WELCOME

AIR POLLUTION AND HEALTH IN LATIN AMERICAN CITIES

WEBINAR

SEPTEMBER 9, 2020
11:00 AM ET
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LAC URBAN HEALTH WEBINAR SERIES
THE SALURBAL PROJECT

Salud Urbana en América Latina – Urban Health in Latin America

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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
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.

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<thead>
<tr>
<th>Health</th>
<th>Built Environments</th>
<th>Social Equity</th>
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<td>Deaths and causes of death</td>
<td>Land use and urban form</td>
<td>Poverty</td>
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<td>Life expectancy</td>
<td>Transit options</td>
<td>Income inequality</td>
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<td>Health risk factors</td>
<td>Traffic congestion</td>
<td>Housing conditions</td>
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<td>Violence</td>
<td>Walkability</td>
<td>Employment</td>
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<td>Green space</td>
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<td>Housing</td>
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- Air pollution
- Land use and urban form
- Transit options
- Traffic congestion
- Water and sanitation
- Housing

- Poverty
- Income inequality
- Housing conditions
- Education
- Employment

[Diagram showing neighborhood, sub-city, and city relationships]
WEBINAR SPEAKERS

DR. NELSON GOUGEIA
Levels of air pollution and urban environment characteristics linked to higher levels of pollution in Latin American cities

DR. ANA ORTIGOZA
Air pollution and infant and child mortality in Latin American cities

DR. JOSIAH KEPHART
COVID-19, air pollution, and environmental health inequities in Latin American cities
AIR POLLUTION (PM2.5) IN LATIN AMERICAN CITIES: LEVELS, POPULATION EXPOSURE, INEQUALITIES, AND ASSOCIATED CITY CHARACTERISTICS

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University of São Paulo Medical School

One important type of air pollution is **particulate matter (PM)**, some smaller than 2.5 micrometers in width, which can go deep into the lungs when breathed in.

Sources of particulate matter air pollution:
HOW DOES AIR POLLUTION AFFECT THE HUMAN BODY?

Breathing in air pollution can impact many organ systems:

- Brain, eyes, throat
- Lungs
- Heart
- Skin
- Liver
- Reproductive systems
The World Health Organizations recommend that air pollution levels be maintained below a certain threshold to prevent negative health outcomes:

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Maximum number of micrograms of pollutant per cubic meter of air on average during the course of 1 year</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM$_{2.5}$</td>
<td>10 micrograms per m$^3$</td>
</tr>
</tbody>
</table>
UNHEALTHY LEVELS OF AIR POLLUTION

GLOBALLY
9 out of 10 people
4.2 million deaths

LATIN AMERICA
Over 110 million people
58,000 deaths
SALURBAL’S RESEARCH QUESTIONS: AIR POLLUTION IN LATIN AMERICAN CITIES

• What are the levels of air pollution in Latin American cities?

• Are air pollution levels in Latin American cities meeting the WHO’s air quality guidelines?

• Are characteristics of cities linked to their air pollution levels?
AIR POLLUTION DATA FROM SATELLITE READINGS (2015)

Blue dots show satellite readings of air pollution for 1km x 1km areas in São Paulo.
LEVELS OF PM2.5 IN LATIN AMERICAN CITIES IN 2015

- Each dot represents one sub-city.
- Air pollution levels vary greatly across different cities within each country, and across countries.
- Almost 40% of cities and 55% of sub-cities experience air pollution levels above the WHO’s air quality guideline of 10 micrograms per cubic meter of air.
AIR POLLUTION EXPOSURE

Exposed to unhealthy levels of air pollution:

- 38.5% of cities
- 55% of sub-cities
- 171.1 million people total
- 12.3 million children ages under 5 years of age
- 14.1 million adults over age 65

<table>
<thead>
<tr>
<th>Country</th>
<th>Proportion of urban population exposed to unhealthy levels of air pollution</th>
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<tbody>
<tr>
<td>Argentina</td>
<td>71% (21,227,417 people)</td>
</tr>
<tr>
<td>Brazil</td>
<td>53% (62,236,144 people)</td>
</tr>
<tr>
<td>Central America</td>
<td>10% (1,139,304 people)</td>
</tr>
<tr>
<td>Chile</td>
<td>86% (10,968,452 people)</td>
</tr>
<tr>
<td>Colombia</td>
<td>38% (10,965,939 people)</td>
</tr>
<tr>
<td>Mexico</td>
<td>67% (51,444,741 people)</td>
</tr>
<tr>
<td>Peru</td>
<td>74% (13,160,574 people)</td>
</tr>
</tbody>
</table>
INEQUITIES IN AIR POLLUTION EXPOSURE

• No difference by gender
• No difference by socioeconomic status
• In Argentina, Brazil, Chile, Mexico, and Peru: the elderly are more exposed to unhealthy levels of air pollution
• In Colombia and Central America, the younger population is more exposed to unhealthy levels of air pollution
CITY CHARACTERISTICS AND AIR POLLUTION LEVELS

- Larger cities
- Higher per capita gross domestic product
- Higher motorization rate
- Higher traffic congestion
- Higher street intersection density

HIGHER POLLUTION

- Higher population density
- More green space
- Presence of mass transit

LOWER POLLUTION
POLICY IMPLICATIONS: WHAT CAN CITIES DO?

- **Green spaces**
  - Urban gardens
  - Tree lines
  - Superblocks

- **Traffic congestion**
  - Unique lanes for public transport
  - Bike lanes
  - Pedestrian paths
  - Street improvements

- **Mass Transit**
  - Network expansion
  - Accessible & affordable public transportation
  - Public safety

- Better air quality monitoring
- Environmental protection policies at national levels
EFFECT OF AIR POLLUTION ON UNDER-5 MORTALITY IN LATIN AMERICAN CITIES

Ana Ortigoza
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Twitter: @AnaOrtigoza14
WHY IS THIS IMPORTANT IN LATIN AMERICA?

- Almost 10% of the population in Latin America is under five years of age.
- More than 80% of Latin Americans live in cities, where air pollution levels are among the highest in the world.
- Limited evidence on the effect of air pollution on infant and child health in the region, especially in small and medium-sized cities.
CHILDREN ARE MORE VULNERABLE TO AIR POLLUTION

- Immature airways and lungs
- Immature kidneys and liver, less ability to filter toxins
- High breathe rate
- Mouth breathing
- Lots of time outside
Are increases in air pollution (PM2.5) over time linked with mortality among children under 5 years of age?

Is this association different for infants (less than one year) compared to young children (1-4 years)?

What are the potential actions at the local level that could be motivated by our research findings?
TECHNICAL NOTES

Setting

- 337 cities in Argentina, Brazil, Chile, Colombia, Costa Rica, Guatemala, and Mexico
- 1,152 sub-city units in these cities
- Study period 2010-2015

Air pollution exposure

- Average annual levels of air pollution (micrograms of PM2.5 per cubic meter of air) for each sub-city unit

Outcomes

- **Under 5** mortality rate: Number of deaths before the fifth year of life for every 1,000 live births
- **Infant** mortality rate: Number of deaths during the first year of life for every 1,000 live births
- **Child** mortality rate: Number of deaths of children between 1-4 years of age per 10,000 children in that age group
INCREASES IN AIR POLLUTION OVER TIME ARE ASSOCIATED WITH INCREASES IN UNDER-5 AND INFANT MORTALITY IN LATIN AMERICAN CITIES

Each increase in 1 μgr/m3 in PM2.5 is linked to:

- 0.3% increase in under-5 mortality rate
- 0.4% increase in infant mortality rate
If cities with the lowest levels of air pollution in our sample (4.5 μg/m$^3$) became similar to those at the highest levels (24.0 μg/m$^3$) we would observe

**Under-five mortality**

- ~ 6% increase in U5MR
- 9.4 additional deaths per 1,000 live births to the mean U5MR (15.7 deaths/1,000 live births)

**Infant mortality**

- ~ 8% increase in IMR
- 10.8 additional death per 1,000 live births to the mean IMR (13.6 deaths/1,000 live births)

Note: 4.5 μg/m$^3$ corresponds to the 5th percentile and 24 μg/m$^3$ corresponds to the 95th percentile of sub-city level exposure that we observed
THESE ASSOCIATIONS OVER TIME ARE INDEPENDENT OF THESE OTHER URBAN CHARACTERISTICS

- **Population size and growth**
  - City population size 2010-2015

- **Housing and living conditions**
  - % households with piped water in the house
  - % of households with overcrowding conditions (3+/room)
  - % population 15-17 age attending school

- **Service provision**
  - % of households with water connected to municipal network
  - % of households with sewage system connected to municipal network

- **Population education**
  - % population 25+ ≥ high school level
  - % population 25+ ≥ university level

- **Mass transit availability**
  - Presence of either subway or bus rapid transit (BRT) networks

- **GDP per capita**
  - Yearly Gross Domestic Product per capita for each city
CONCLUSIONS

Increases in air pollution (PM2.5) are associated with increased under-5 mortality

Infant population most vulnerable to effects of PM2.5 exposure

Urban interventions along with environmental protection and air quality policies are key to reduce preventable deaths among infants and children
COVID-19 AND AIR POLLUTION IN LATIN AMERICAN CITIES

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Twitter: @JLASHK
Post-Doctoral Research Fellow, SALURBAL
LATIN AMERICA IS THE GLOBAL EPICENTER OF COVID-19

Share of population with confirmed COVID-19 case

- 7 of the top 20 countries with highest % of the population with a confirmed COVID-19 case are in Latin America and the Caribbean
- Within last 7 days, 10 of top 20 countries are in Latin American and the Caribbean


COVID-19 RESTRICTIONS HAVE LED TO SHARP TRAFFIC REDUCTIONS

Many countries and cities in Latin America have implemented “lockdowns” and/or stay-at-home orders to slow the spread of COVID-19.

Reductions in traffic congestion in four Latin American cities, compared to pre-lockdown levels

[Graph showing traffic reductions in four Latin American cities: Ciudad de México, Lima, Santiago, and São Paulo over time.]

AIR POLLUTION HAS DROPPED DURING COVID-19 RESTRICTIONS

LIMA, PERU

MEXICO CITY

SANTIAGO, CHILE

SÃO PAULO, BRAZIL

WE COMPARED AIR POLLUTION* LEVELS DURING COVID-19 LOCKDOWNS WITH PREVIOUS YEARS

*PM$_{2.5}$
SOME CITIES HAD MAJOR REDUCTIONS IN AIR POLLUTION COMPARED TO PREVIOUS YEARS, WHICH BROUGHT LEVELS MUCH CLOSER TO GUIDELINES
WHY DOES THIS MATTER?

• Pervasive pessimism about reducing air pollution
  • “Nothing we can do about climate, geography, etc.”
• COVID-19 lockdown reductions are unintended
• Long-term goal is efficient, targeted policies that reduce air pollution while:
  • Prioritizing equity
  • Limiting economic cost
• Are real-life air pollution reductions in 2020 enough to impact public health?
HYPOTHETICAL SCENARIO: AIR POLLUTION IS REDUCED LONG-TERM

• How would deaths in each city change if current reductions of a major air pollutant (PM$_{2.5}$) were maintained long-term?

• Assuming...
  • No changes in other air pollutants (outdoor or indoor)
  • Only looking at adults aged 30+ years
  • Deaths from any cause
REDDUCING AIR POLLUTION COULD LEAD TO LARGE REDUCTIONS IN DEATH

Air pollution reductions during COVID-19

<table>
<thead>
<tr>
<th>City</th>
<th>Change in death rate per year</th>
<th>Fewer deaths per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lima</td>
<td>↓ 41%</td>
<td>↓ 7%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>↓ 2,522</td>
</tr>
<tr>
<td>Mexico City</td>
<td>↓ 5%</td>
<td>↓ 0.6%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>↓ 730</td>
</tr>
<tr>
<td>Santiago</td>
<td>↓ 21%</td>
<td>↓ 3%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>↓ 930</td>
</tr>
<tr>
<td>Sao Paulo</td>
<td>↓ 31%</td>
<td>↓ 3%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>↓ 3,573</td>
</tr>
</tbody>
</table>
CRUCIAL OPPORTUNITY TO RETHINK LONG-TERM AIR POLLUTION

• Current levels of ambient air pollution cause 145,000 non-Covid-19 deaths in Latin America and the Caribbean every year

• May get worse with a return to car-based transit

• Covid-19 reopening: critical opportunity for policies and structural changes which reduce air pollution, prevent chronic diseases, and promote health equity

https://upload.wikimedia.org/wikipedia/commons/4/4f/Guatemala_City_%28663%29.jpg
Q&A
LEARN MORE AND CONTACT US

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