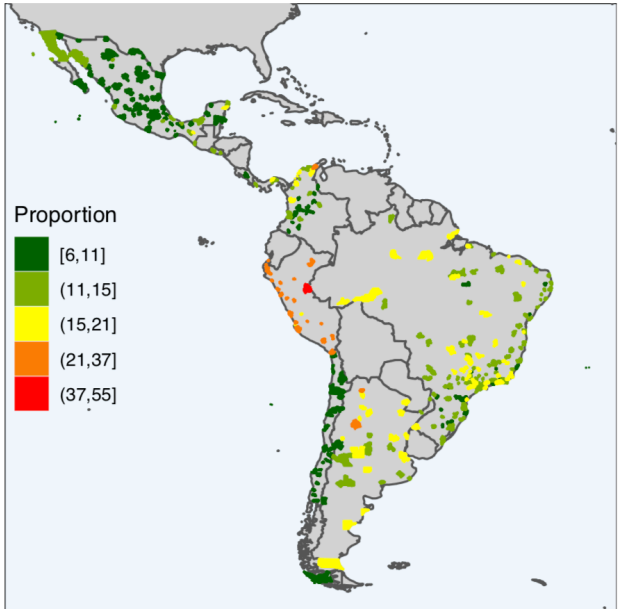


How do mortality profiles vary across Latin American Cities?

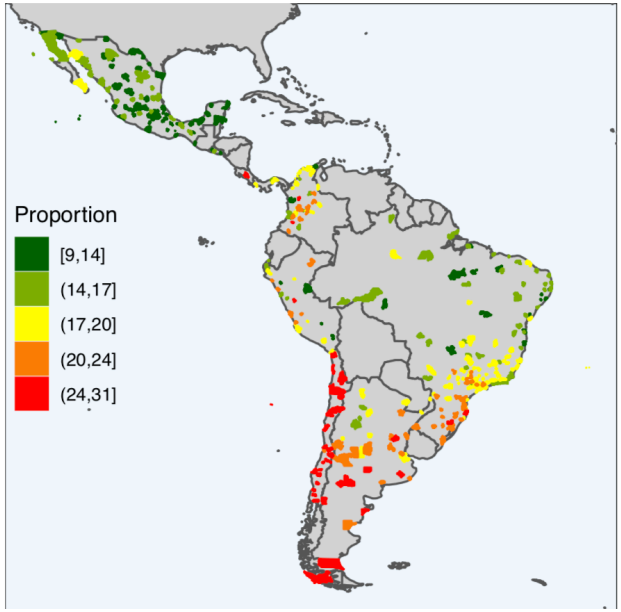


How do mortality profiles vary across Latin American Cities?

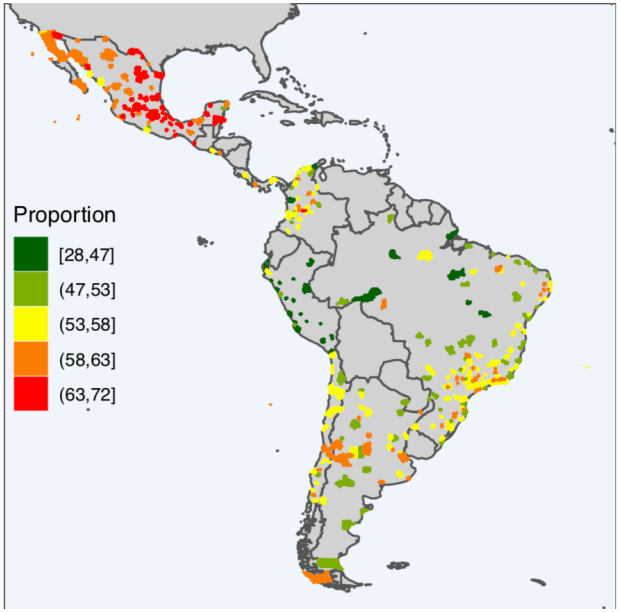
CMNN



Cancer

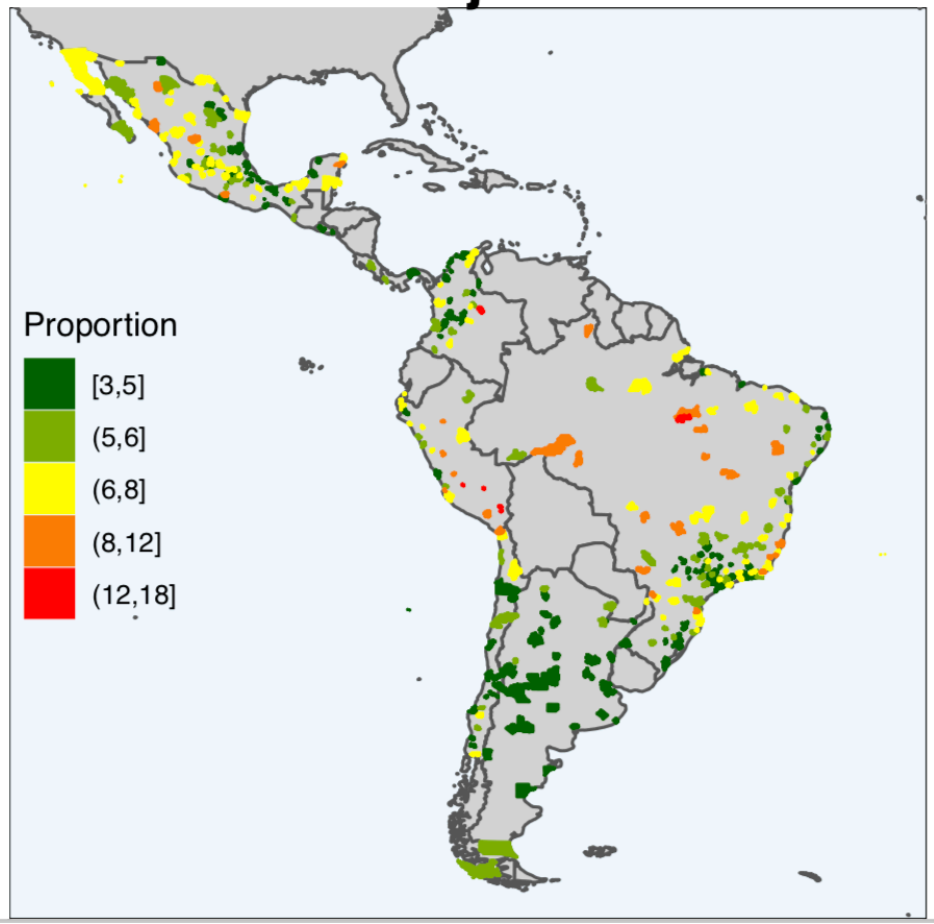


CVD/NCDs

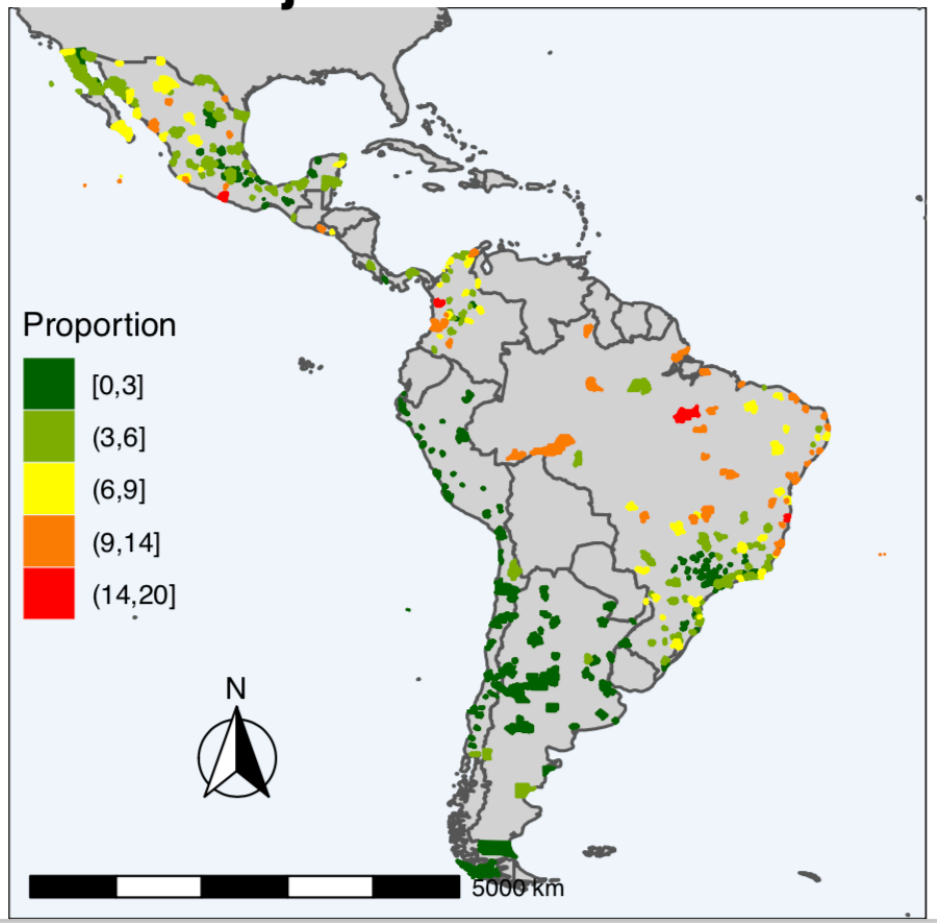


How do mortality profiles vary across Latin American Cities?

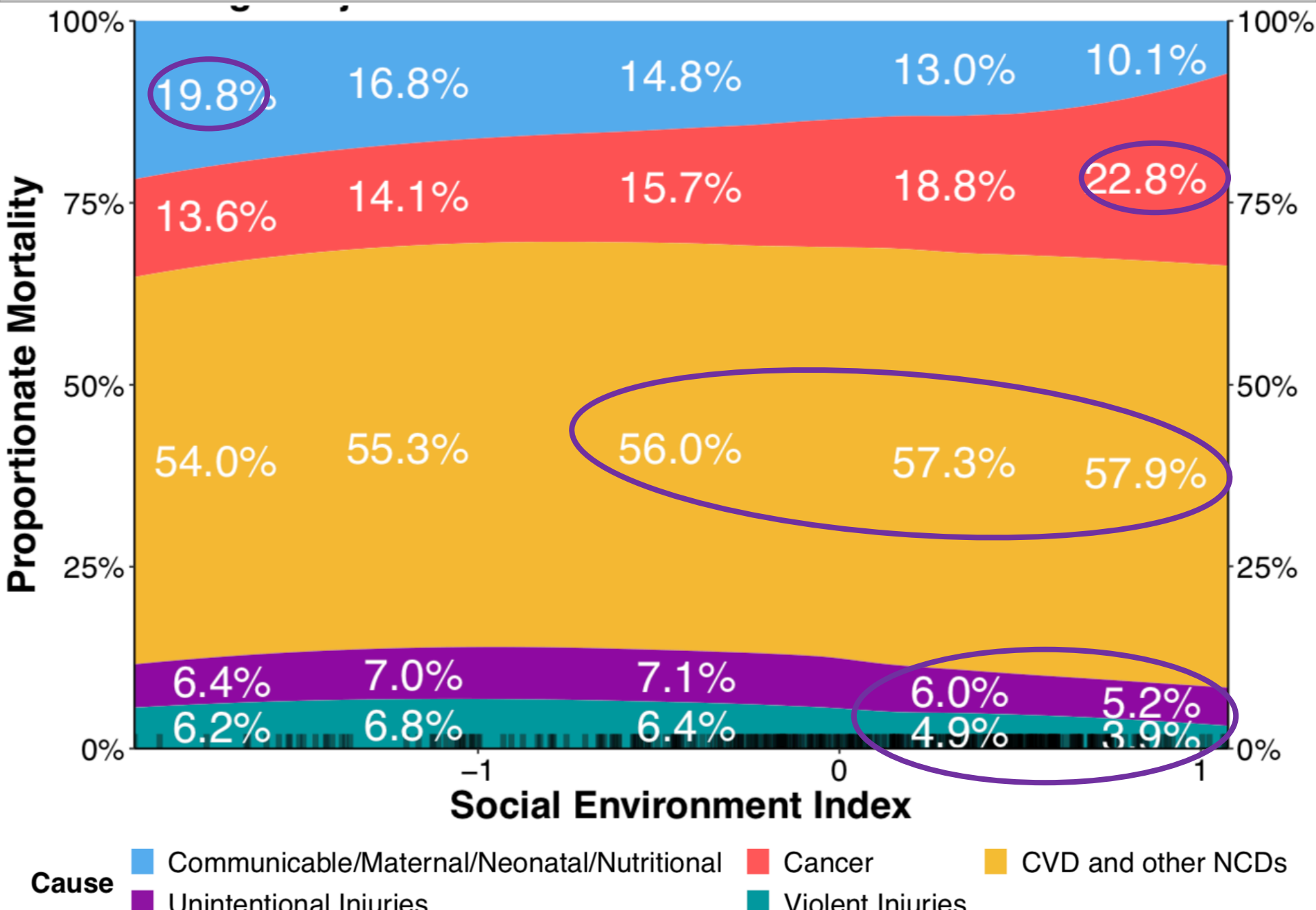
Unintentional Injuries



Violent Injuries



How do mortality profiles vary across Latin American Cities?



Summary

- Life Expectancy and mortality profiles are highly heterogeneous across Latin American cities.
- Life expectancy at birth ranges from 74-83 and 63-77 years in women and men.
- In many countries there is large variability in life expectancy across cities,
  - sometimes as large as a difference of 7-10 years as is the case with Mexico, Brazil, Colombia and Peru.
- Heterogeneity in mortality profiles between and within countries varied widely by cause.
- Social environment variables were highly predictive of life expectancy.

Conclusions

- We observed wide heterogeneity in the life expectancy of Latin American cities
- There is no clear urban advantage (especially for men)
- While we cannot test whether a transition is occuring (cross-sectional data), we found a strong association between social development and cause-specific mortality

Thank you!
Gracias!
Obrigado!

www.lacurbanhealth.org

Usama Bilal & Philipp Hessel

Extra Slides

Data and analyses

Identify City Universe

- 371 Urban Agglomerations with a population of >=100,000 people by 2010

Level 1_AD: Composed of administrative units (Level 2) with easily available data

Level 1_UX: Urban extent of the built-up area of a city quantitatively determined from satellite imagery

Level 1_MA: Follows exact country-specific definitions of urban areas

CITIES (Level 1)

Level 2: Individual administrative "subcity" units nested in Level 1_AD (e.g., municipios or comunas). In some cases Level 2 may be nested in Level 1_MA

SUB-CITIES (Level 2)

Level 3: "Neighborhoods" that are small census units (e.g., setor censitario) that are nested within Level 2 and may approximately be linked with Level 1_UX.

NEIGHBORHOODS (LEVEL 3)

Harmonized Data

Health Outcomes

- Vital Statistics
  Census Data
  Population Projections
- Surveys

Context

- Physical and Built Environment
- Social Environment
- Other (e.g., Food Env.)

Sources of Health and Context Data (e.g., CAF Survey)

Ancillary Primary Data Collection

Harmonized Data

- **All at least at level 2 (municipality-like)**
- Vital Registration
  - Deaths
  - Births
- Population projections and census data
- Physical and Built environment: landscape metrics, street design, air pollution
- Social environment data: demographic, socioeconomic, gender empowerment indicators