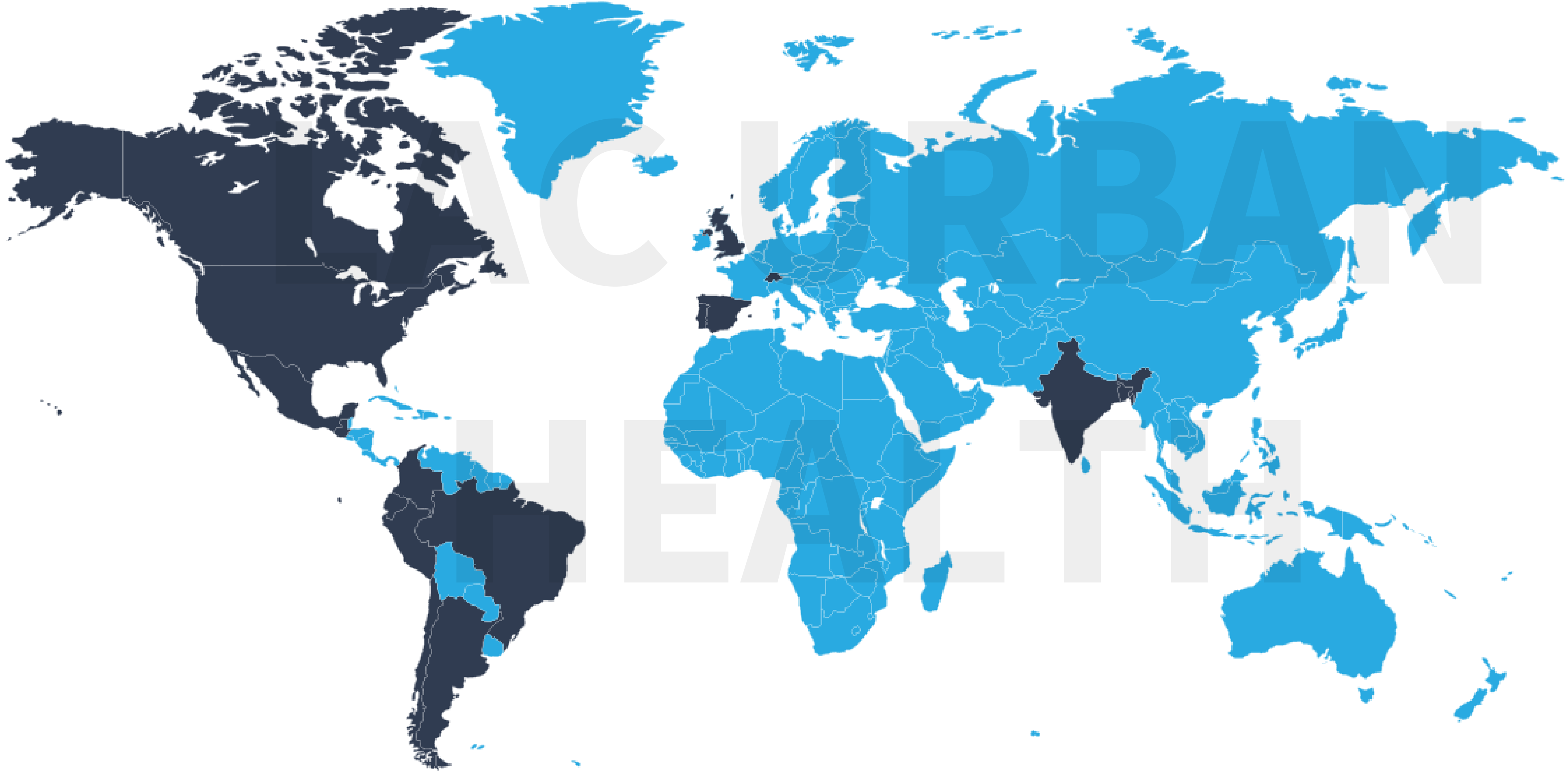
WELCOME

ROAD SAFETY IN LATIN AMERICAN CITIES WEBINAR

NOVEMBER 17, 2020
11:00 AM ET

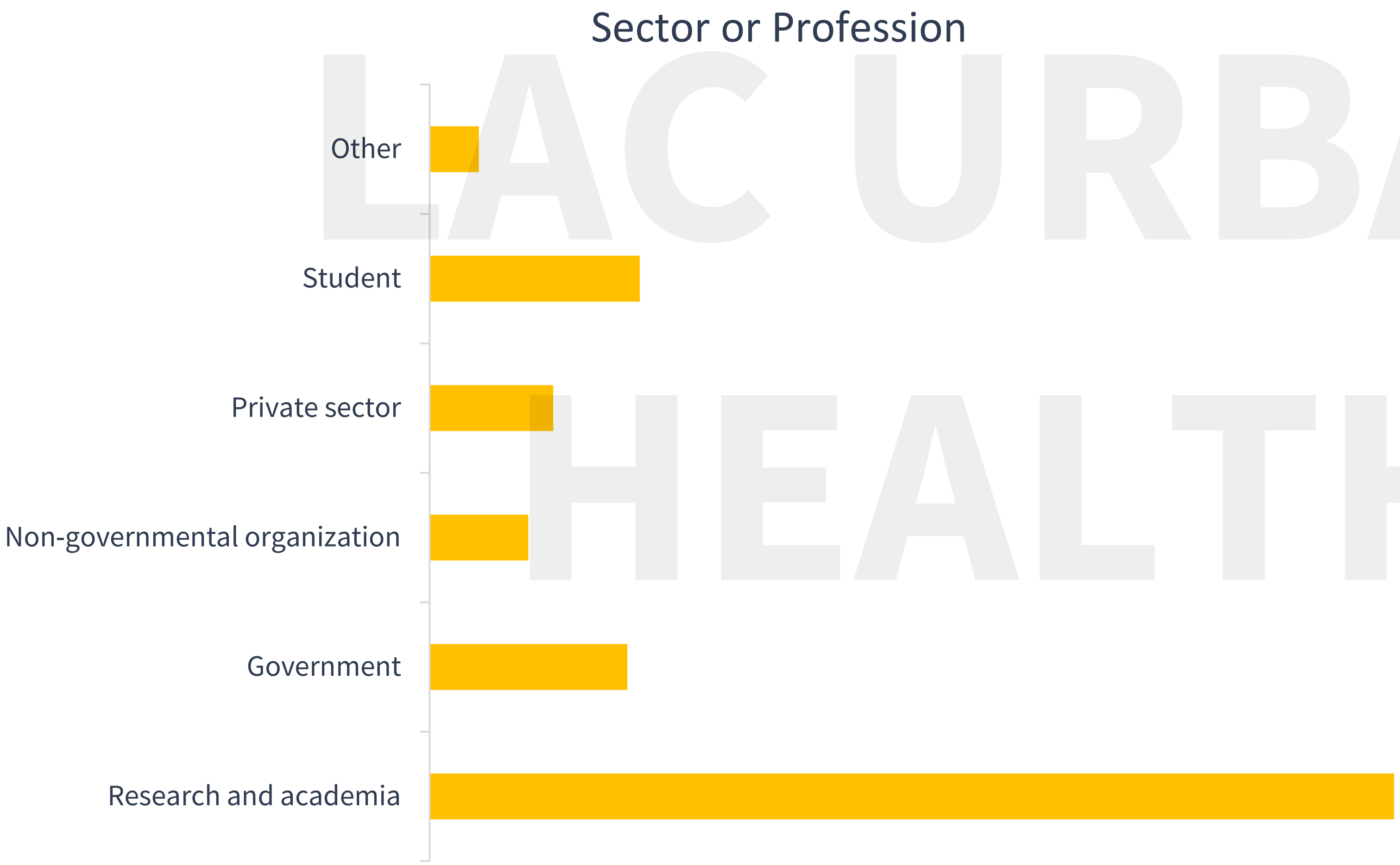
wellcome
DREXEL UNIVERSITY Urban Health Collaborative Dornsife School of Public Health
LAC-URBAN HEALTH Urban Health Network for Latin America and the Caribbean
SALURBAL Urban Health in Latin America

OUR AUDIENCE TODAY



● CONNECTED COUNTRIES

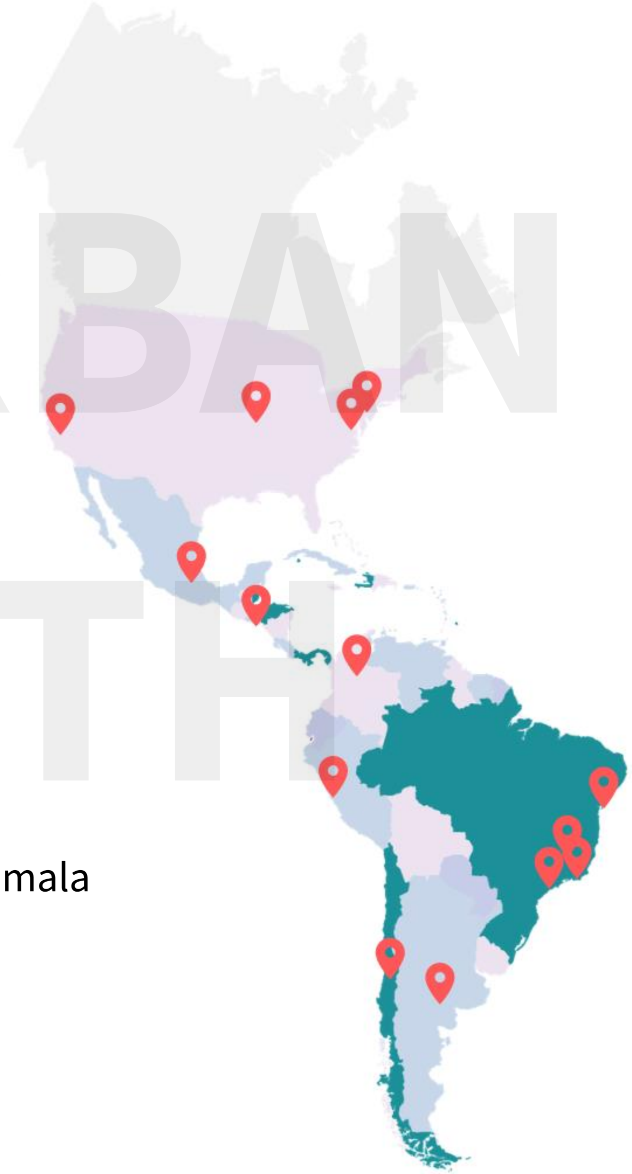
OUR AUDIENCE TODAY



THE SALURBAL PROJECT

Salud Urbana en América Latina – Urban Health in Latin America

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
Pan American Health Organization, Washington, D.C., USA
University of California at Berkeley, Berkeley, California, USA
Washington University in St Louis, St Louis, Missouri, USA



SALURBAL'S RESEARCH

How do urban policies impact urban built and natural environments?

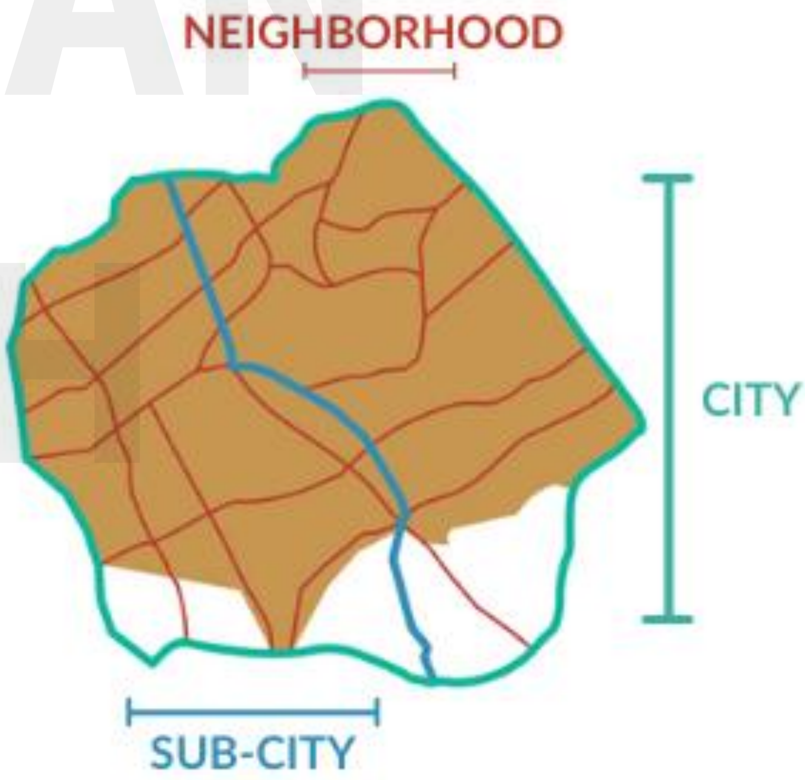
How do urban built and natural environments impact urban health outcomes, disparities, and factors related environmental sustainability?

How can cities act to improve health, reduce disparities, and support environmental sustainability?

SALURBAL DATA

- SALURBAL has compiled data for 371 cities of 100,000 people or more in 11 countries.
- This data has been linked to sub-city units and neighborhoods in these cities.

Health	Built Environments	Social Equity
• **Deaths and causes of death** • Life expectancy • Health risk factors • Health-related behaviors • Violence	• Land use and urban form • **Transit options** • Traffic congestion • Air pollution • Walkability • Green space • Water and sanitation • Housing	• Poverty • Income inequality • Housing conditions • Education • Employment



WEBINAR SPEAKERS

DR. ALEX QUISTBERG

City characteristics and road traffic mortality in Latin American cities

DR. CAROLINA PÉREZ

Evaluation of speed limits and traffic enforcement in Mexico City

GERMAN CARVAJAL

Bicycle Safety in Bogota

DISCUSSANTS

DR. DARIO HIDALGO
Senior Mobility Researcher,
WRI

DR. CARLOS DORA
Incoming President,
International Society for Urban Health

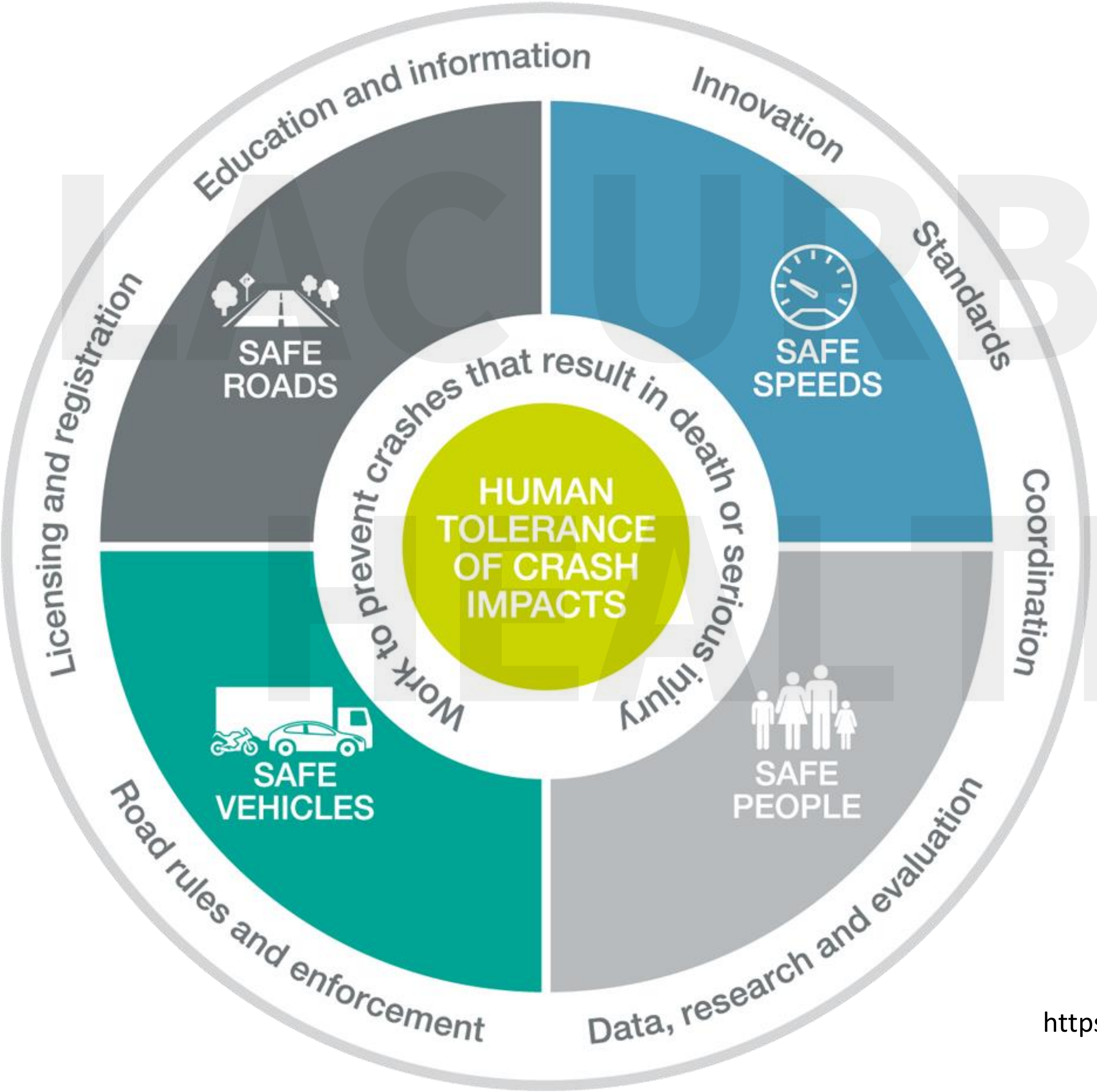
ROAD TRAFFIC DEATHS IN LATIN AMERICAN CITIES:
CITY-LEVEL EPIDEMIOLOGY AND BUILT & SOCIAL ENVIRONMENT FACTORS

Dr. Alex Quistberg
Assistant Research Professor
daq26@drexel.edu

There are on average **95,000 road traffic deaths in Latin America** annually and are the leading cause of death of 5-14-year old's in the Americas and 2nd leading cause of 15-44-year old's

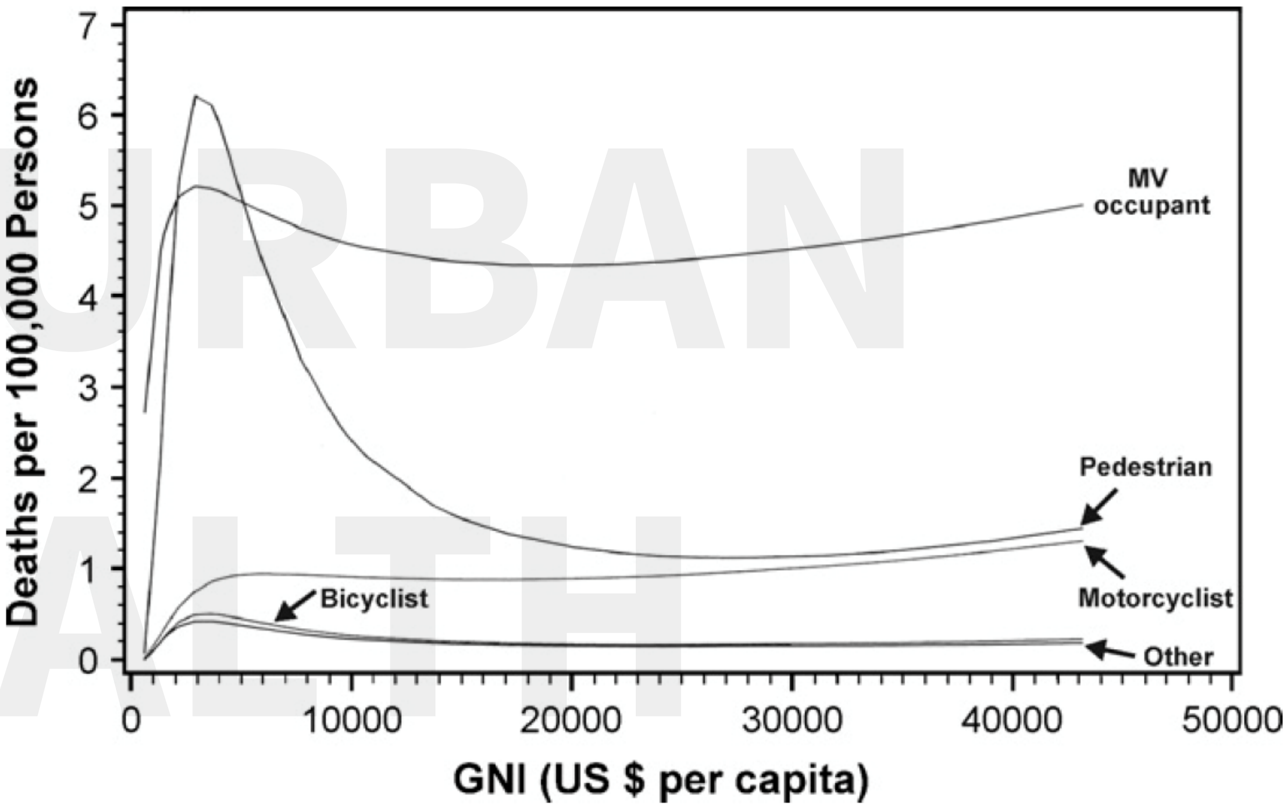
https://www.childinthecity.org/2019/01/17/why-we-need-a-summit-on-youth-urban-road-safety/

ROAD SAFETY SYSTEMS



https://www.roadsafety.gov.au/nrss/safe-system

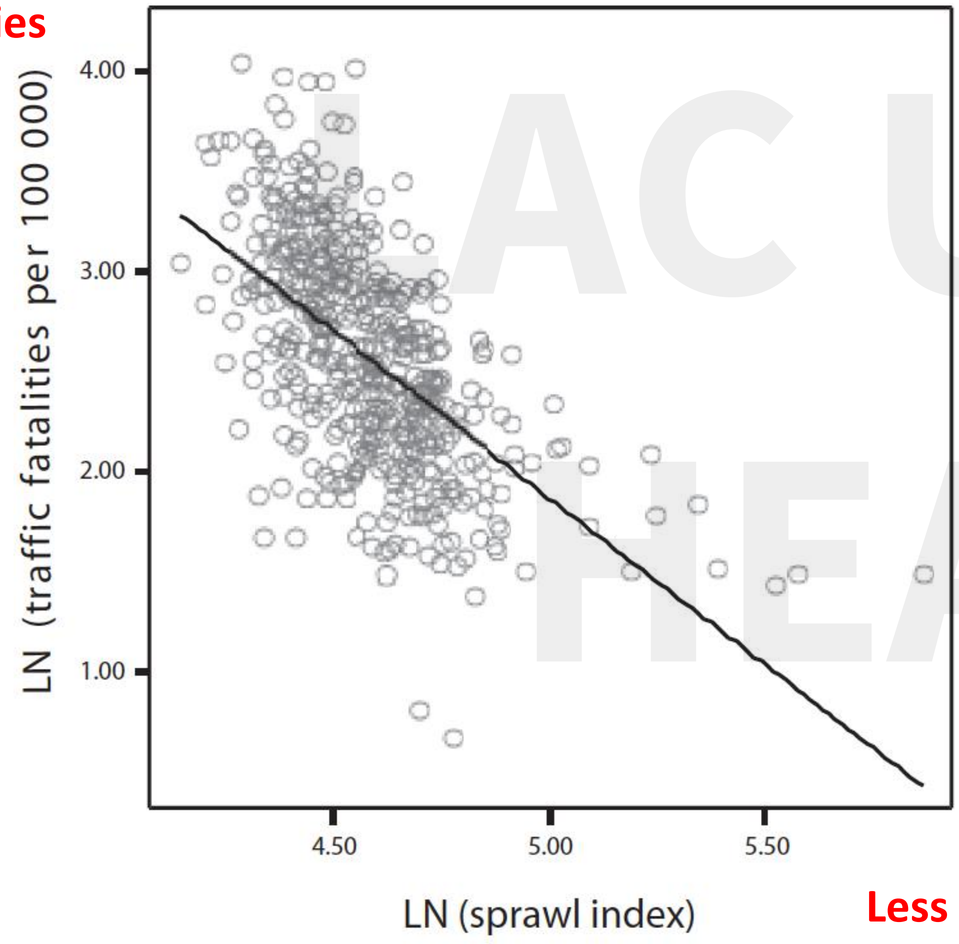
They also result in a major economic impact of **annual 4.4% Gross Domestic Product (GDP) loss in the region** due to impacts on young lives, trauma care costs, employment, and other impacts



Paulozzi, 2007, Acc An Prev

CITY-LEVEL FACTORS

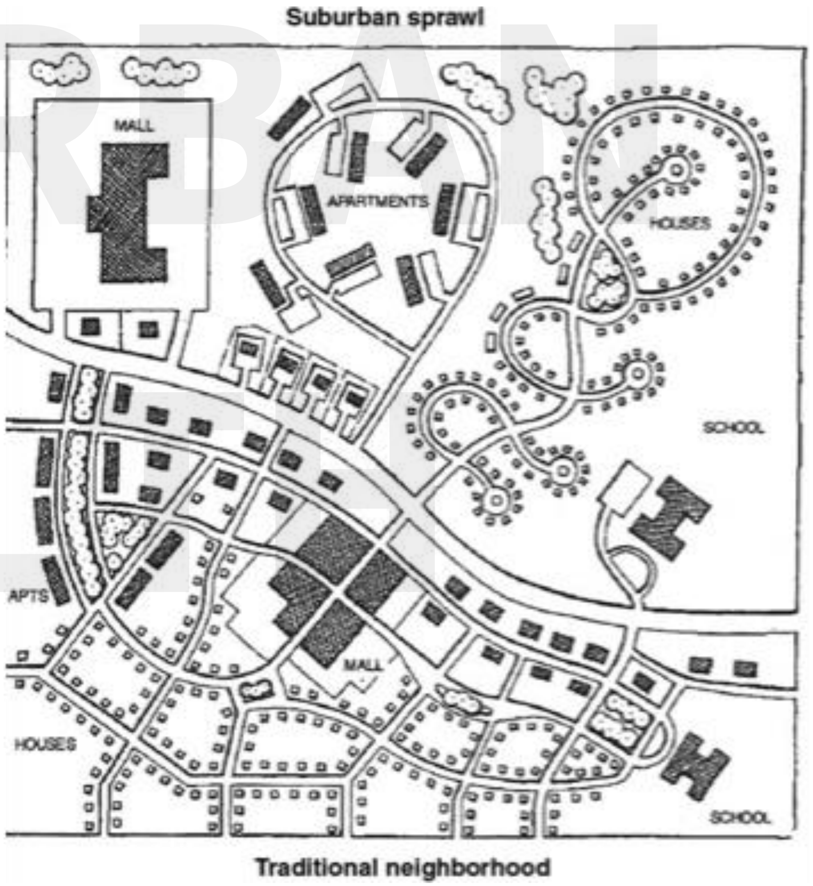
More traffic fatalities



Ewing, 2003 *AJPH*

Less urban sprawl

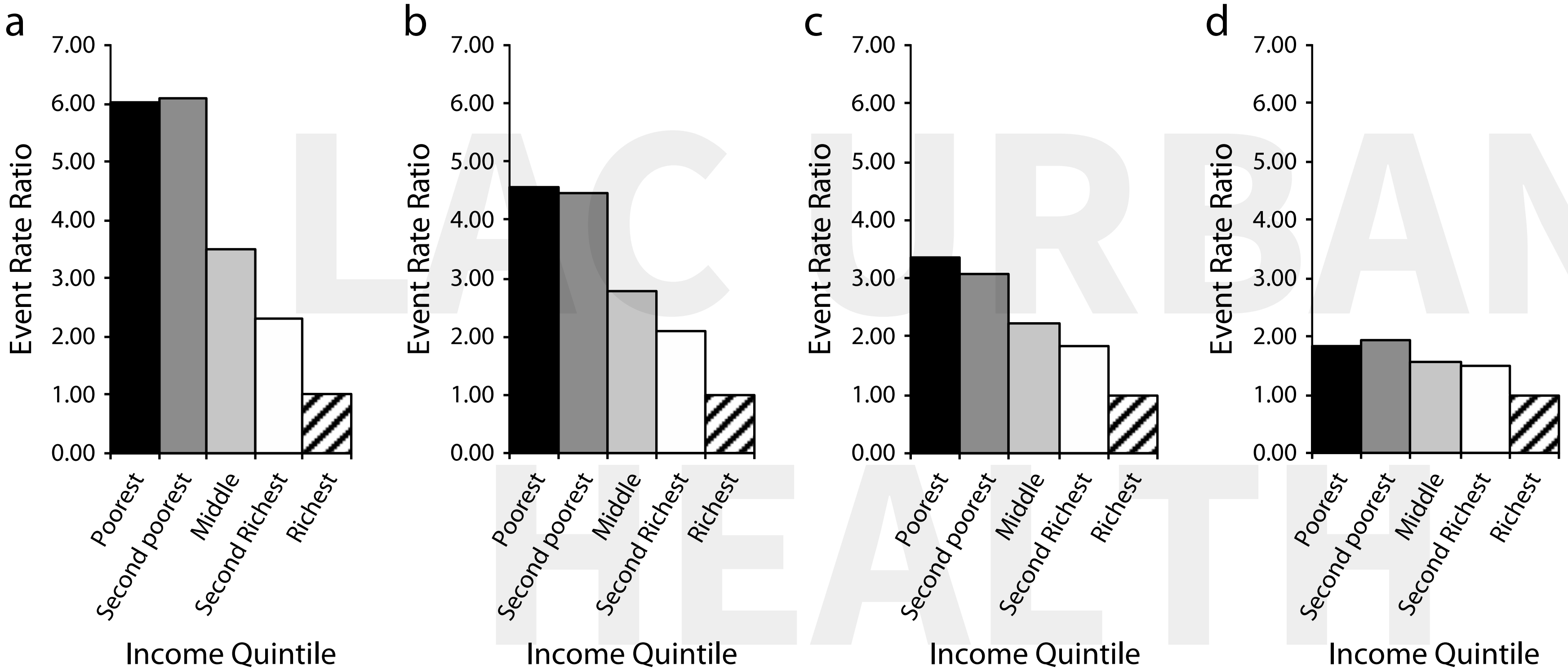
NEIGHBORHOOD-LEVEL FACTORS



AAP Committee on Environmental Health, 2009, *Pediatrics*

STREET-LEVEL FACTORS

SOCIAL ENVIRONMENT

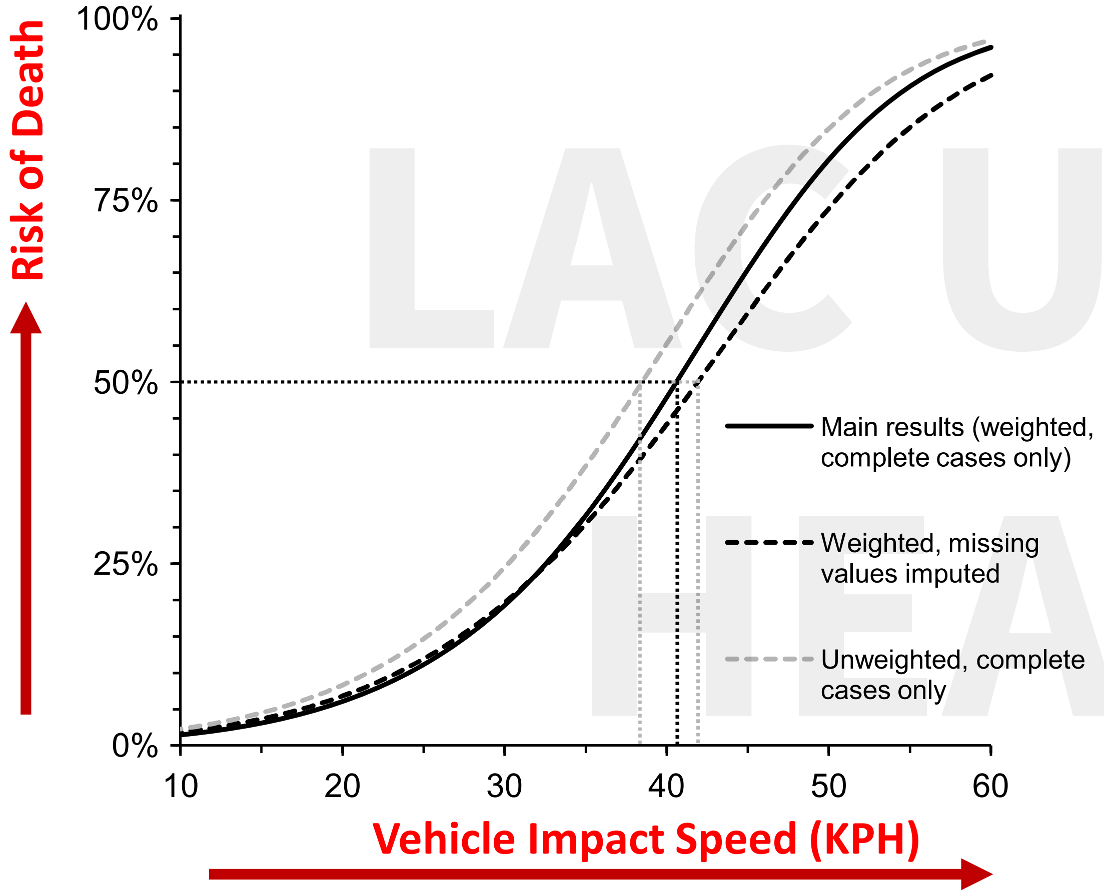


Note. Richest quintile is the reference group.

FIGURE 1—Association between socioeconomic position of census tract residents and the mean number of injured pedestrians at intersections in increasingly complex multivariate models including (a) household income only (model 1); (b) household income plus traffic volume (model 2); (c) household income, traffic volume, and intersection geometry (model 3); and (d) household income, traffic volume, intersection geometry, and proxies of pedestrian volume (model 4): Island of Montreal, Canada, 1999–2003.

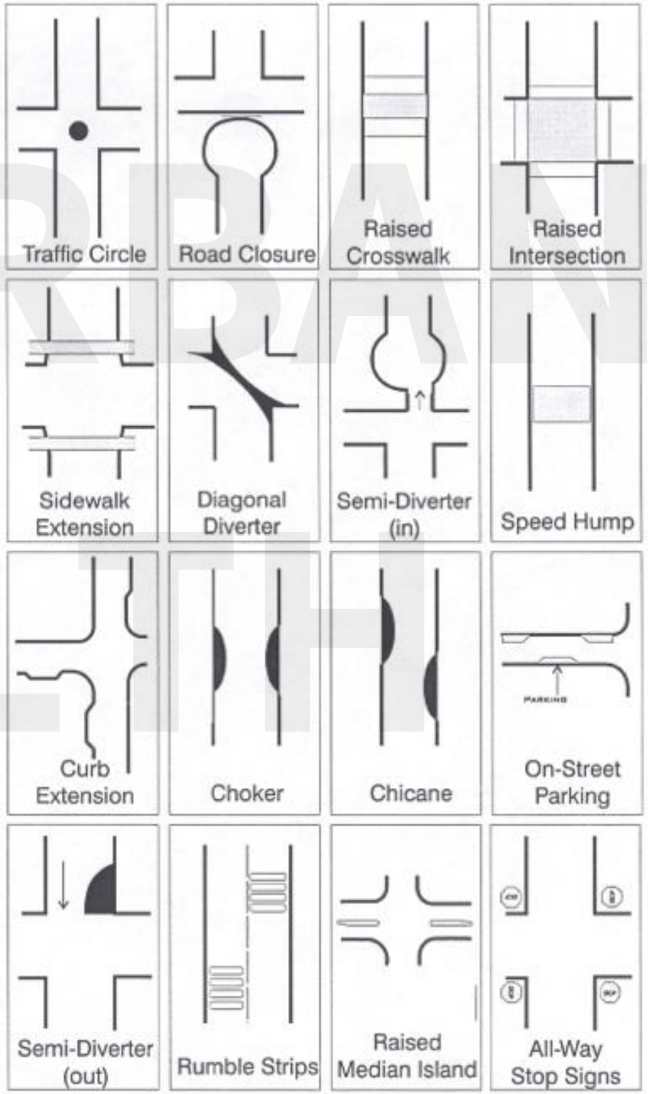
Source: Morency et al, 2012, *Am J Public Health*

SPEEDING

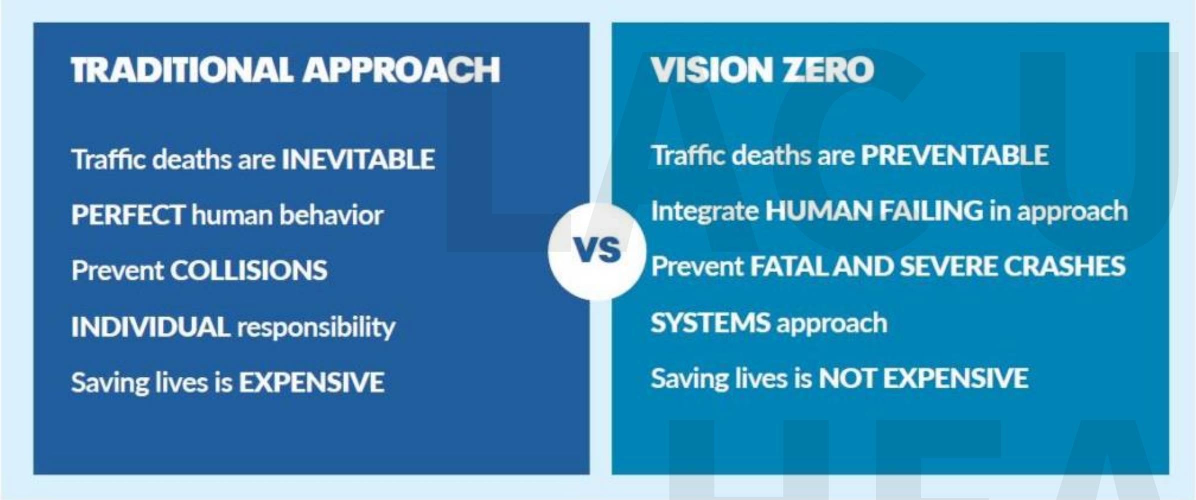


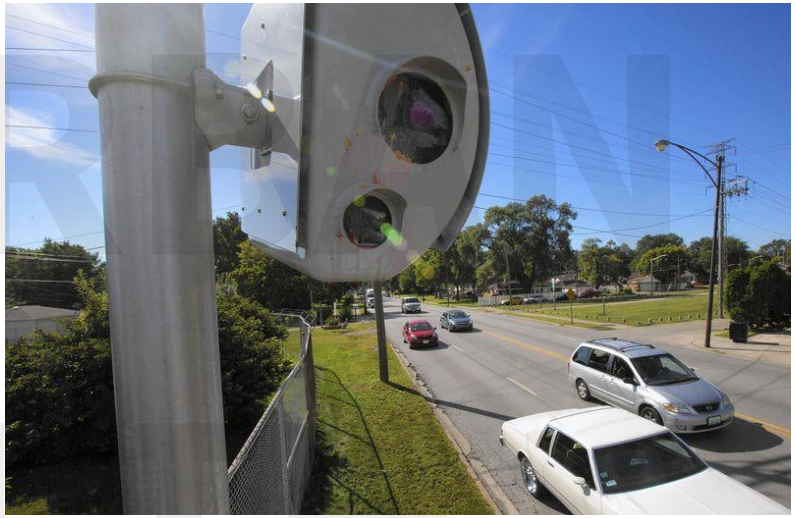
Tefft, 2013, *Acc An Prev*

Street design modifications that can reduce speed



ROAD TRAFFIC SAFETY POLICIES



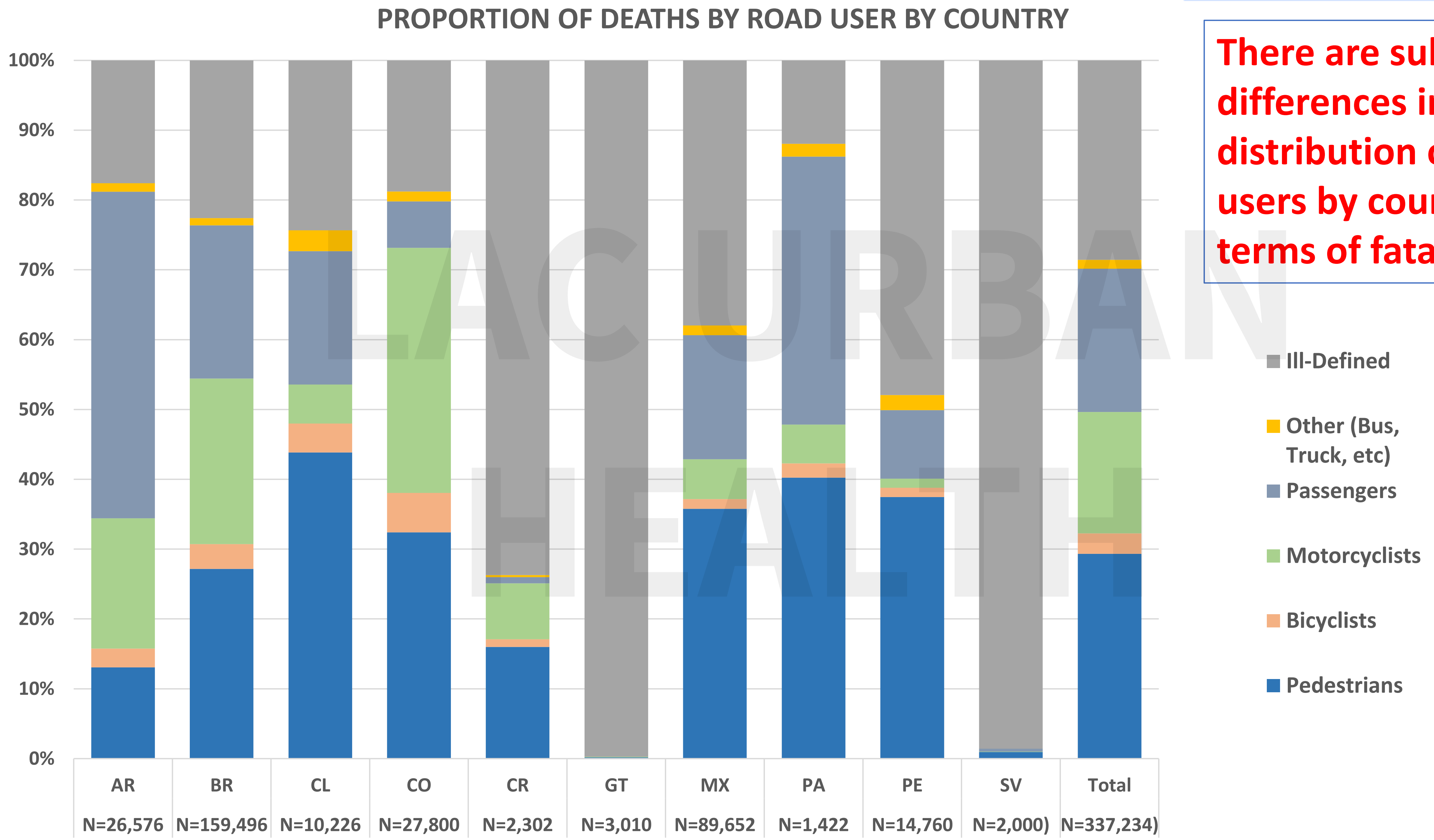


RESEARCH OBJECTIVES

- Assess quality of road traffic death data
- Examine city-level epidemiology of road traffic deaths across cities in Latin America
- Evaluate the association between city-level built and social environment factors with road traffic mortality

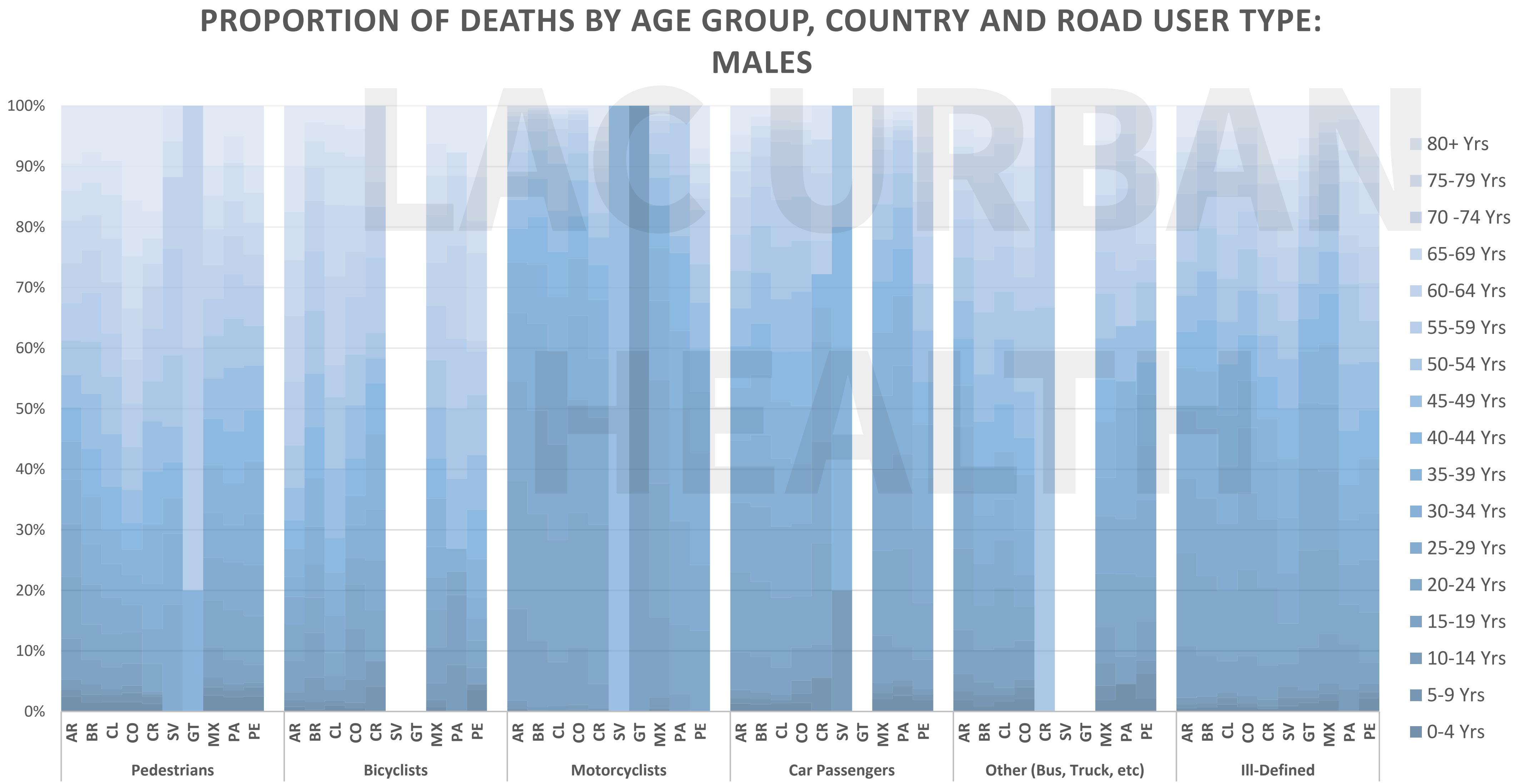
METHODS

- 366 cities ≥100,000 population from 10 countries
- Deaths 2010-2016 from city-level vital registry data
- Examined 5-year age groups by sex
- Assessed factors like population density, urban fragmentation, intersection density, GDP in regression analyses



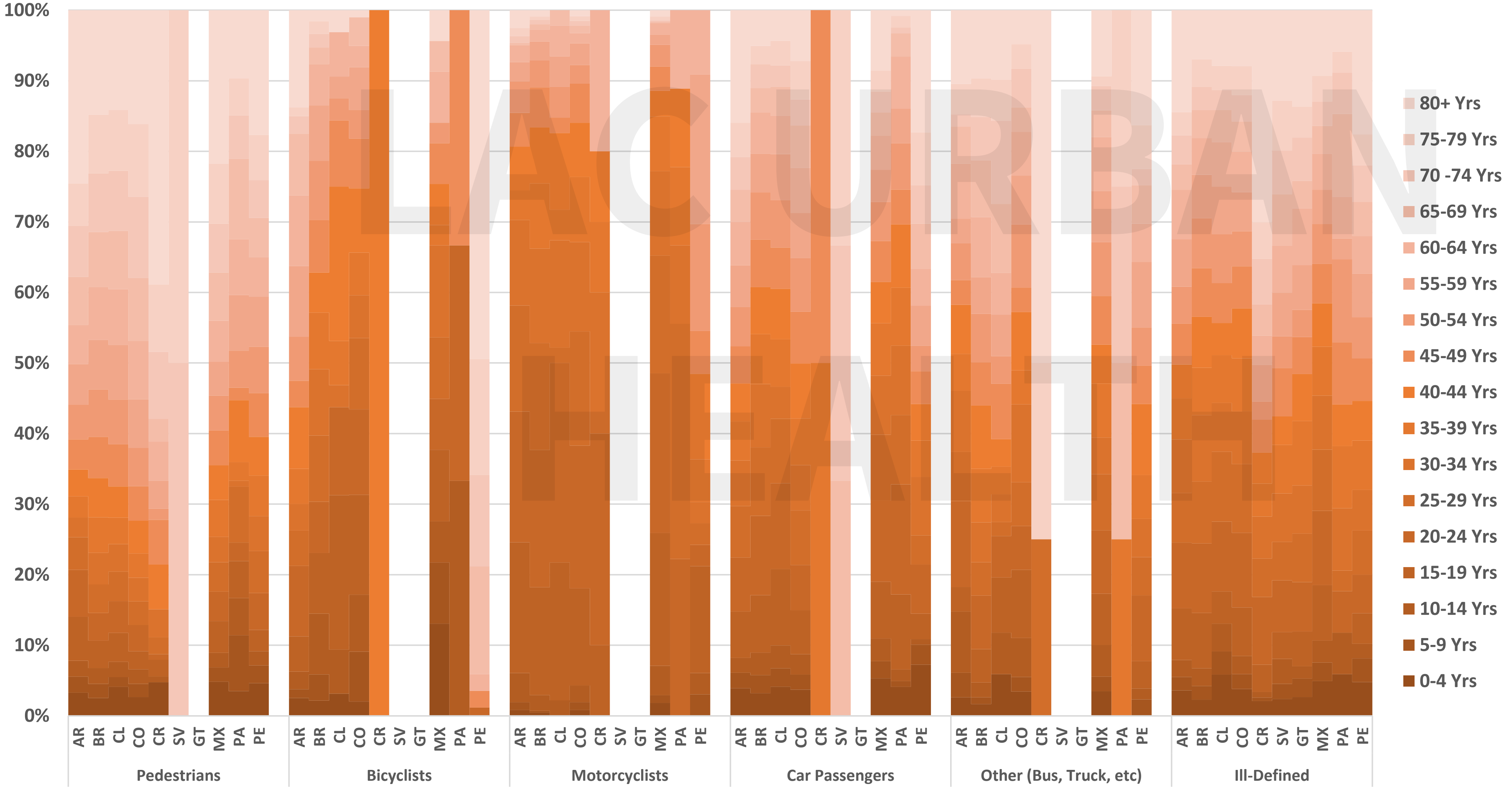
There are substantial differences in the distribution of road users by country in terms of fatal victims

PROPORTION OF DEATHS BY ROAD USER BY 5-YEAR AGE GROUPS AND COUNTRY - MALE



Pedestrians and bicyclists tended to be older, motorcyclists and car passenger occupants were younger

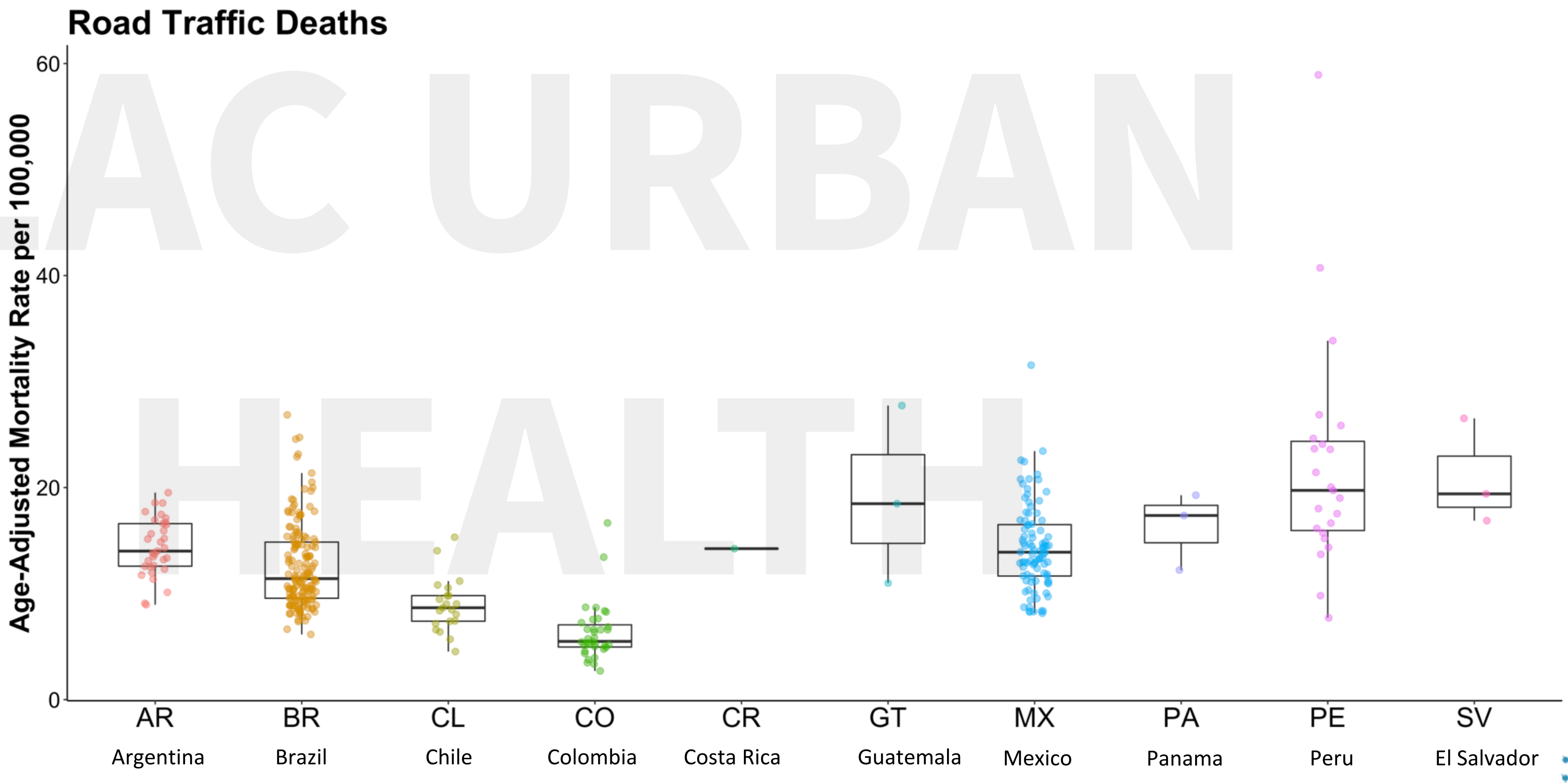
PROPORTION OF DEATHS BY ROAD USERS BY 5-YEAR AGE GROUPS AND COUNTRY - FEMALE



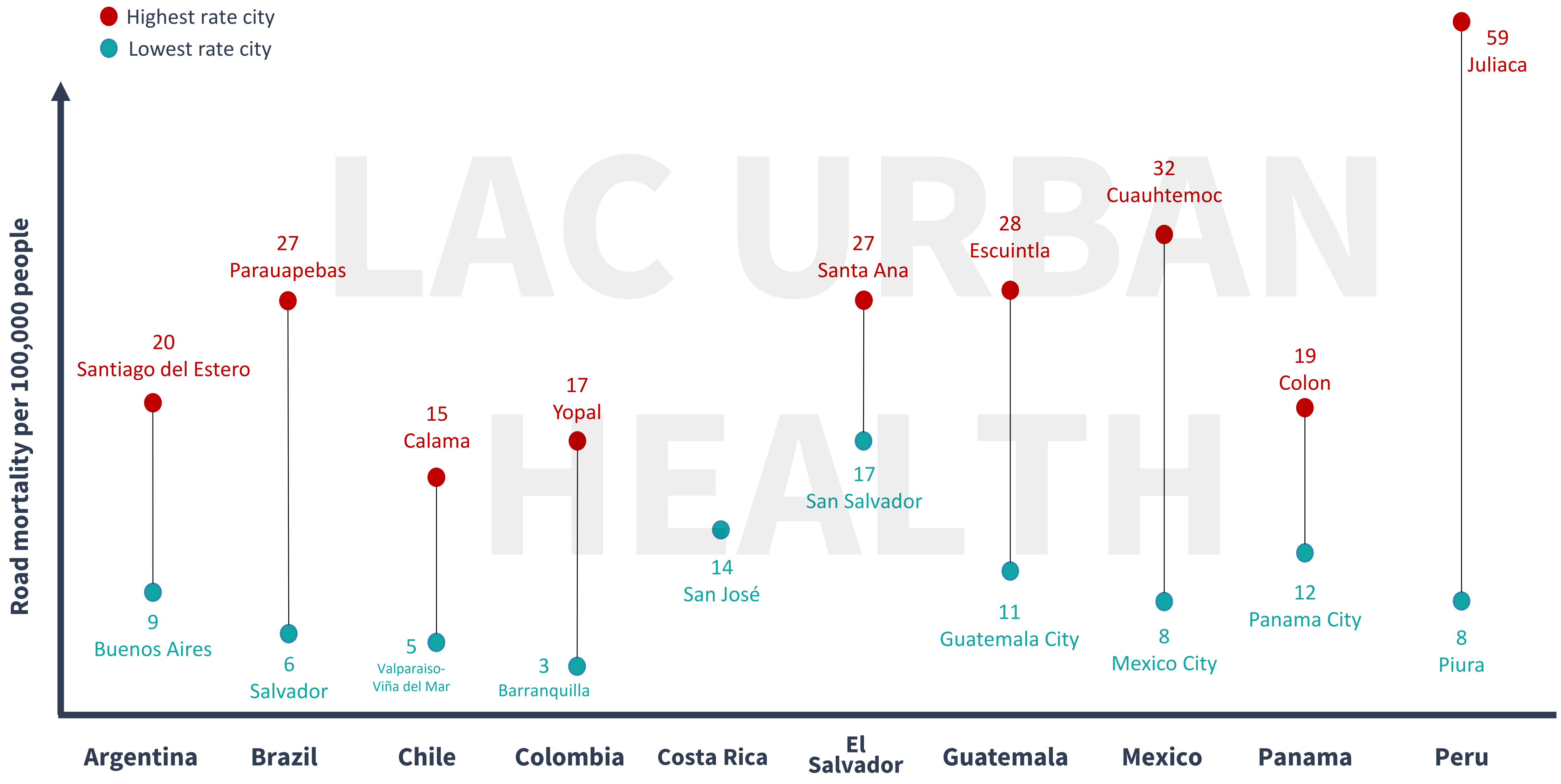
More pedestrians were from older age groups, while pedal cyclists, motorcyclists and passenger vehicle occupants were from younger age groups

AGE STANDARDIZED ROAD MORTALITY PER 100,000 POPULATION

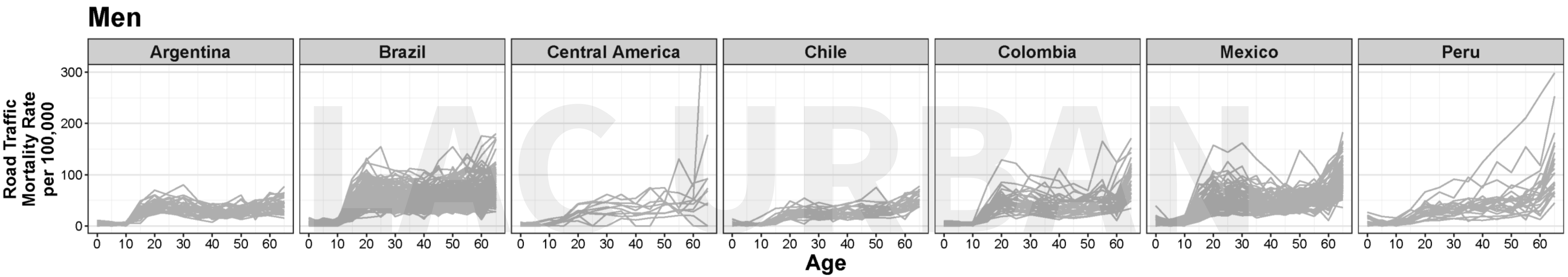
Substantial variation between and within countries in terms of city-level road traffic death rates



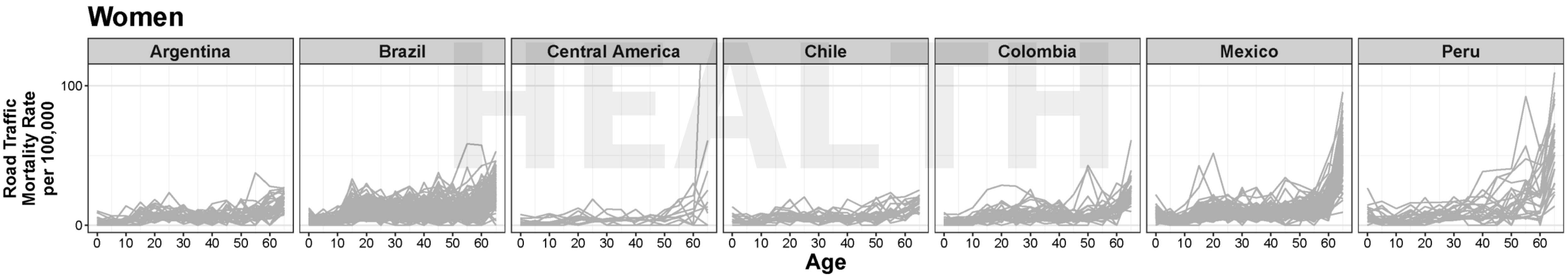
ROAD MORTALITY PER 100,000 POPULATION



BY SEX AND 5-YEAR AGE GROUPS



The road traffic mortality rate for one of the Central American cities goes up to 544



The road traffic mortality rate for one of the Central American cities goes up to 232

WHICH CHARACTERISTICS OF THE URBAN ENVIRONMENT ARE LINKED TO Road Traffic MORTALITY IN CITIES?

Urban Environment Characteristics

Characteristic	Definition
Population Density	2010 Population per 2010 built-up area in square kilometers
Population Growth	Annual average change in population 2010-2016
Annual GDP	Annual gross domestic product in 2010
Social Environment Index	- % population age 25+ ≥ primary school level - % Households overcrowding (>3 people/bedroom) - % Households piped water access - % Households sewage network connection
Urban Development Isolation	Average distance between urban developments in city boundaries
Intersection Density	Number of intersections per square kilometer
Street Length Average	Average length of street segments
Streets per Intersection	Average number of streets emanating from intersections
Mass Transit System	Presence or absence of a bus rapid transit system or subway system
Urban Travel Delay Index	Average minutes delay

WHICH CHARACTERISTICS OF THE URBAN ENVIRONMENT ARE LINKED TO Road Traffic MORTALITY IN CITIES?

Urban Environment Characteristics

Characteristic	Association
Population Density	6% Lower
Population Growth	5% Higher
Annual GDP	4% Lower
Social Environment Index	No Association
Urban Development Isolation	5% Higher
Intersection Density	8% Lower
Street Length Average	4% Lower
Streets per Intersection	3% Higher
Mass Transit System	7% Lower
Urban Travel Delay Index	No Association

Association is per 1 standard deviation

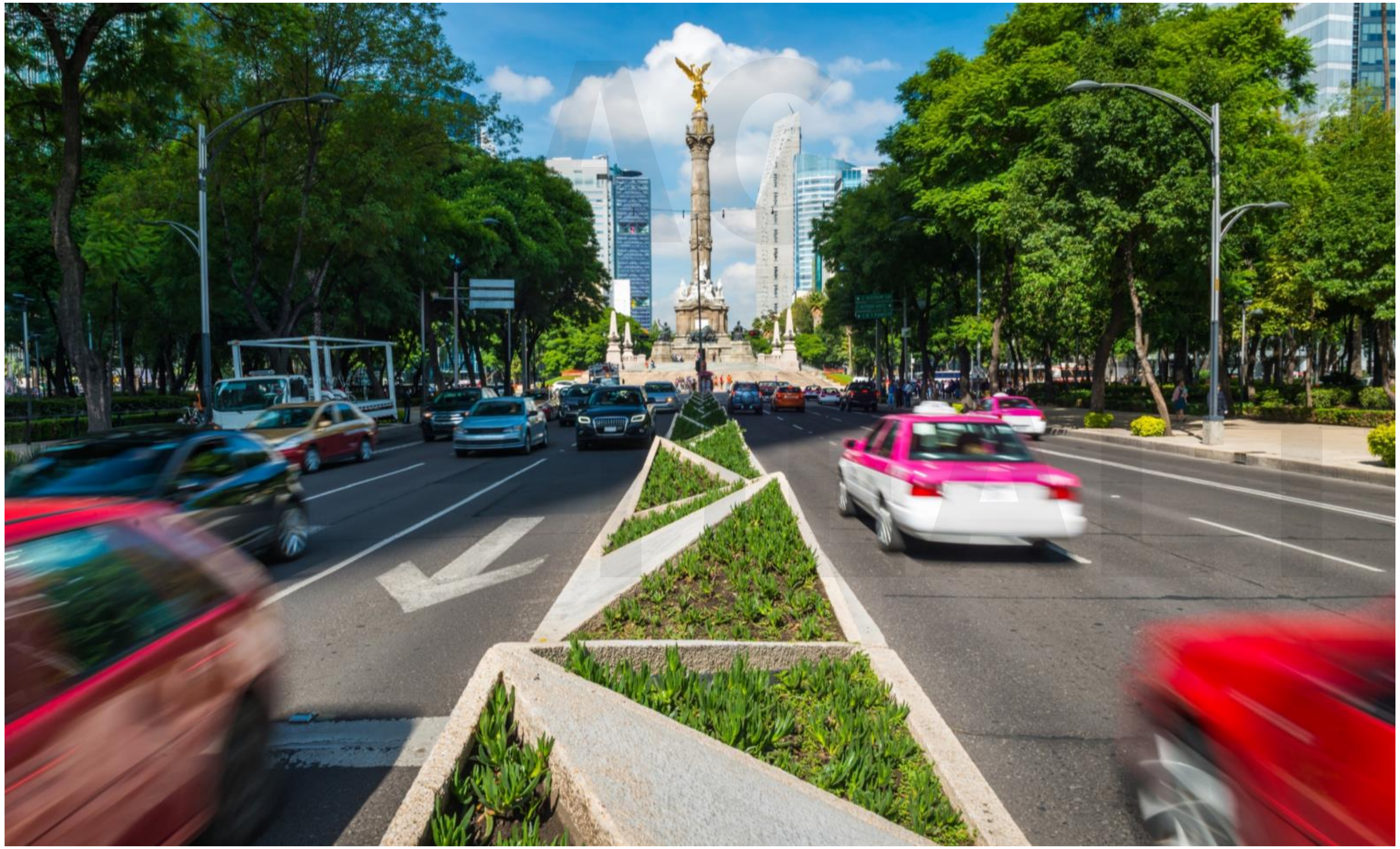
CONCLUSIONS

- Urban planners and traffic engineers can consider ways to **increase street connectivity and reduce fragmented urban development**
- Cities can consider **mass transit systems, such as BRT and subways**, which also can provide other health benefits (e.g., less air pollution)
- Future work should **examine other road safety outcomes** (e.g., police reports), **subgroups** (e.g., pedestrians) and **smaller geographic areas** within cities
- Given heterogeneity, it is important to look beyond only the largest capital cities and see what smaller and middle-sized cities are doing successfully

THANK YOU!

- Collaborators:
  - Philipp Hessell
  - Usama Bilal
  - Olga Lucia Sarmiento
  - Daniel Rodriguez
  - Fatima Pina
  - Waleska Caiaffa
  - Carlos Guevel
  - Akram Hernandez-Vasquez
  - Jaime Miranda
  - Ana V. Diez Roux

EVALUATION OF SPEED LIMITS AND TRAFFIC ENFORCEMENT IN MEXICO CITY



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GITS Geotecnología en Infraestructura Transporte y Sustentabilidad

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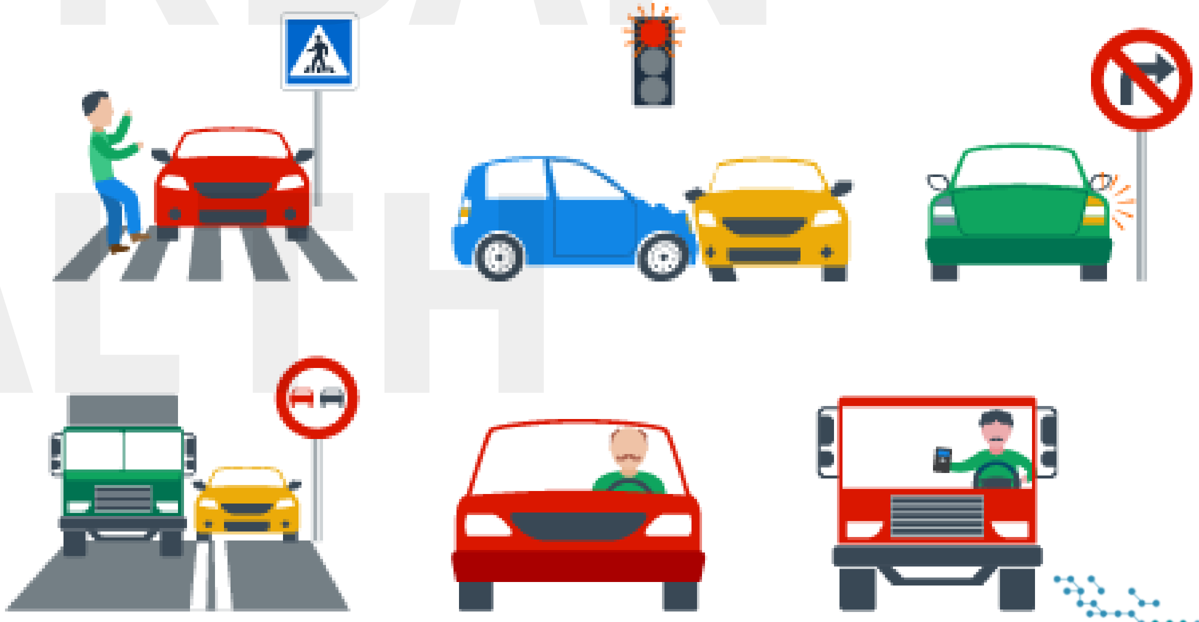
- Hector Resendiz, UNAM
- Alex Quistberg, Drexel University
- Tonatiuh Barrientos, INSP

ROAD SAFETY IN MEXICO CITY

- Mortality rate of 8.7 per 100,000 in 2015
- Mexico City adopts Vision Zero in 2015
- New road traffic regulations - December 15, 2015

1) lower speed limits, introduction of speed radars and higher fines for speeding vehicles

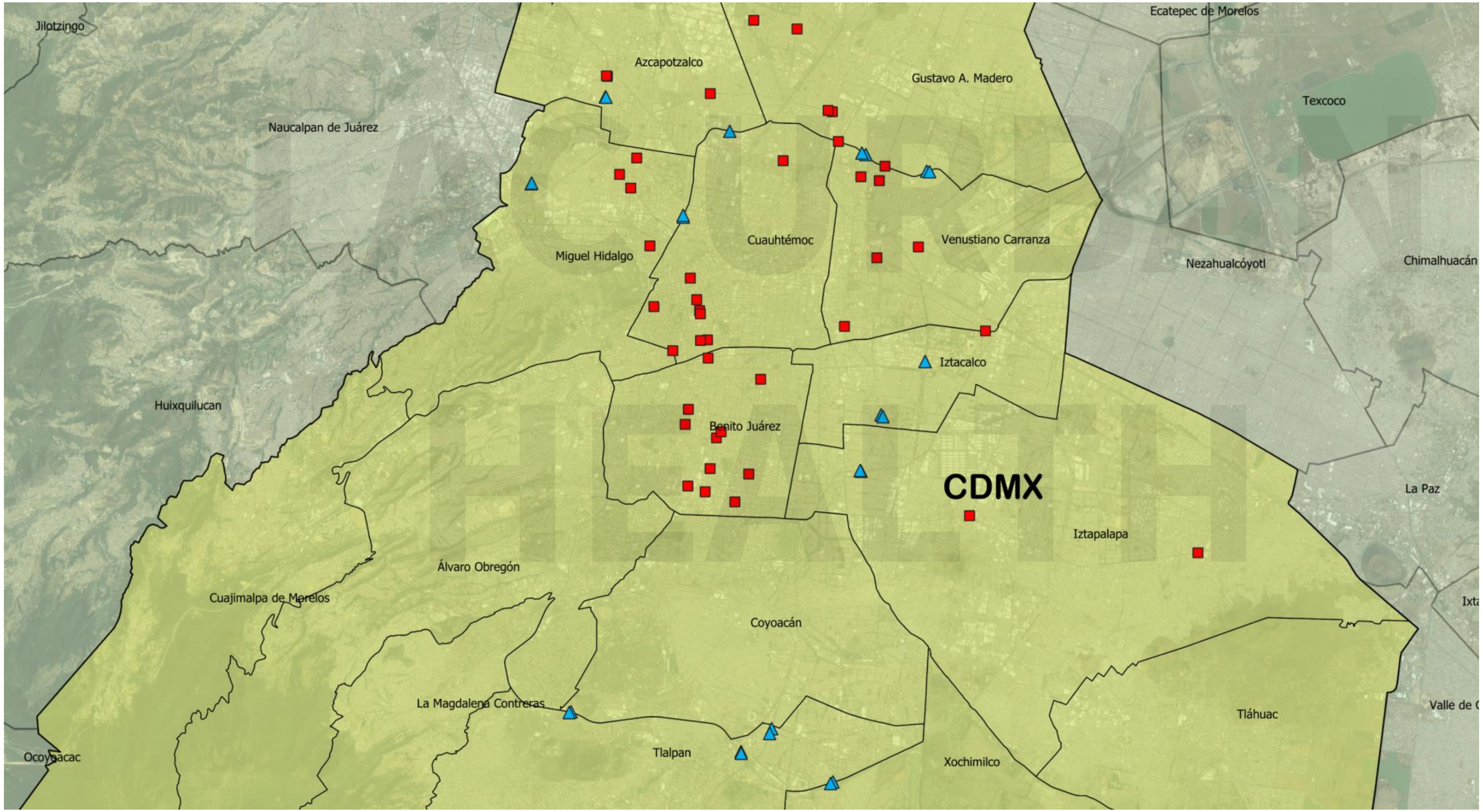
2) traffic enforcement devices to detect nine motoring offences.



ROAD SAFETY IN MEXICO CITY

66 new automated traffic enforcement devices installed which were linked to the new fines.

Location of enforcement devices



Speed radar

Fotomulta

THE EVIDENCE ON SPEED LIMITS AND ENFORCEMENT DEVICES

- Speed management interventions are effective to reduce the number of injured and dead (Sadeghi-Bazergani, H 2016)
- The use of cameras for detecting multiple motoring offences has been associated with a **reduction of 19% of all crashes and a 25% reduction of injury and fatal crashes** (Martínez-Ruíz DM 2019, Wilson C, 2010).
- In Mexico City these interventions were unpopular and never formally evaluated, resulting in the suspension of economic fines in early 2019.

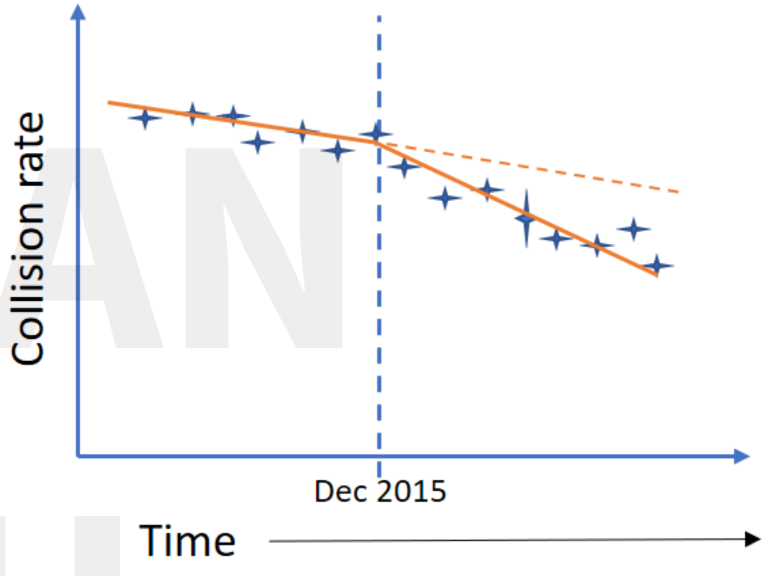
OBJECTIVE AND HYPOTHESIS

Objective: To estimate the effect of the road traffic regulations implemented in December 2015 in Mexico City on police-reported collisions, police-reported collisions resulting in injury and mortality from road traffic collisions.

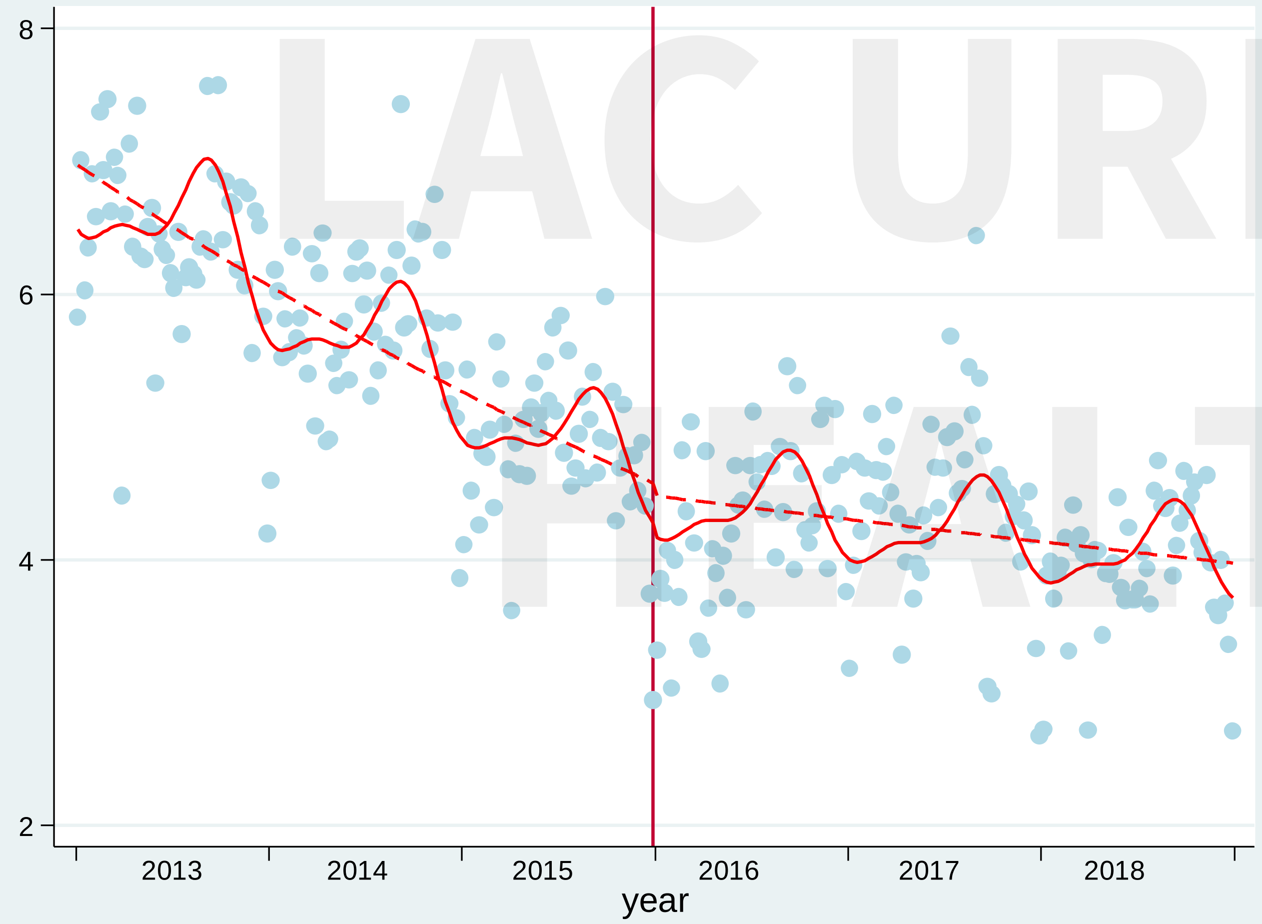
- **Hypothesis:** Total collisions, collisions resulting in injury and mortality will decline in Mexico City after December 2015. Collisions and mortality will decline more in municipalities with enforcement devices compared with control municipalities.

METHODS

- **Data sources for collisions**: police reported collisions (ATUS, INEGI), number of registered vehicles (INEGI)
- **Data sources mortality**: vital registry data, total population (CONAPO)
- Weekly data from January 2013 to December 2018
- Compared trends before and after the intervention



TOTAL COLLISIONS RATE PER 100,000 VEHICLES

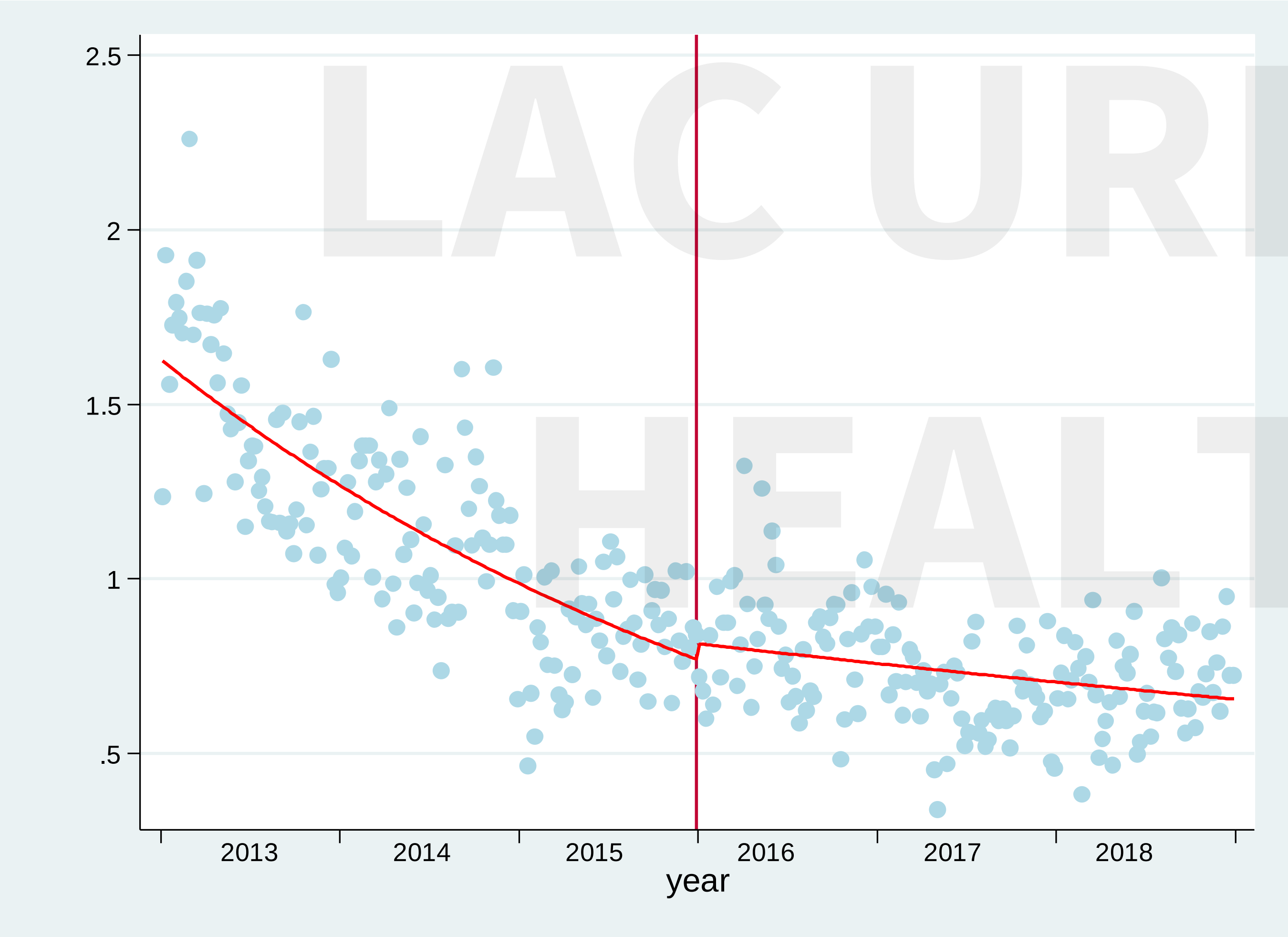


Adjusted for seasonality

Increase of 0.2%* per week after the intervention

*(95% CI, 0.1% ± 0.3%)

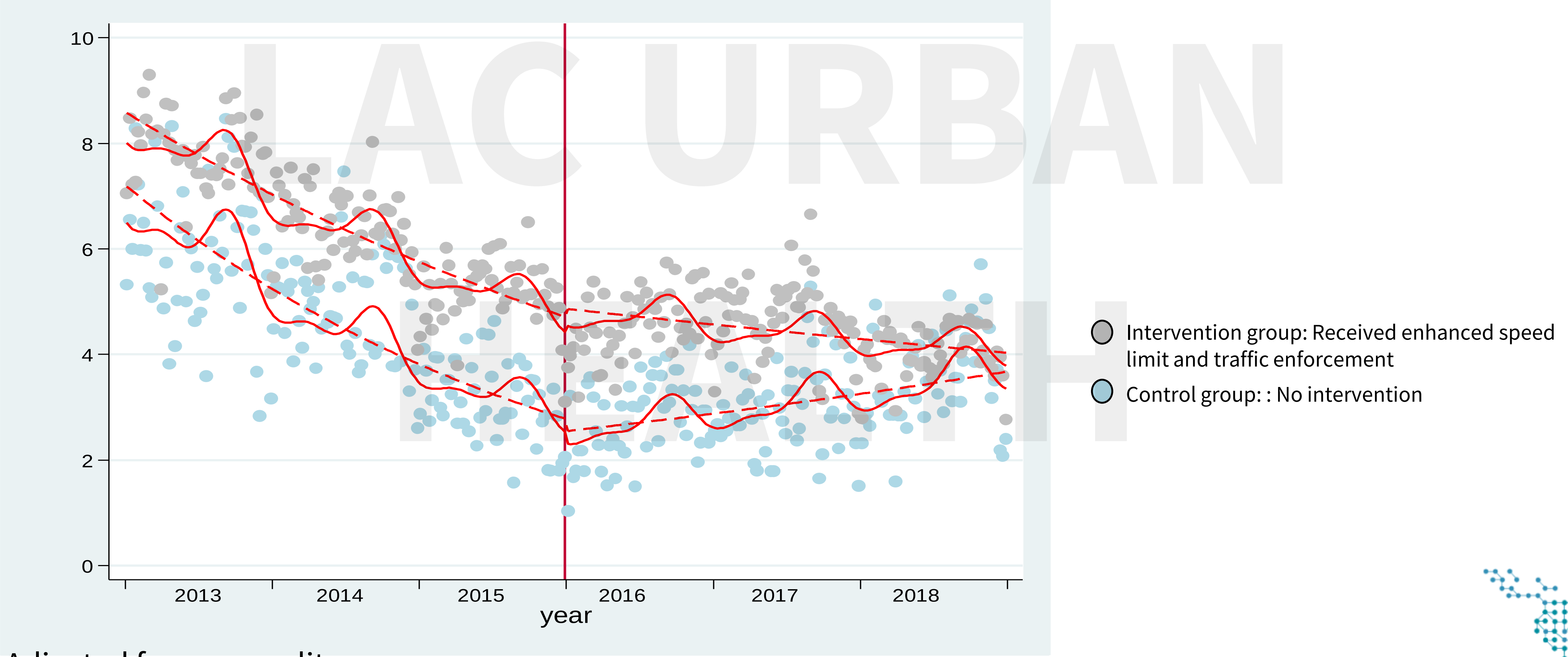
COLLISION RESULTING IN INJURY RATE PER 100,000 VEHICLES, MEXICO CITY



Increase of 0.3%* per week after the intervention

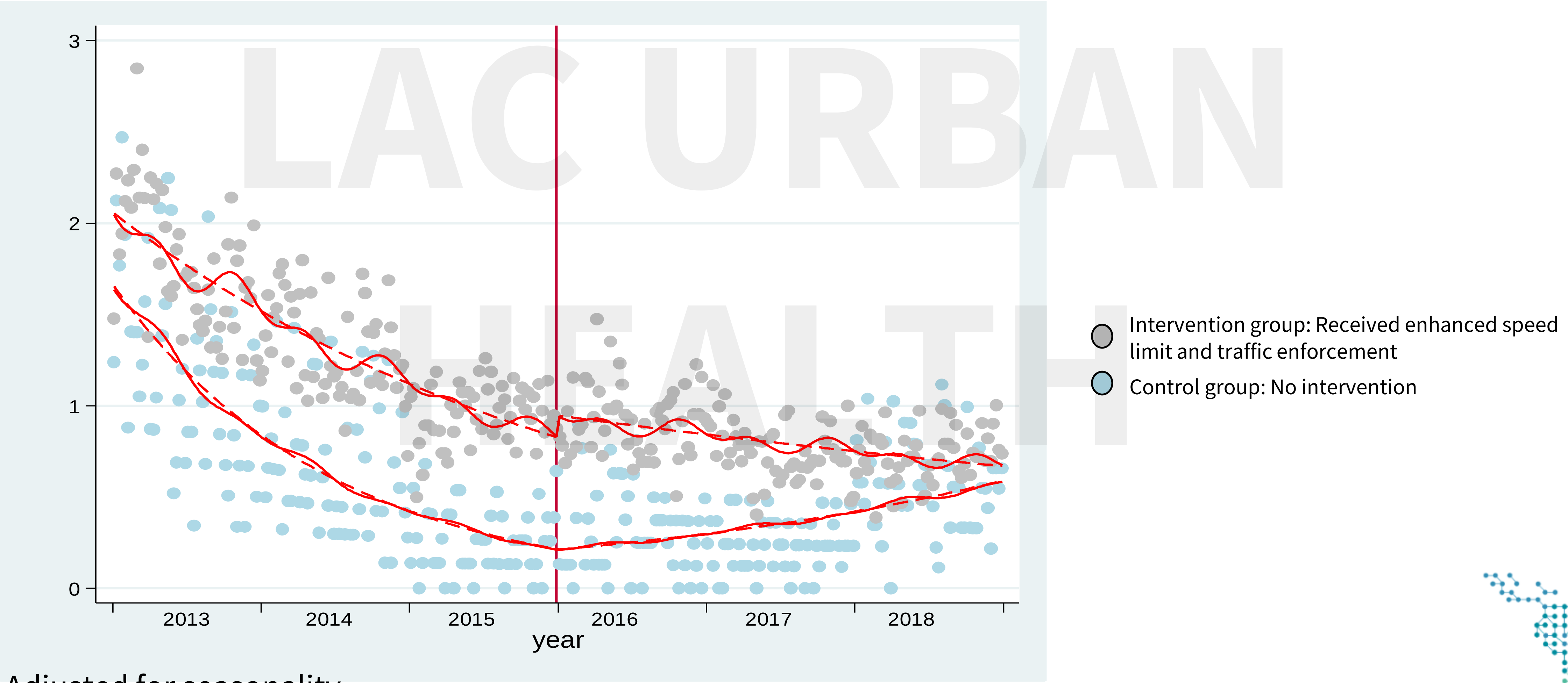
*(95% CI, 0.2% ± 0.4%)

TOTAL COLLISION RATE FOR CONTROL AND INTERVENTION MUNICIPALITIES



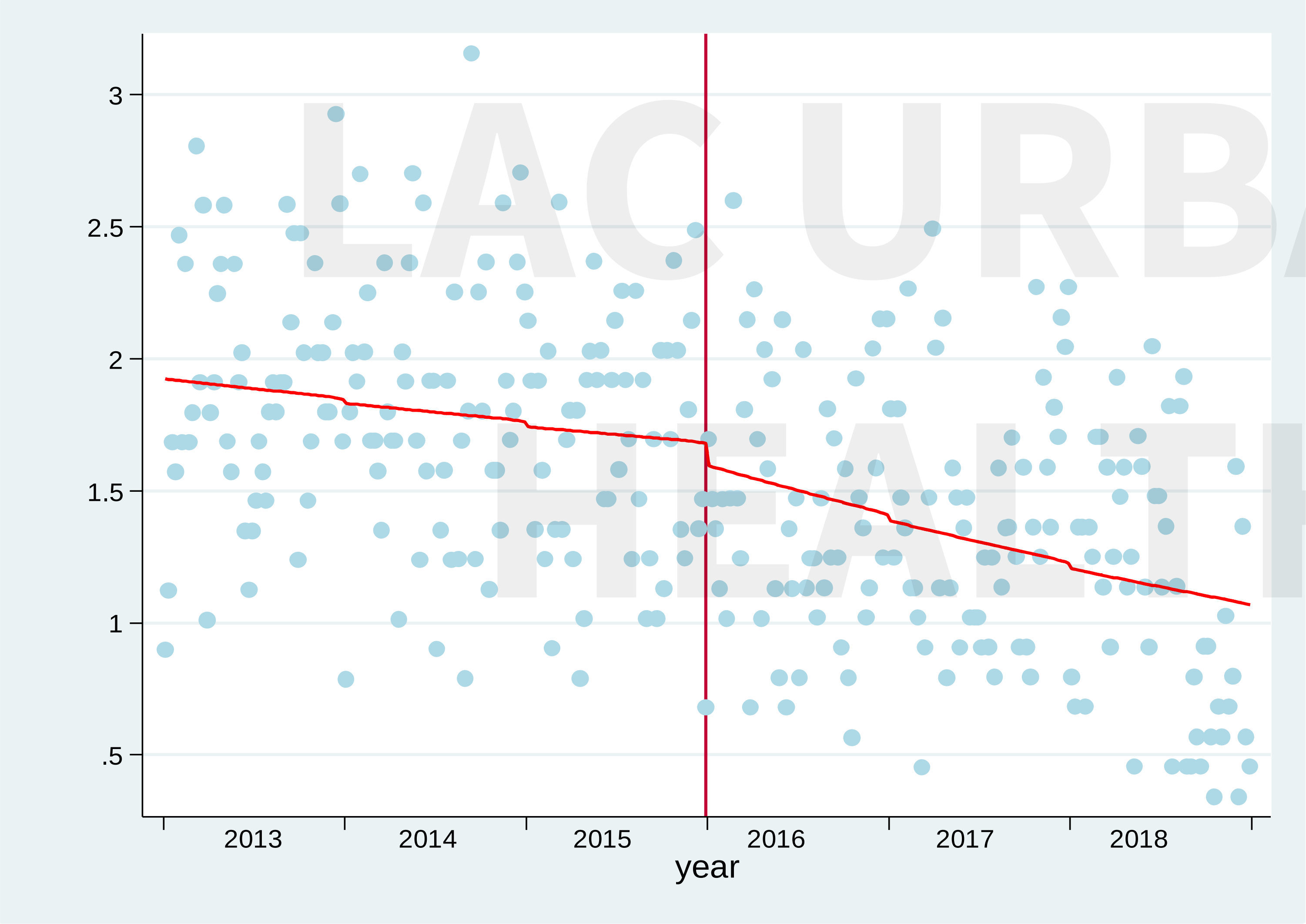
Adjusted for seasonality

COLLISION RESULTING IN INJURY RATE FOR CONTROL AND INTERVENTION MUNICIPALITIES



Adjusted for seasonality

MORTALITY RATE PER 1M, MEXICO CITY



Decrease of 0.2%* per week after the intervention

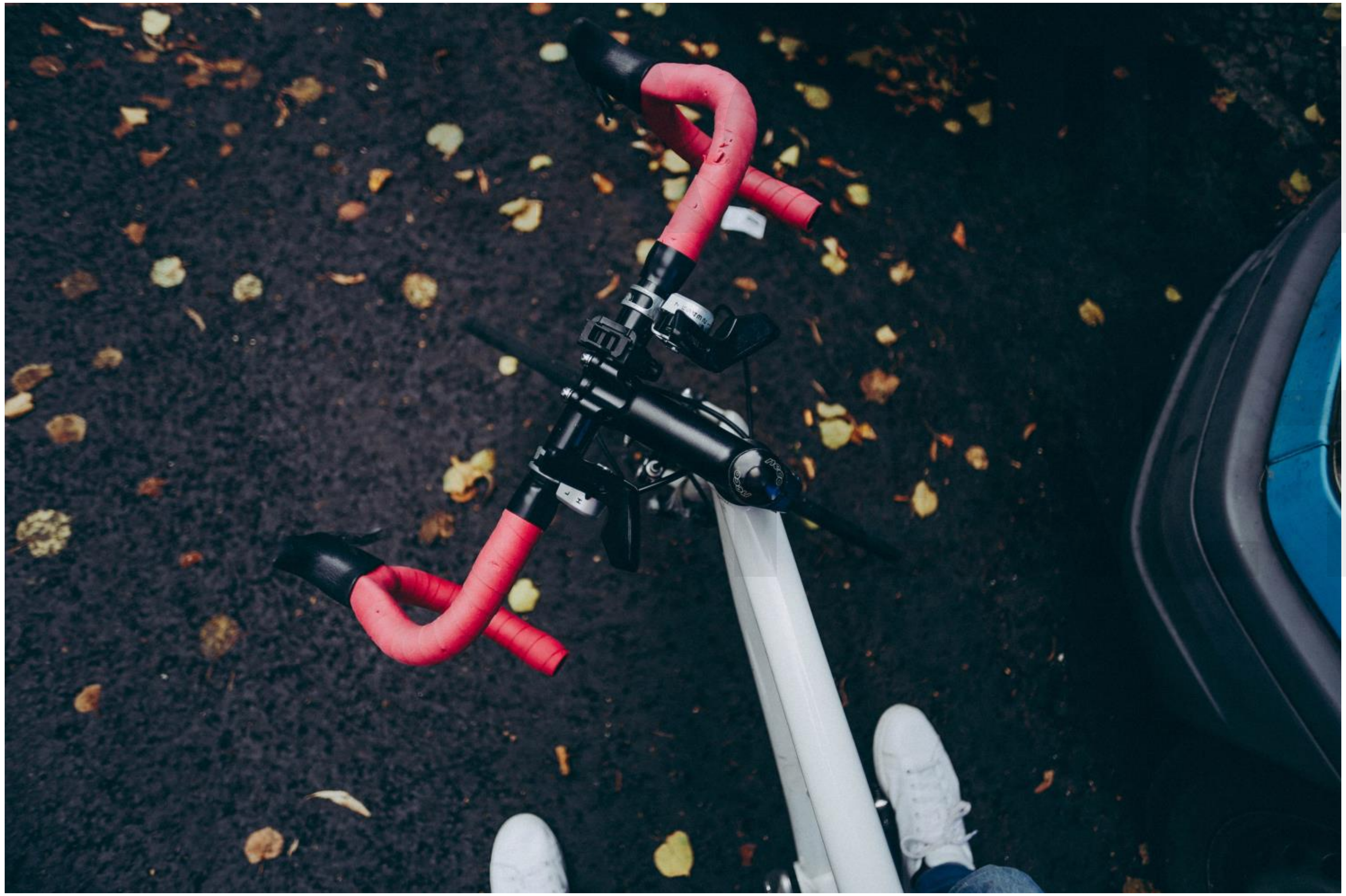
*(95% CI, -0.3% ± -0.1%)

CONCLUSIONS

Hypothesis: Total collisions, collisions resulting in injury and mortality will decline in Mexico City after December 2015. Collisions and mortality will decline more in municipalities with automated traffic enforcement compared with control municipalities.

- The **effect on mortality at city level was a decrease of 0.2% per week after the intervention.**
- **Effect on police reported collisions not as expected** – looking into explanations for this.
- However, **municipalities that did not have automated traffic enforcement experienced a larger increase in collisions** compared to municipalities with devices

BICYCLE SAFETY IN BOGOTÁ:
A SEVEN-YEAR ANALYSIS OF BICYCLISTS' COLLISIONS AND FATALITIES



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OUTLINE

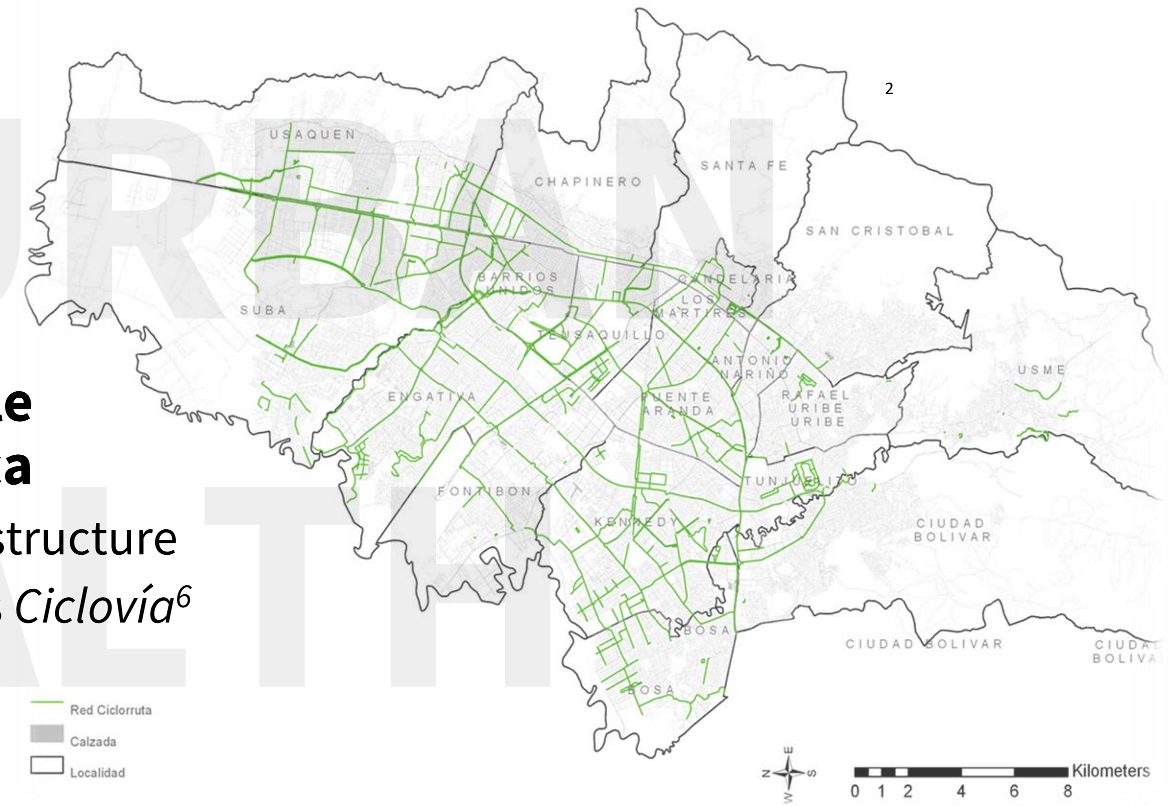
- The city of Bogotá
- Bicycling: status and concerns
- Research questions
- Data source
- Results
- Policy recommendations

Alcaldía Mayor de Bogotá, 2018. Ciclovía calle 26.

THE CITY OF BOGOTA


[1]

- **7.2 million inhabitants**[3]
  - 17.2 million trips per day[4]
  - 5% of bicycle modal share[5]



- **Largest network of bicycle pathways in Latin America**
  - 500 Km of dedicated infrastructure
  - Add 126 Km with Sunday's *Ciclovía*[6]


[8]

- ***2016 – 2020 Policy interventions***[7]
- Vision Zero
- Speed limits reduction

1 Bicycle by Creaticca Creative Agency from the Noun Project 2 Dedicated bicycle pathways in Bogotá at the end of 2017. Own elaboration based on IDECA information.
3 Secretaría Distrital de Planeación, 2018; 4, 5 Transconsult & Infometrika, 2015b ; 6 Instituto Distrital de Recreación y Deporte, n.d.; 7 EL TIEMPO & Secretaría Distrital de Movilidad, 2017; Secretaría Distrital de Movilidad, 2018); 8 Target by Vectors Point from the Noun Project

PUBLIC POLICY: BICYCLING

Multisectoral perspective policies, including transportation, sports and recreation, education, and health

Ley Pro Bici [1]

al colegio EN BICI BOGOTÁ MEJOR PARA TODOS [3]

VISION ZERO NO MORE TRAFFIC DEATHS [5]

IDRD BOGOTÁ CICLOVÍA [4]

Bogotá as the world's bicyclist' capital with the greatest total traveled Km by bicycle in the year 2038

PLAN bici

"Build it and they will come"[6]

1 Copyright: Andrés García Zuccardi, 2016; Congreso de Colombia, 2016; 2 Copyright: Secretaría Distrital de Movilidad, 2016; Secretaría Distrital de Movilidad, 2016
3 IDRD, 2014; Hidalgo, Miranda, Lleras, & Ríos, 2016; 4 Copyright: Alcaldia mayor de Bogotá, 2014; Verma, López, & Pardo, 2015
5 Copyright: Greater Mercer, 2019; Sweden Government 1996/97:137, Government Bill 1996/97:137, & Sweden Government 1996/97:137, n.d.; Welle et al., 2018
6 Dill, J., Carr, T., 2003

BICYCLING: STATUS

Road safety concerns are a major barrier to bicycling[3]


[6]

More than half of all road traffic deaths are among vulnerable road users including **bicyclists**, pedestrians, and motorcyclists[4]


[7]

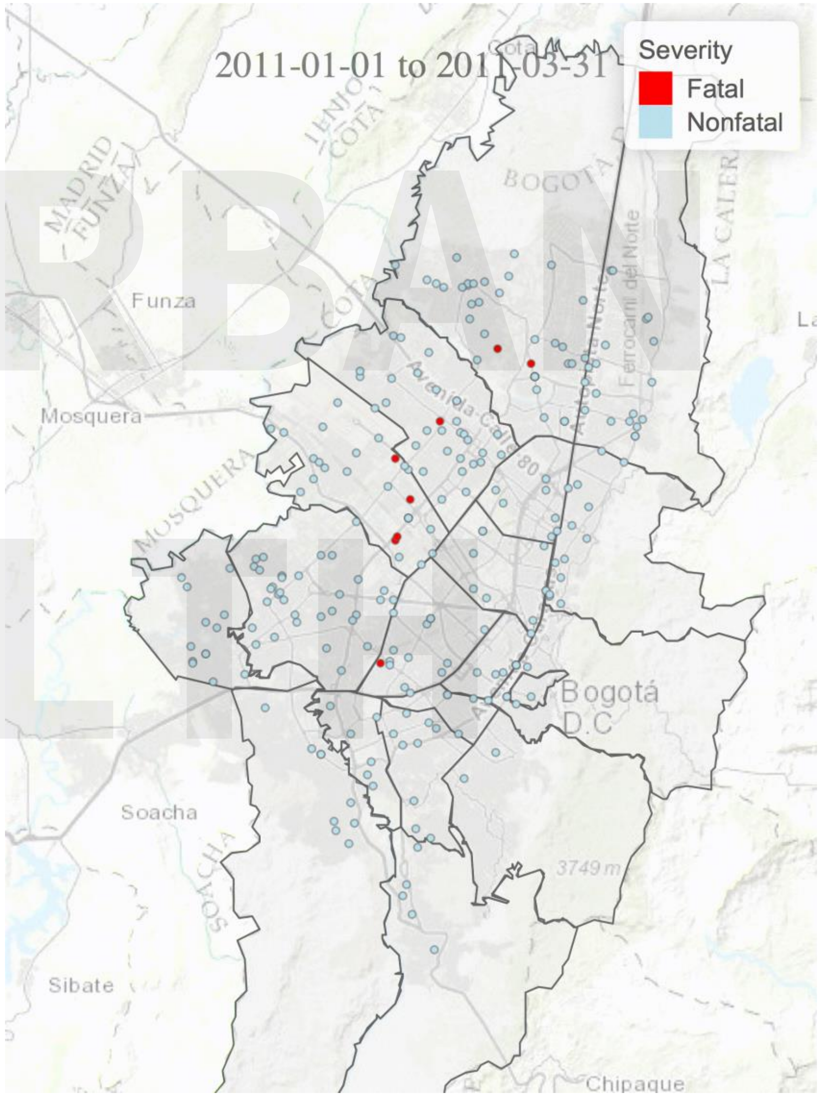
Traffic collisions are the leading cause of death among children and young adults in low- and **middle-income countries**[5]

Road traffic collisions are the second **leading cause of mortality** in men and the first in women[8]

1 Copyright: Surrey County Council, UK. 2019
2 Oja et al., 2011; Sarmiento et al., 2015; Ding et al., 2016; Elvik, 2000; Fishman, Schepers, & Kamphuis, 2015; Gössling, Choi, Dekker, & Metzler, 2019; Krizec, 2007; Macmillan et al., 2014; Rabl & de Nazelle, 2012.
3 Dill & McNeil, 2017; Pettit & Dogde, 2014; 4 World Health Organization, 2015; 5 Hazen & Ehiri, 2006; World Health Organization, 2018; 6 Copyright: US Department of transportation, US, 2019;
7 Latin america by anbileru adaleru from the Noun Project; 8 Ministerio de Salud y Protección Social, 2016

BICYCLING: PUBLIC CONCERNS

City officials in Bogotá have reported an increase of the frequency of bicycle-related fatalities over the last decade[1]



1 Concejo de Bogotá, 2018; Gil et al., 2009

RESEARCH QUESTIONS

Examine spatiotemporal trends and potential contextual risk factors explaining bicyclist collisions and fatalities in Bogotá

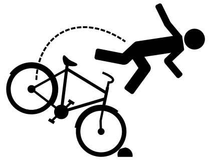
[1] To analyze temporal trends in bicyclist mortality and nonfatal collision rates

[2] To identify areas within the city where there is higher risk of bicyclist mortality

[3] To determine the individual and contextual risk factors associated with bicyclist mortality.

1 Downward Trend by Joel Olson from the Noun Project; 2 Standardized rates by total bicyclists' population; 3 Chain created by David from the Noun Project

DATA SOURCES: COLLISIONS



SAMPLE

Data source:
Secretaria de Movilidad and Despacio / WRI
2011 – 2017

- 366,814 total collisions
  - ∟ 10.043 bicycle collisions (2.73%)
    - ∟ 9,950 usable bicycle collisions (2.71%)[1]
      - ∟ 358 fatal collisions (0.09%)

MORTALITY DEFINITION

A death in a road traffic accident is declared whenever the person involved dies because of the traffic collision between the moment of the event until February of the following year[2]

Fatal collisions
Subject to stricter control and validation

1 bicyclists' collisions involving people less than 5 years old were removed;
2 Secretariat of Mobility, personal meeting, May 24th of 2018

DATA SOURCES: EXPOSURE CONTROLS

SOURCES

Multipurpose Survey

- 2014
- 2017

Mobility Survey

- 2005
- 2011
- 2015

Bicyclists: commuter population

Estimation by interpolation

[1] Shortest bicycle paths

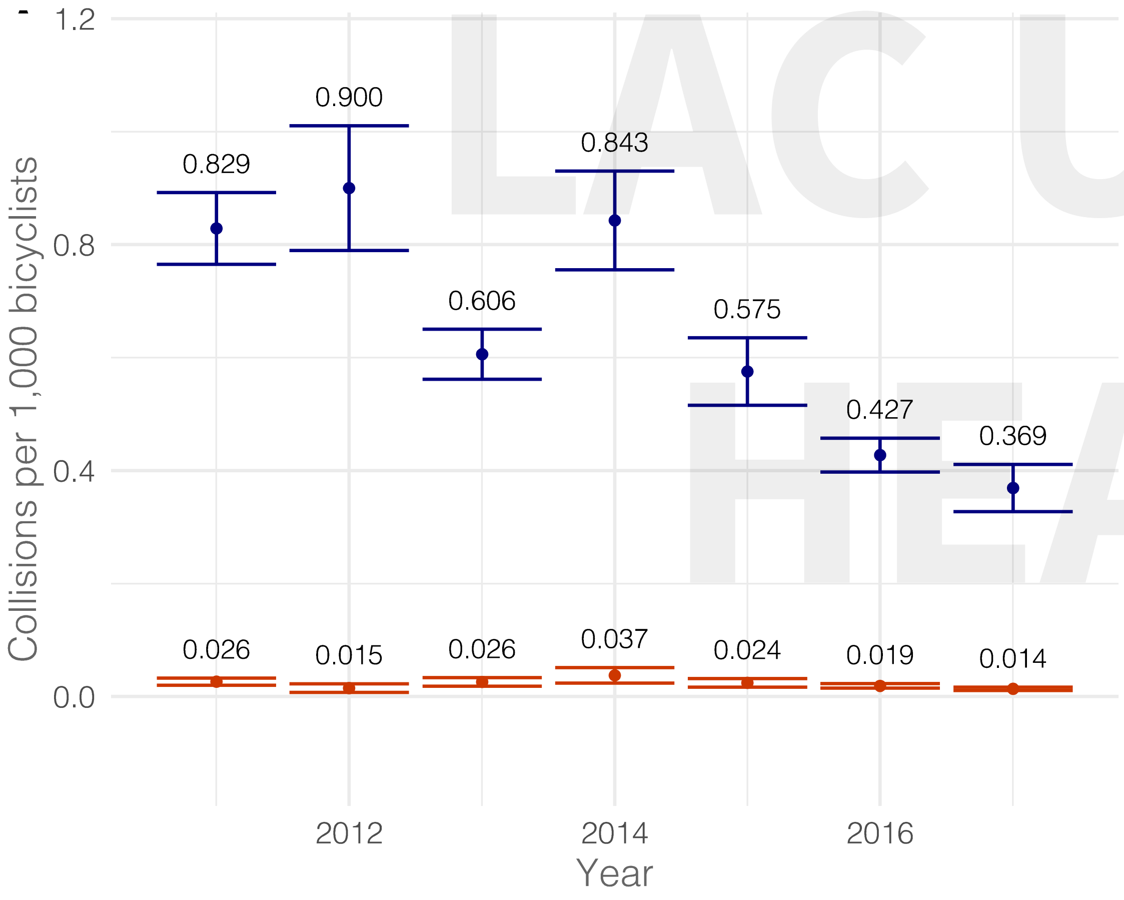
Daily trips

Estimation by interpolation

Daily Vehicle Kilometers traveled (VKmT)

RESULTS: COLLISION RATE TRENDS

Yearly averages of fatal and nonfatal bicyclist collisions

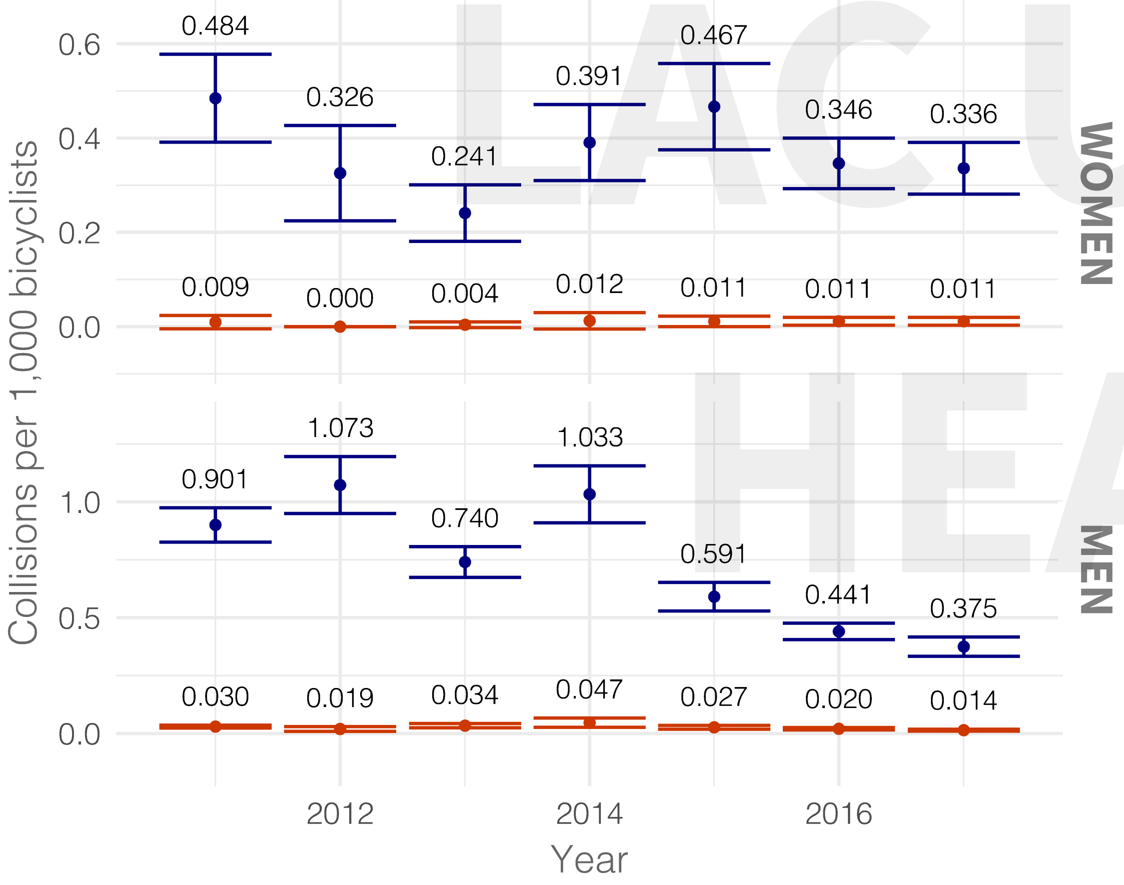


Rates standardized per bicyclists' population

- 55% reduction in **nonfatal** collision rates
- 46% reduction in **fatal** collision rates

RESULTS: COLLISION RATE TRENDS

Yearly averages of fatal and nonfatal bicyclist collisions



Rates standardized per bicyclists' population: Women

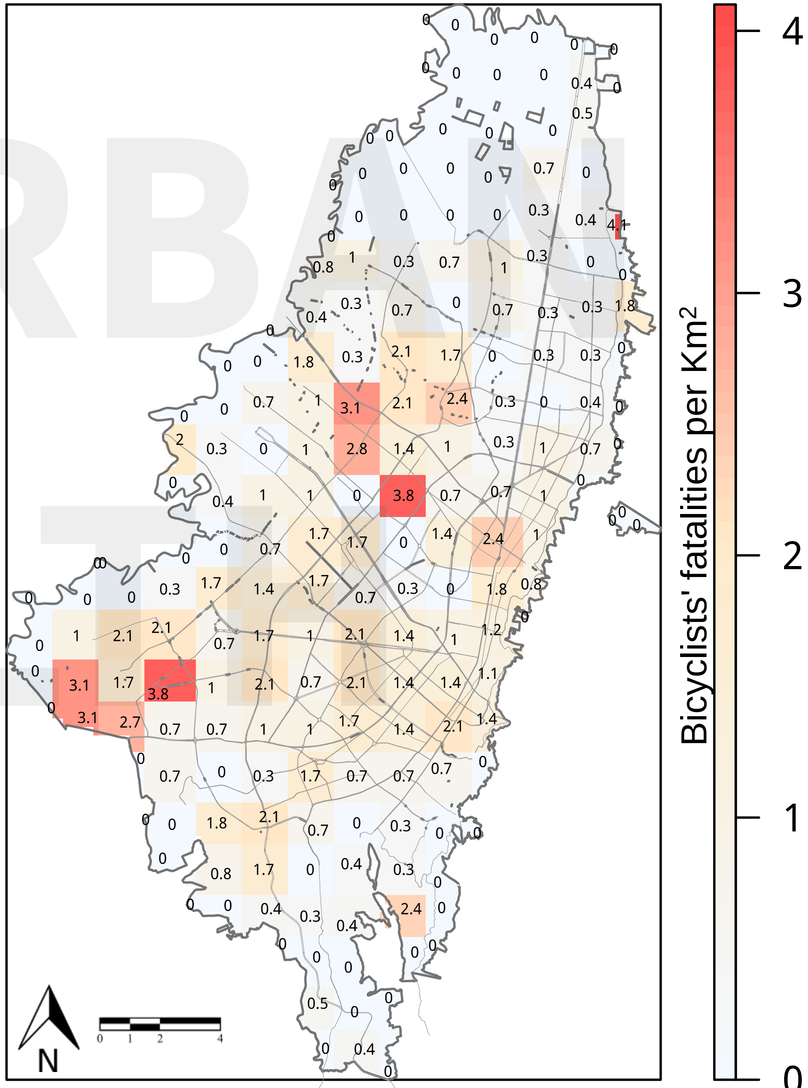
- 30% reduction in **nonfatal** collision rates
- no reduction in **fatal** collision rates

Rates standardized per bicyclists' population: Men

- 58% reduction in **nonfatal** collision rates
- 53% reduction in **fatal** collision rates

HIGHER RISK GEOGRAPHICAL AREAS

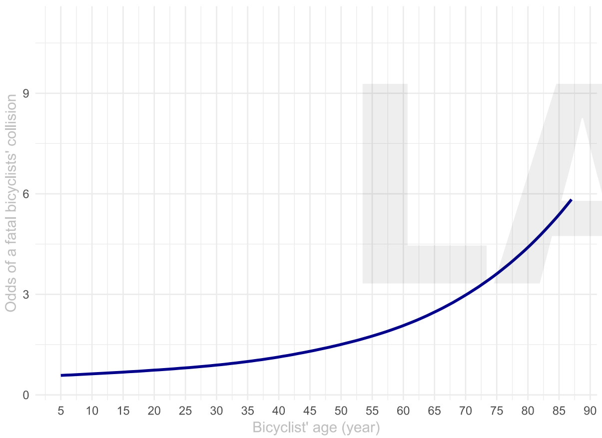
Income level	Neighborhood	Fatalities per km²
Low	Casablanca / Kennedy	3.8
	León XII / Bosa	3.1
	Santa Rita / San Cristobal	2.4
Middle	Calle 68 with Avenida Boyacá / Engativá	3.8
	Autopista Medellín with Avenida Ciudad de Cali / Engativa	3.1
	San Felipe / Barrios Unidos	2.4
High	Calle 127 with Avenida Boyacá / Usaquen	2.5



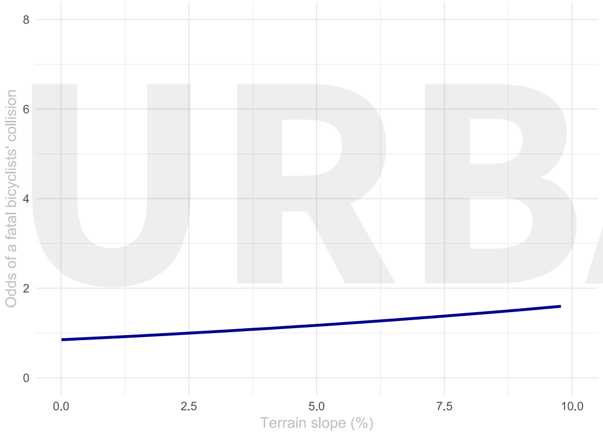
Fatal collision quadrat analysis with a grid of 1 by 1.2 Km squares.

FACTORS ASSOCIATED WITH HIGHER RISK OF BICYCLIST FATALITIES

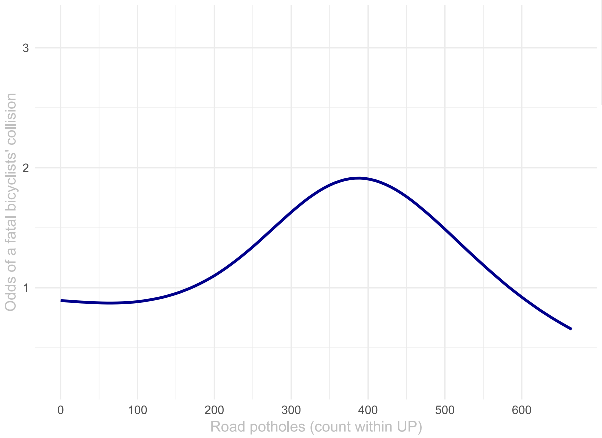
BICYCLIST'S AGE (YEARS)



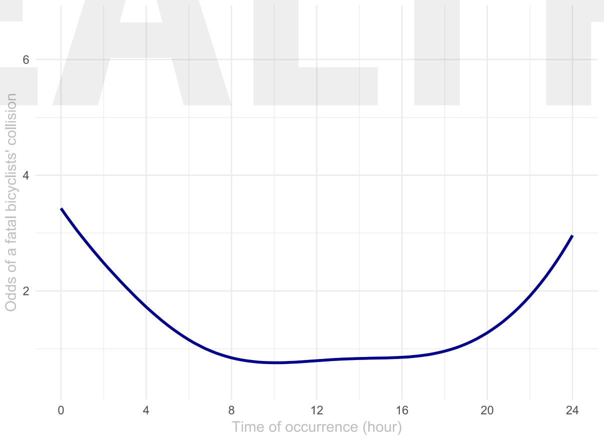
TERRAIN SLOPE (%)



ROAD SURFACE FAILURES



TIME (HOUR)

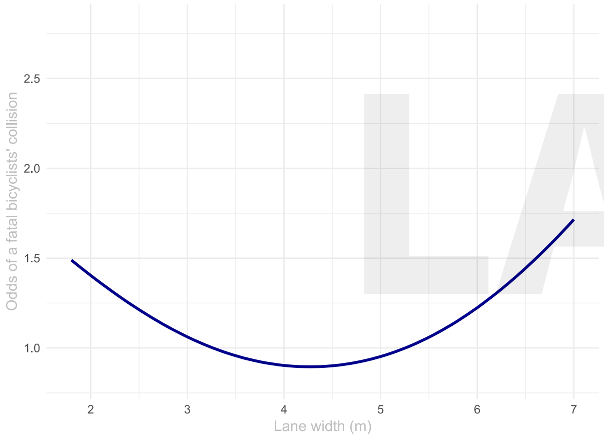


Higher risk:

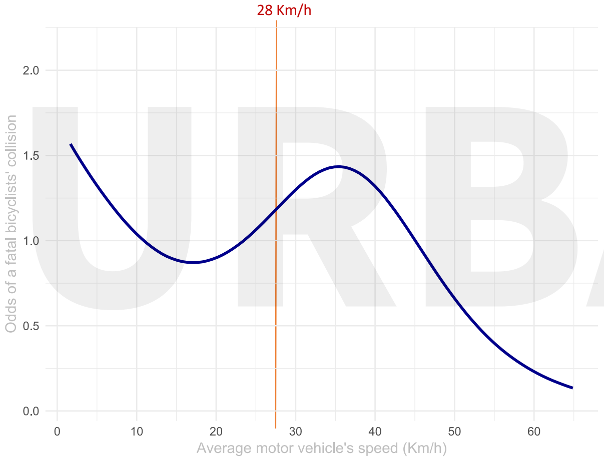
- Higher age of cyclist (over 40 years)
- Higher terrain slope (steeper roads over 3%)
- Moderate to bad road surface conditions
- Collisions that occur during nighttime

FACTORS ASSOCIATED WITH LOWER RISK OF BICYCLIST FATALITIES

LANE WIDTH (M)



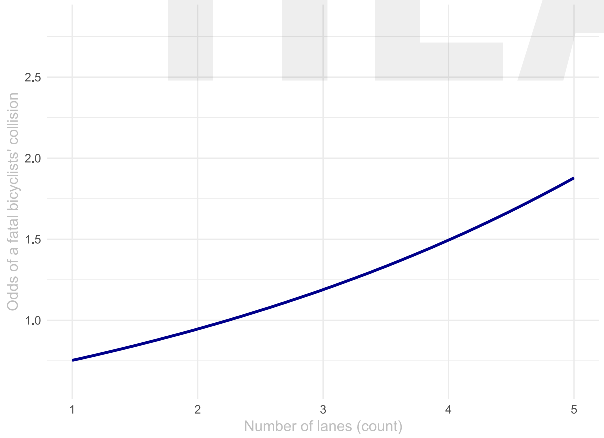
AVERAGE SPEED (KM/H)



Safer infrastructure:

- Medium size lane widths
- Reduced average vehicle speed
- Narrow roads

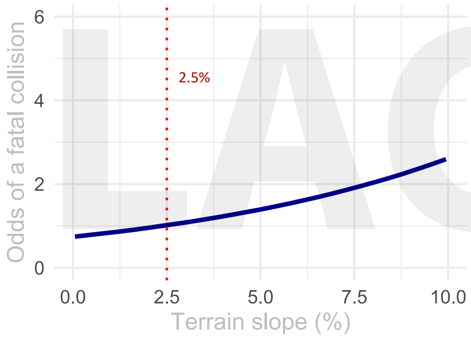
NUMBER OF LANES (COUNT)



FACTORS ASSOCIATED WITH RISK OF FATALITY: SEX DIFFERENCES

WOMEN

Terrain slope (%)

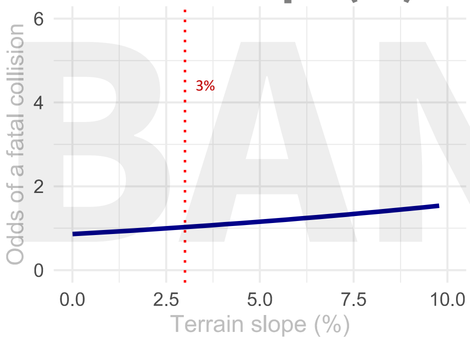


Vehicle type

Automobile	=	1
TransMilenio	?	-
Cargo vehicle	↑	43.1
Bus	↑	11.9
Motorcycle	=	1
Other	↑	9.5

MAN

Terrain slope (%)



Vehicle type

Automobile	=	1
TransMilenio	↑	6.6
Cargo vehicle	↑	8.9
Bus	↓	2.5
Motorcycle	↓	0.5
Other	↓	1.7

FACTORS ASSOCIATED: DEDICATED BICYLE INFRAESTRUCTURE

PRESENCE OF A BICYCLE PATHWAY

80% reduction in the probability of a fatal collision compared to roads with no presence of a bicycle pathway

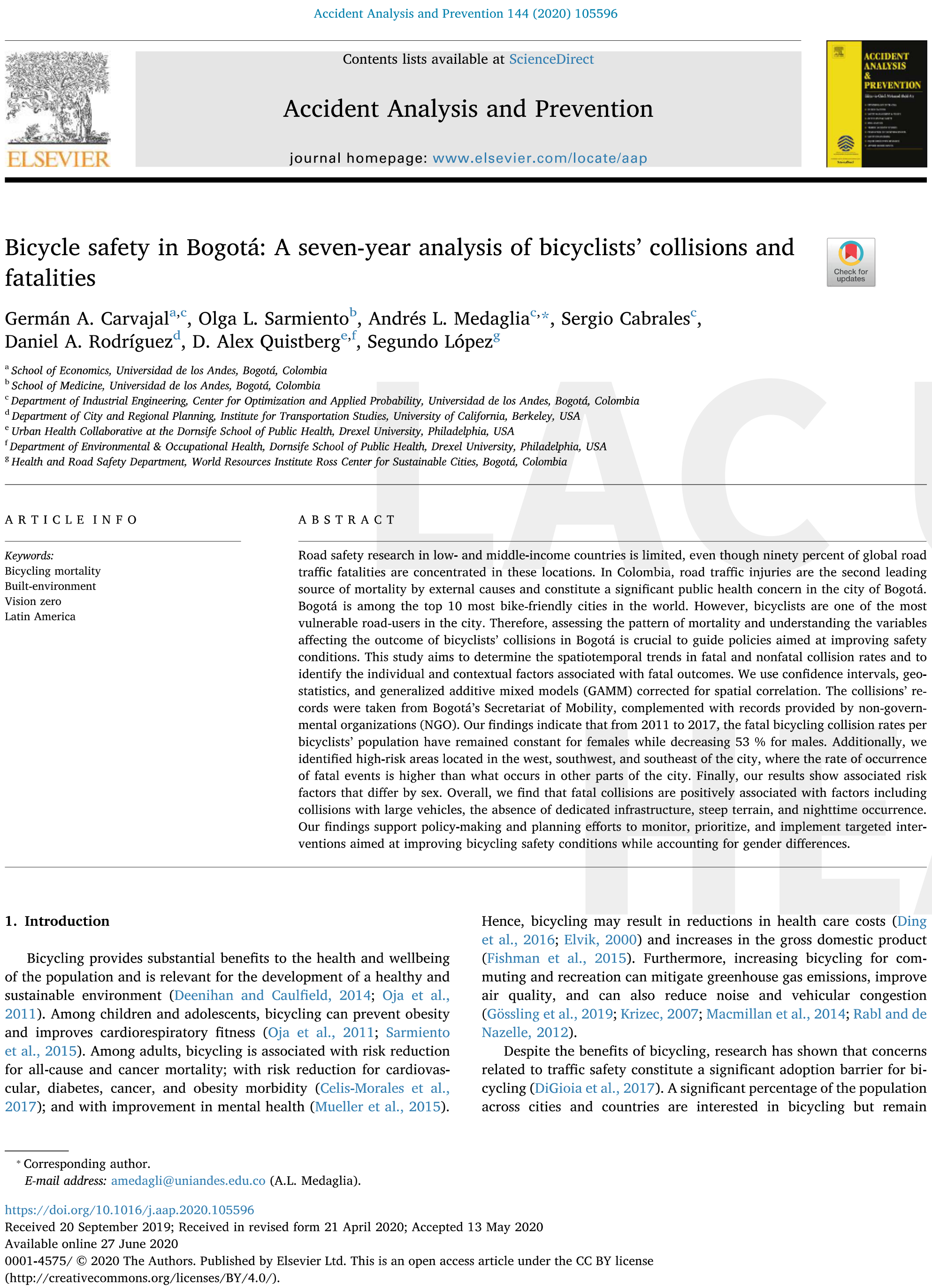
CONCLUSIONS AND POLICY RECOMMENDATIONS

- ✓ Bicycling collision rates have **decreased during the 7-year period**. Reductions **differ by sex**: no reduction in the fatal collision rates for women
- ✓ Identified higher risk areas along main corridors and locations with inadequate infrastructure
- ✓ Identified factors associated with fatal collisions. The factors and their effects **differ by sex**
- ✓ Recommendations:
  - Continue building and enhancing safe bicycle infrastructure
  - Separate infrastructure bicyclists from large vehicles
  - Continue law enforcement of reduced speed limits
  - Prioritize geographical areas that could be intervened in the city
  - Design a public policy guideline with a **gender and equality focus**


[1]

- ✓ Efficient open-data methodology for monitoring end evaluating bicycle safety conditions could be a potential tool for monitoring and being applied in **other Latin American cities**

1 Policy by Yogesh More from the Noun Project



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Bicycle safety in Bogotá: A seven-year analysis of bicyclists' collisions and fatalities

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ABSTRACT

Road safety research in low- and middle-income countries is limited, even though ninety percent of global road traffic fatalities are concentrated in these locations. In Colombia, road traffic injuries are the second leading source of mortality by external causes and constitute a significant public health concern in the city of Bogotá. Bogotá is among the top 10 most bike-friendly cities in the world. However, bicyclists are one of the most vulnerable road-users in the city. Therefore, assessing the pattern of mortality and understanding the variables affecting the outcome of bicyclists' collisions in Bogotá is crucial to guide policies aimed at improving safety conditions. This study aims to determine the spatiotemporal trends in fatal and nonfatal collision rates and to identify the individual and contextual factors associated with fatal outcomes. We use confidence intervals, geostatistics, and generalized additive mixed models (GAMM) corrected for spatial correlation. The collisions' records were taken from Bogotá's Secretariat of Mobility, complemented with records provided by non-governmental organizations (NGO). Our findings indicate that from 2011 to 2017, the fatal bicycling collision rates per bicyclists' population have remained constant for females while decreasing 53 % for males. Additionally, we identified high-risk areas located in the west, southwest, and southeast of the city, where the rate of occurrence of fatal events is higher than what occurs in other parts of the city. Finally, our results show associated risk factors that differ by sex. Overall, we find that fatal collisions are positively associated with factors including collisions with large vehicles, the absence of dedicated infrastructure, steep terrain, and nighttime occurrence. Our findings support policy-making and planning efforts to monitor, prioritize, and implement targeted interventions aimed at improving bicycling safety conditions while accounting for gender differences.

1. Introduction

Bicycling provides substantial benefits to the health and wellbeing of the population and is relevant for the development of a healthy and sustainable environment (Deenihan and Caulfield, 2014; Oja et al., 2011). Among children and adolescents, bicycling can prevent obesity and improves cardiorespiratory fitness (Oja et al., 2011; Sarmiento et al., 2015). Among adults, bicycling is associated with risk reduction for all-cause and cancer mortality; with risk reduction for cardiovascular, diabetes, cancer, and obesity morbidity (Celis-Morales et al., 2017); and with improvement in mental health (Mueller et al., 2015). Hence, bicycling may result in reductions in health care costs (Ding et al., 2016; Elvik, 2000) and increases in the gross domestic product (Fishman et al., 2015). Furthermore, increasing bicycling for commuting and recreation can mitigate greenhouse gas emissions, improve air quality, and can also reduce noise and vehicular congestion (Gössling et al., 2019; Krizec, 2007; Macmillan et al., 2014; Rabl and de Nazelle, 2012).

Despite the benefits of bicycling, research has shown that concerns related to traffic safety constitute a significant adoption barrier for bicycling (DiGioia et al., 2017). A significant percentage of the population across cities and countries are interested in bicycling but remain

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