Conducting air pollution and health studies in Colombia: Experience with local and global collaborations

HEI Annual Conference 2023 Panel
“Exploring the Link Between Air Pollution and Health in High Pollution Environments: Insights from Recent Research Studies”

Laura Andrea Rodríguez, MD, PhD
Department of Public Health - School of Medicine
Universidad Industrial de Santander
Bucaramanga, Colombia

Boston, May 2 2023
Outline

- Overview of the research work on air pollution and health in Colombia
- Key findings and policy applications
- From local to international collaborations
- Challenges, opportunities and lessons learnt
- Expectations and future work
Overview of the research work on air pollution and health in Colombia

- **First local studies**
  - Air quality surveillance system
  - Year range: 1993-2005

- **Multi-city studies on short-term effects**
  - Morbidity

- **Long-term effect studies**
  - Year ranges: 2015-2020, 2020-

- **Local studies on short-term effects**
  - Mortality, Symptoms

- **Health effects other than circulatory and respiratory outcomes**

From local to national and international collaborations
Contents

✓ Overview of the research work on air pollution and health in Colombia

✓ Key findings and policy applications

✓ From local to international collaborations

✓ Challenges, opportunities and lessons learnt

✓ Expectations and future work
Local studies in cities

Effect of particulate matter less than 10μm (PM$_{10}$) on mortality in Bogota, Colombia: a time-series analysis, 1998-2006

Supported by researchers from HEI-ESCALA Study

Contaminación por material particulado (PM$_{2.5}$ y PM$_{10}$) y consultas por enfermedades respiratorias en Medellín (2008-2009)
Particulate air pollution (PM$_{2.5}$ and PM$_{10}$) and medical consultations due to respiratory disease in Medellín (2008-2009)

Factores de riesgo para enfermedad respiratoria en población de 5 a 14 años de una Localidad de Bogotá, 2012-2013

Respiratory disease risk factors in the 5-14 year-old population in an area of Bogota, 2012-2013

Incidencia de síntomas respiratorios y su asociación con contaminación atmosférica en preescolares: un análisis multinivel
Incidence of respiratory symptoms and the association with air pollution in preschoolers: a multilevel analysis

Policy application: local evidence to inform national air quality standards (air quality regulation 2010 updated in 2017)
National studies on short-term effects

Ongoing:
Development of an Air Quality Health Index for Colombia

Short-term joint effects of ambient air pollutants on emergency department visits for respiratory and circulatory diseases in Colombia, 2011–2014

Laura Andrea Rodríguez-Villamizar, Néstor Yezid Rojas-Roa, Julián Alfredo Fernández-Niño

Policy application: regulation need to include mixture effects of pollutants: Air Quality Health Index development (IBOCA)
Lessons learnt for policy: reduction in vehicle emissions will help to achieve lower pollutant levels close to WHO guidelines.
Assessment of long-term effects on health

Laura A. Rodríguez
Yurley Rojas
Jhon J. Cáceres
Victor M. Herrera
Leandro López
Nestor Y. Rojas
Sonia C. Mangones
Luis C. Belalcázar
Dayana M. Agudelo

First program in environmental health research funded in Colombia

MINISTERIO DE CIENCIA, TECNOLOGÍA E INNOVACIÓN

Proyect “Air quality and urban environmental Health in five cities in Colombia”

Sara Grisales
Juan G. Piñeros
Diana Marín
Jonathan Ochoa
Oscar A. Rojas
Scott Weichenthal
Jill Baumgartner

Ligia Oviedo
Sanint Castillo
Margarita Castillo
Sec Salud Bga-Sder
Maria C. Vicini
Oscar M. Rojas
Leonor Montes
Gisela Arizabaleta
Wilson Salas
Enrique Henao
Verónica Lopera
Ana Z. Orrego
Katalina Medina
Hugo Sáenz
Luis Hernández

McGill
National studies on long-term effects

Application: To provide estimations of health benefits of reducing air pollution levels below current national standard.

Fig. 4 Avoidable mortality for all causes derived from estimations of annual surface PM$_{2.5}$ concentrations based on ACAG model by municipality, Colombia, 2014–2019 (a) for national standard of 25 µg/m$^3$ (b) for international interim target of 15 µg/m$^3$. 

[Image: Map of Colombia showing distribution of avoidable mortality by municipality, with color coding for PM$_{2.5}$ concentrations.]

[Source: Rodriguez-Vilariño et al., Environmental Health, DOI: 10.1186/s12940-019-0094-8]
### LUR models developed for cities

<table>
<thead>
<tr>
<th>City</th>
<th>LUR PM$_{2.5}$</th>
<th>LUR NO$_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>$R^2$</td>
</tr>
<tr>
<td>Barranquilla</td>
<td>20</td>
<td>0.73</td>
</tr>
<tr>
<td>Bucaramanga</td>
<td>20</td>
<td>0.77</td>
</tr>
<tr>
<td>Cali</td>
<td>17</td>
<td>0.70</td>
</tr>
<tr>
<td>Medellin</td>
<td>19</td>
<td>0.82</td>
</tr>
<tr>
<td>Bogotá</td>
<td>40</td>
<td>0.44</td>
</tr>
</tbody>
</table>

RMSE= Root mean square error

**Applications:** collaborative work government-academia, detailed spatial characterizations of pollutants to inform local actions, input for further exposure assessment in cohort studies.

**Diagram:** Maps of PM$_{2.5}$ and NO$_2$ concentration levels across selected cities, showing high and low areas.
Contents

✓ Overview of the research work on air pollution and health in Colombia
✓ Key findings and policy applications
✓ From local to international collaborations
✓ Challenges, opportunities and lessons learnt
✓ Expectations and future work
From local to national and international collaborations

US GEO Health Program NIH-Fogarty: GEOHealth Hub Colombia (2012-2015)

Environmental and occupational research and training needs: creation of national network

ARTÍCULO ORIGINAL

Environmental and occupational health research and training needs in Colombia: A Delphi study

Laura A. Rodríguez-Villamizar¹, Beatriz Elena González¹, Lina María Vera¹,
Jonathan Patz², Leonelo E. Bautista²

¹ Departamento de Salud Pública, Escuela de Medicina, Universidad Industrial de Santander, Bucaramanga, Colombia
² Department of Population Health Sciences, School of Medicine and Public Health, University of Wisconsin-Madison, Madison, WI, USA

www.nodosaocolombia.com
From local to national and international collaborations

Predicting Within-City Spatial Variations in Outdoor Ultrafine Particle and Black Carbon Concentrations in Bucaramanga, Colombia: A Hybrid Approach Using Open-Source Geographic Data and Digital Images

Association between air pollution and suicide: a time series analysis in four Colombian cities
Julián Alfredo Fernández-Niño, Claudia Iveth Astudillo-Garcia, Laura Andrea Rodríguez-Villamizar, and Vicente Alfonso Florez-García

Surface, satellite ozone variations in Northern South America during low anthropogenic emission conditions: a machine learning approach
Alejandro Casillas, Maria Paula Castillo-Camacho, Edwin Ricardo Sanchez, Yuri González, Nathalia Celis, Juan Felipe Mendez-Espinosa, Luis Carlos Belalcazar, and Camilo Ferro
From local to national and international collaborations

Funder:
IAEA: International Atomic Energy Agency

Results:
Characterization of key components of aerosols of the air pollution mixture in the Aburrá Valley (Medellín) and chemical speciation of PM$_{2.5}$ fractions with temporal resolution 2020-2022

Effects of sources such as dust, industry, diesel on PM$_{2.5}$ concentrations and variations over time including pandemic period

PI: Myriam Gómez
Closing the gap:

We have achieved important developments in air pollution and health research, but we are about 10 years behind HIC in terms of research and policy implementation.
Contents

✓ Overview of the research work on air pollution and health in Colombia

✓ Key findings and policy applications

✓ From local to international collaborations

✓ Challenges, opportunities and lessons learnt

✓ Expectations and future work
# Building evidence on air pollution and health in Colombia

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Data availability (limited air quality network) and open data access</td>
<td>• Local authorities working with academic groups for building local evidence</td>
</tr>
<tr>
<td>• Long-term effects exposure assessment</td>
<td>translated into policy</td>
</tr>
<tr>
<td>• Limited national funding for long-term cohort studies</td>
<td>• Building national research capacity through training</td>
</tr>
<tr>
<td>• Learning curve for accessing international funding</td>
<td>• Collaborations with international research groups</td>
</tr>
<tr>
<td>• Advancing in environmental justice and intervention studies</td>
<td>• Potential international funding for health research studies in LMIC</td>
</tr>
<tr>
<td>• Linking air pollution and climate change research</td>
<td></td>
</tr>
</tbody>
</table>
Contents

✓ Overview of the research work on air pollution and health in Colombia

✓ Key findings and policy applications

✓ From local to international collaborations

✓ Challenges, opportunities and lessons learnt

✓ Expectations and future work
Next steps

- Integrating national social, health and environmental data systems: Creating a national census-based cohort for environmental and occupational health analysis (CIHR proposal 2023)

- Research training in advanced methods: national training programs with international collaborations

- Evaluation of feasibility scenarios for decreasing air pollution levels

- Promoting environmental education and participation

- Align research and decision-making agenda

- Climate change + air pollution research

Increase international research collaborations aiming to close the gap
Questions

¡Thank you!

laurovi@uis.edu.co

@laurarovi1