



Winds of change: a  
mixed methods quasi-  
experimental evaluation  
of a transport  
intervention improving  
well-being

## The case of TransMiCable

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PIARC

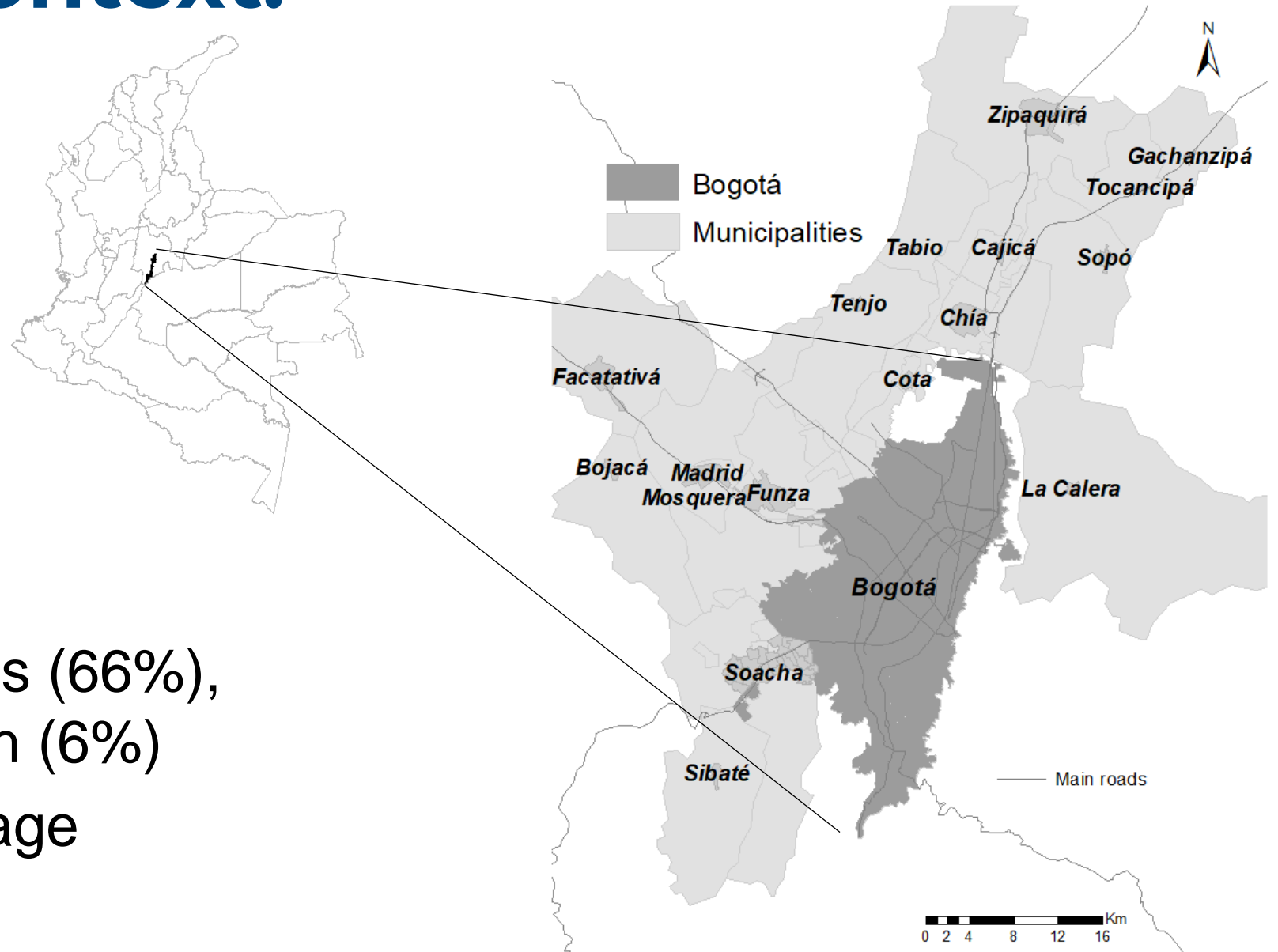
WORLD ROAD ASSOCIATION

May 16, 2023

# Bogotá's context:

Bogotá city (in 2018):

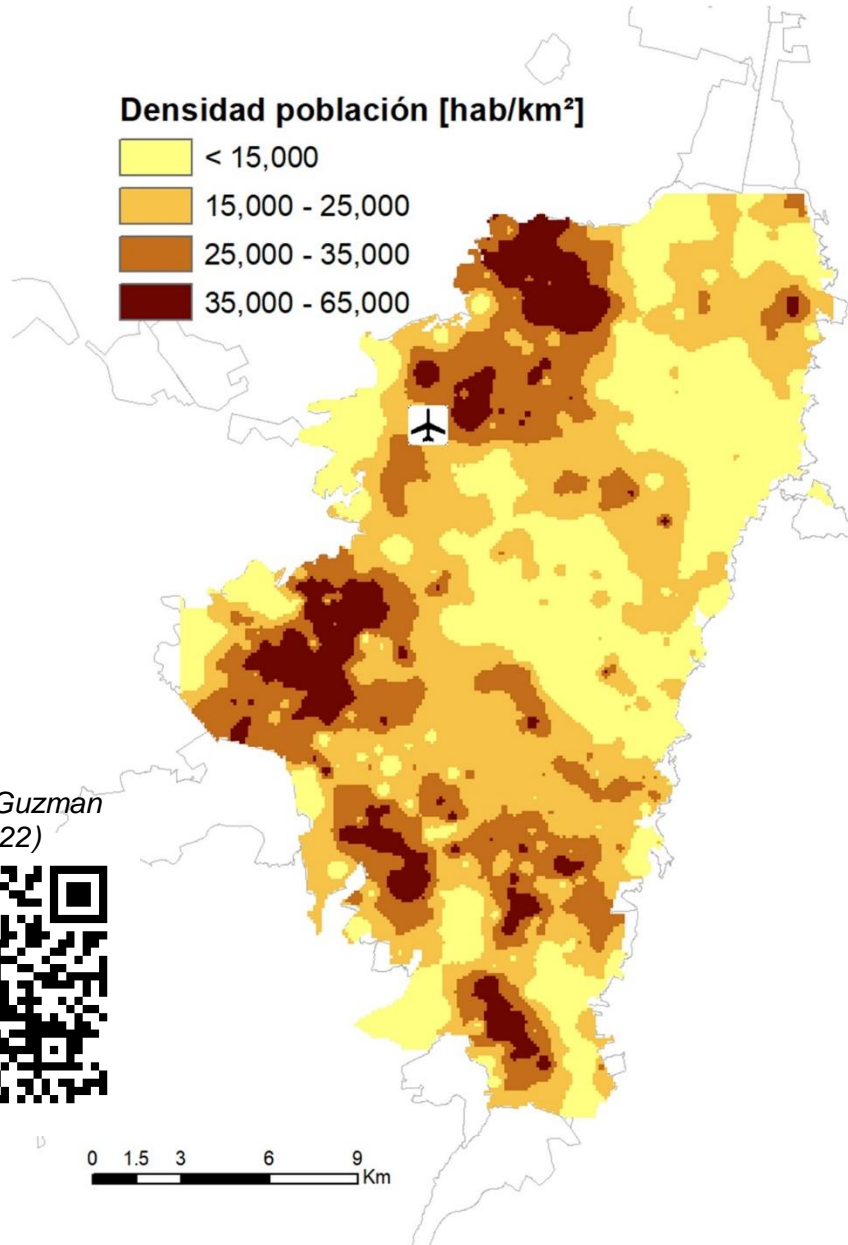
- 7.42 million people
- Low-income households (66%), medium (28%) and high (6%)
- 19,000 inh/km<sup>2</sup> in average





# Activities location:

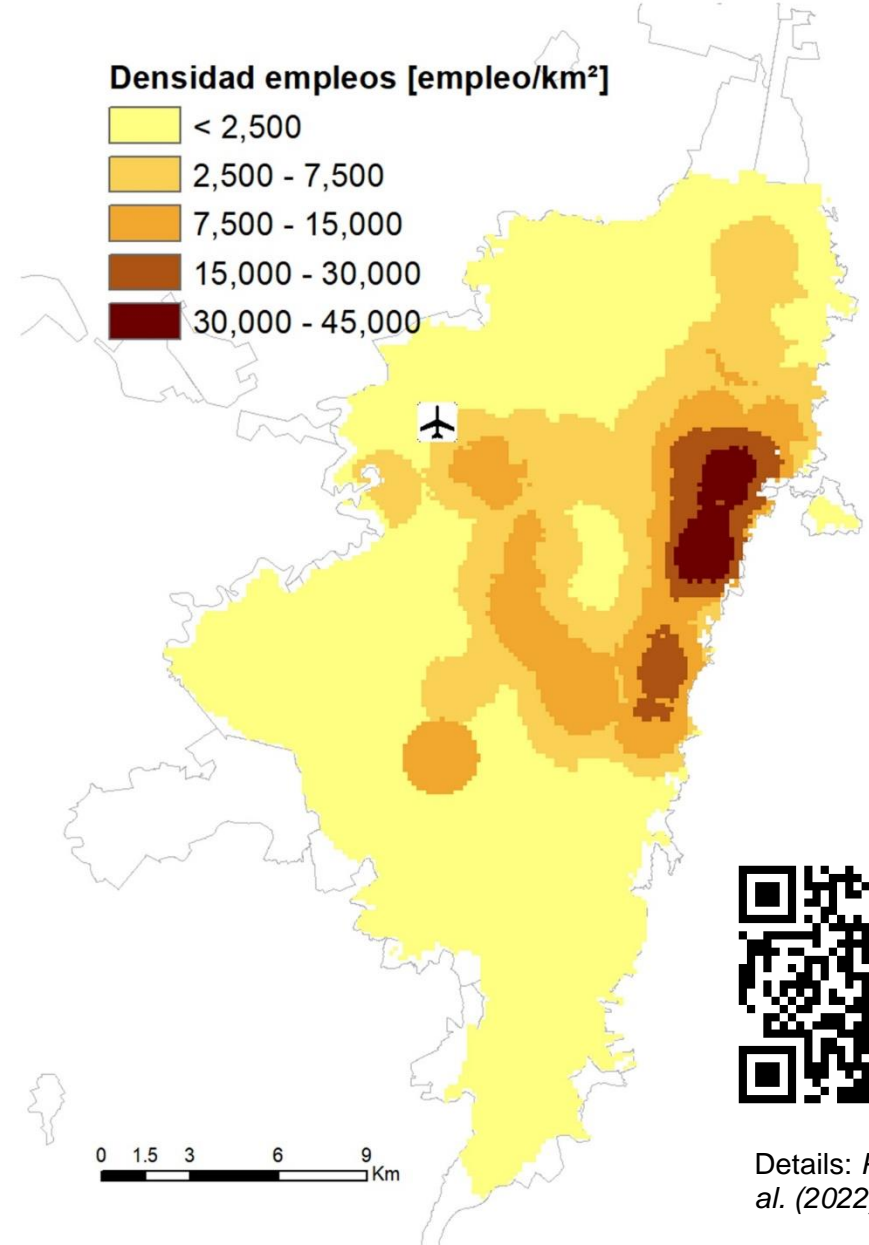
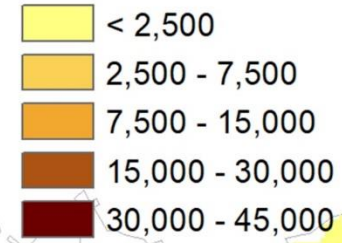
Densidad población [hab/km<sup>2</sup>]



Details: *Guzman et al. (2022)*



Densidad empleos [empleo/km<sup>2</sup>]



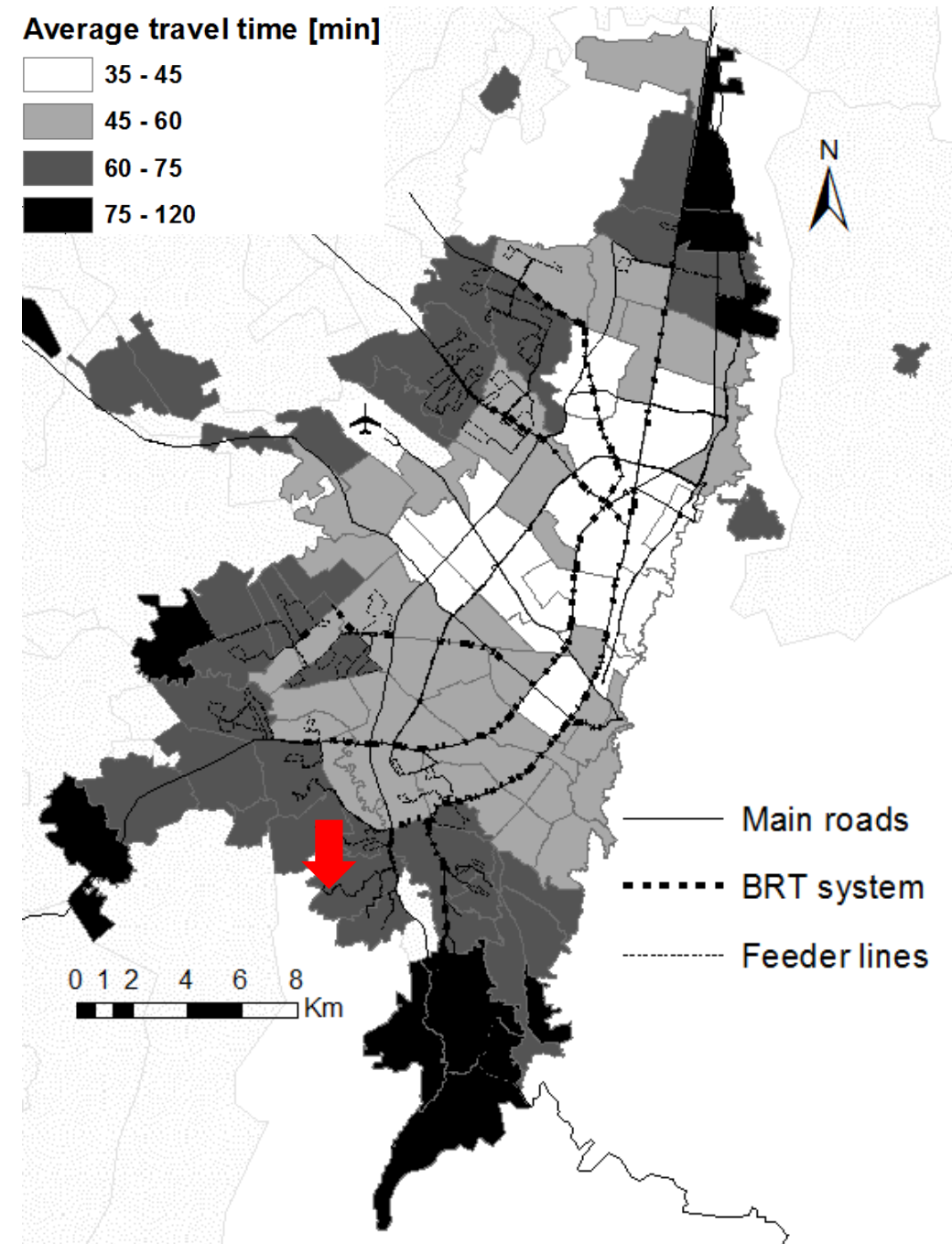
Details: *Peña et al. (2022)*



# Mobility:

**The richest people make about 76% more trips to work than the poorest.**

**And travel faster...**





# The project area

Ciudad Bolívar. UPZ El Lucero 155,380 inh, 28% workers and 43% students. 41,890 HH. 0.07 car/HH. Average HH income US\$380. Trips/inh: 2.05/day. Modal share: car/moto 4%, PT 37%, walk/bike 58%. Average travel time: 80 min (14 min active transport).





# The project area





# The project area





# The project area





# The project area





# The project area





# The project area







# TransMiCable

Inauguration  
**December  
2018**



**4**

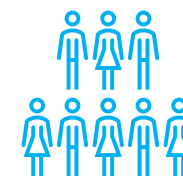
Stations

**3.43 km**  
Length

**163**  
Booths



Passengers/day  
**27,000**



Passengers' 1<sup>st</sup>  
year (2019)  
**7,501,250**

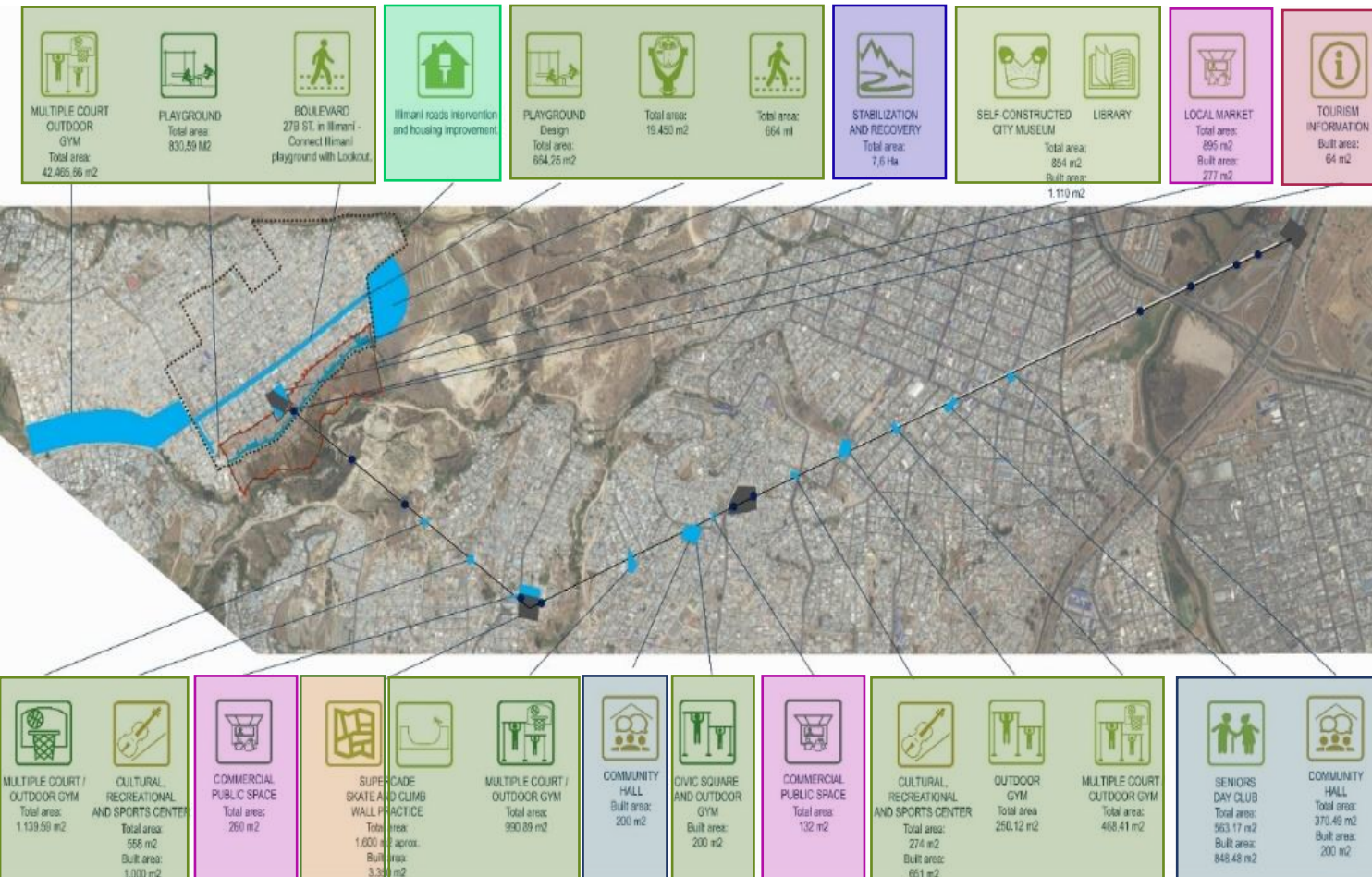


Passengers/day  
-pandemic  
**15,000-25,000**



# Social urbanism

16 urban projects



Local markets



Program to support physical improvements to homes



Project to reduce geomorphological hazards



Community centers



Citizen service office (Super CADE)



Facilities for recreation and cultural activities



Tourism Office



# Aims

To assess the effects of TransMiCable's implementation on:



**Environmental and social determinants of health**  
(transport, micro-environment pollution)



**Health outcomes**  
(health-related quality of life, victimization, homicides)



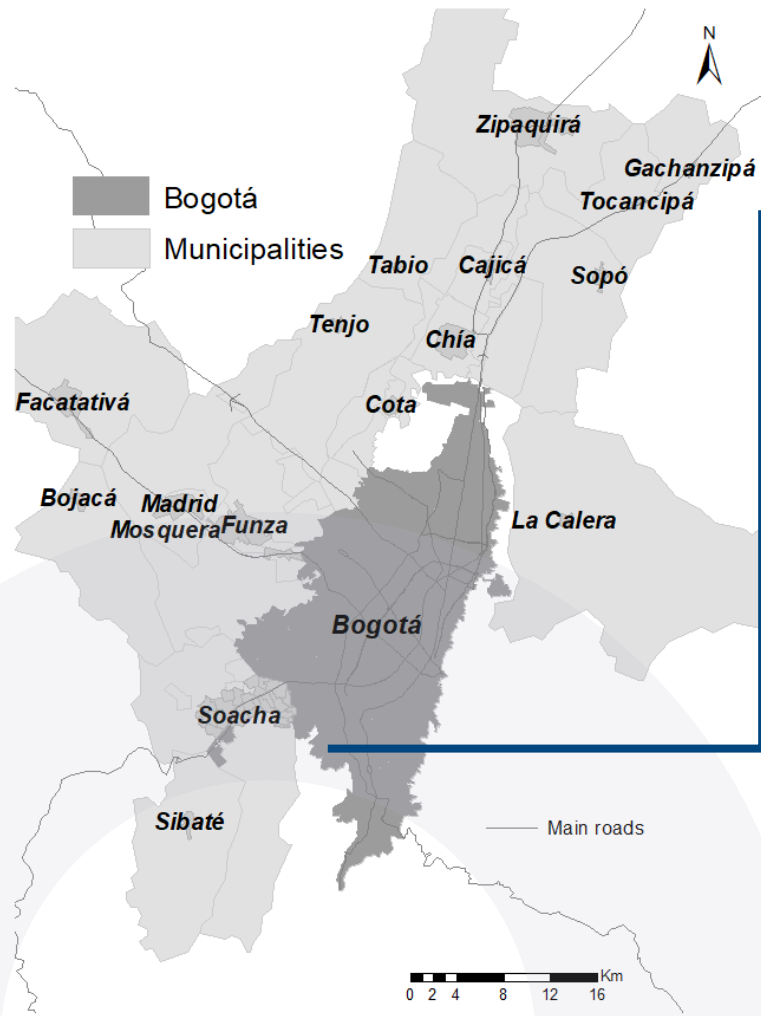
**Physical activity**



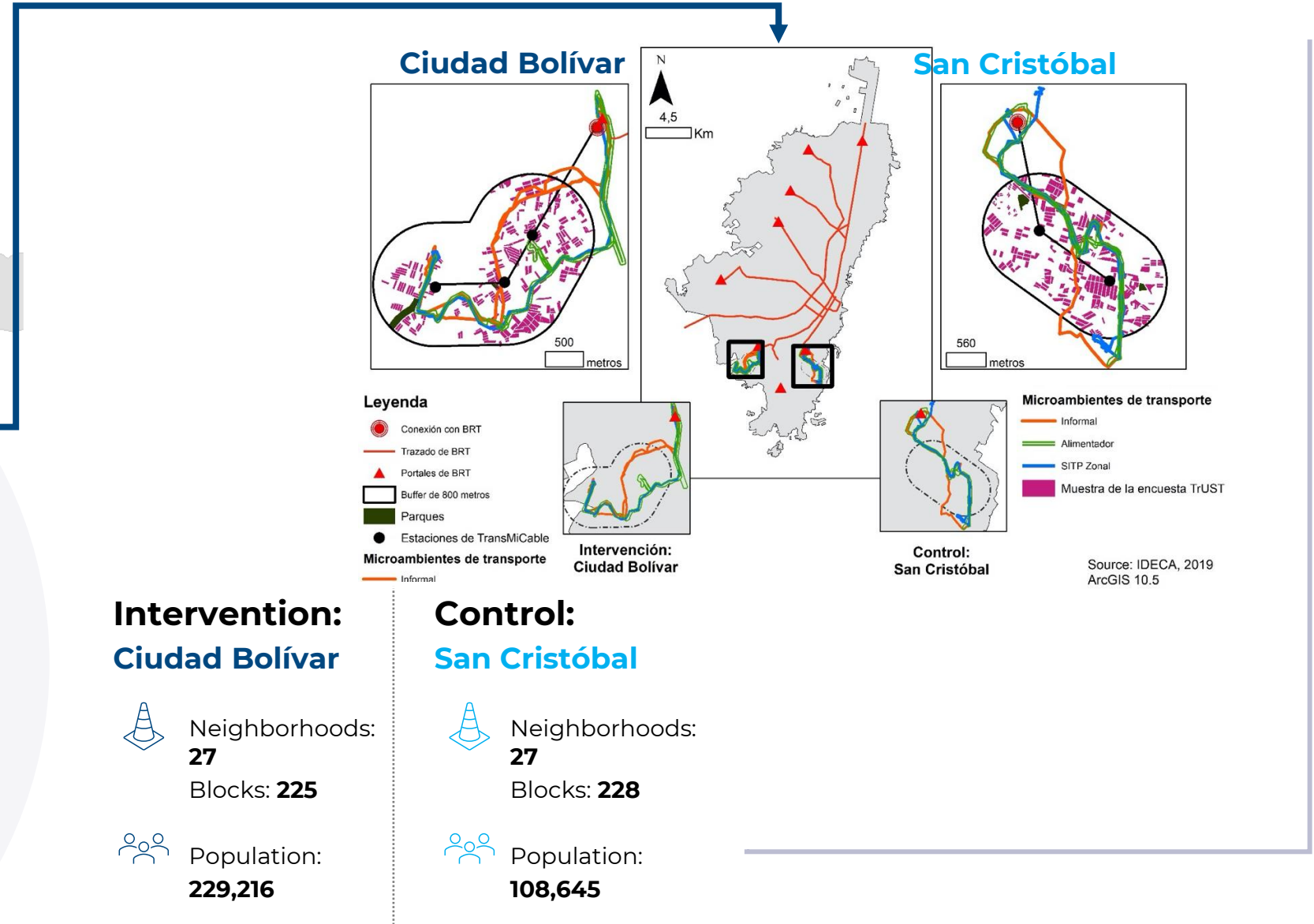
To use **citizen science by the people** and **Ripple effects mapping**, in order to identify barriers and facilitators of livability that could affect the health in the study population.



# Natural experiment



Details: Sarmiento et al. (2020)





# Quantitative methods

## Instruments for data collection

- Household surveys
- Transport diaries
- Monitors of personal exposure to fine particulate matter (PM<sub>2.5</sub>), equivalent Black Carbon (eBC), and Carbon Monoxide (CO) in transport micro-environments (public buses, informal transport, TransMiCable, and pedestrians)
- Accelerometers GT3X GT3X+
- A System for Observing Play and Recreation in Communities (SOPARC)

## Data analysis

- Difference-in-differences methods
- Discrete choice modelling
- Structural equation modelling and Multiple Indicators and Multiple Causes models
- Logistics and OLS models
- Monte Carlo Simulation to estimate the mean inhaled dose per mandatory multimodal trip, that generates synthetic travel times

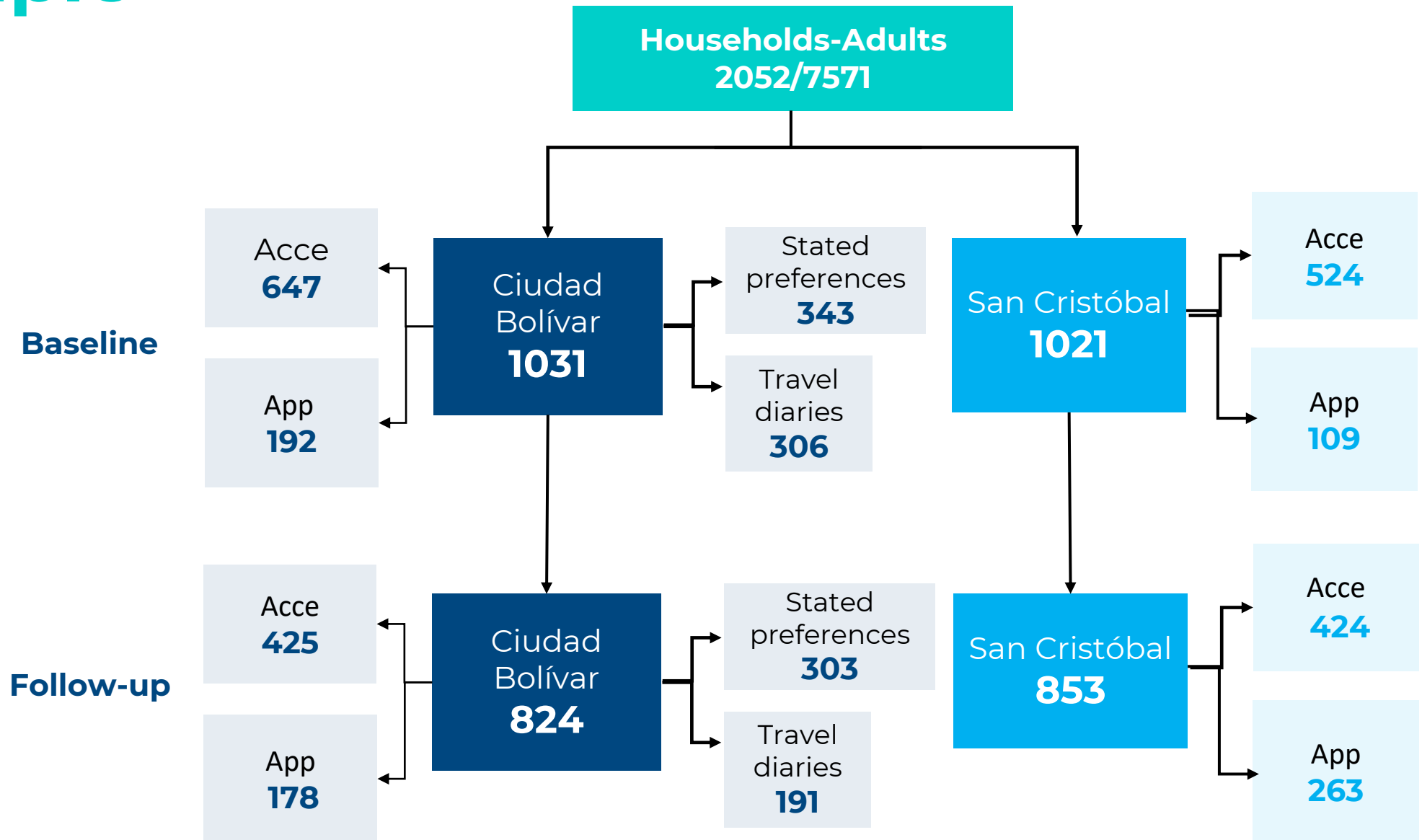


# Results





# Sample



82%

Response  
rate

# Characteristics of the study population

	Characteristics	Intervention	Control	<i>p</i>
<b>Age</b>	Age	45.9 (18.1)	44.4 (17.4)	0.095
<b>Sex</b>	Male	34.7%	38.5%	0.098
	Female	65.3%	61.5%	
<b>Education</b>	Elementary school or less	40.6%	28.3%	<0.001
	High school	43.4%	52.4%	
	College	15.7%	24.4%	
	Post-graduate	0.2%	0.2%	
<b>Income</b>	≤ 1 minimun wage (\$280 USD)	52.9%	35.9%	<0.001
	> 1 minimun wage	47.1%	64.1%	



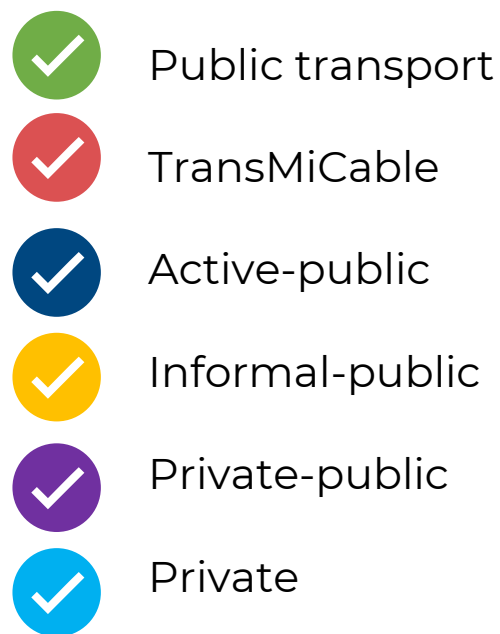
# Mobility





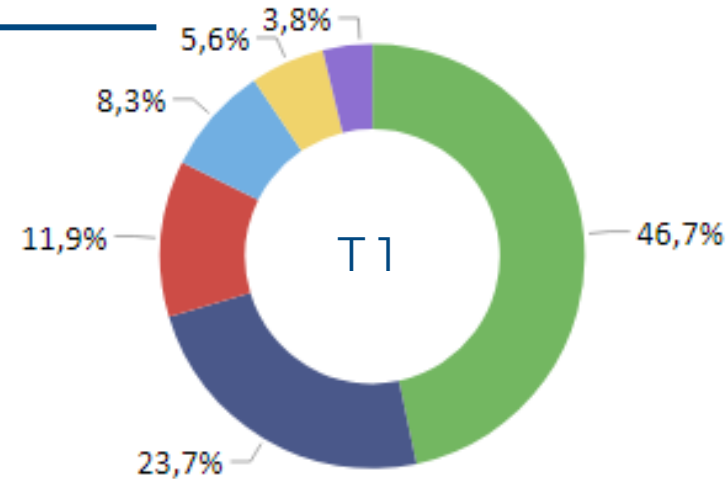
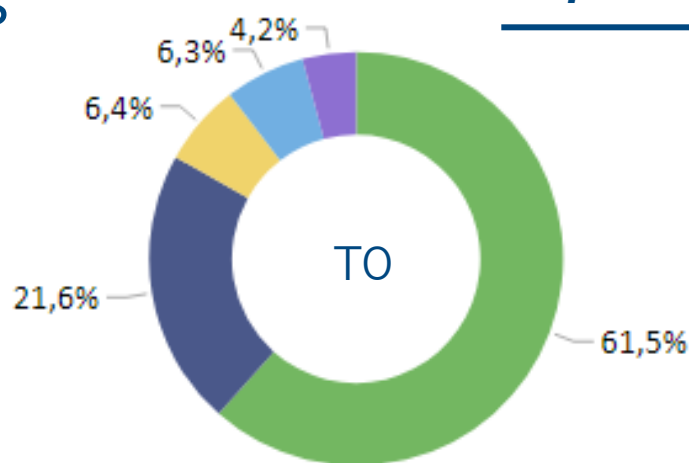
# Transport

## Modal share of trips



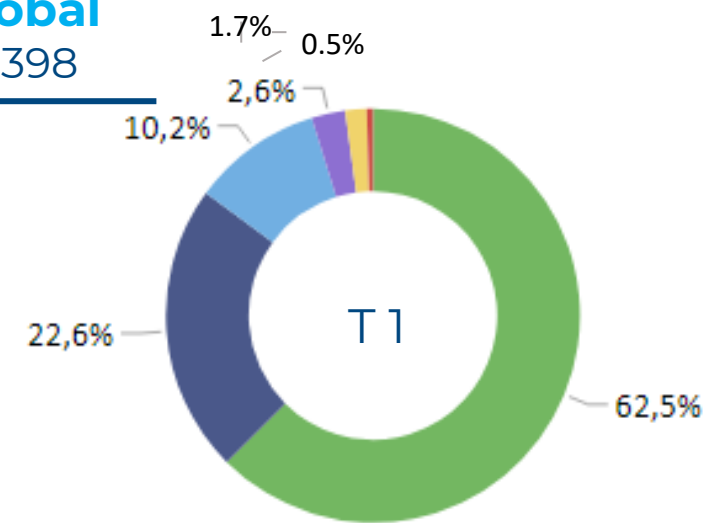
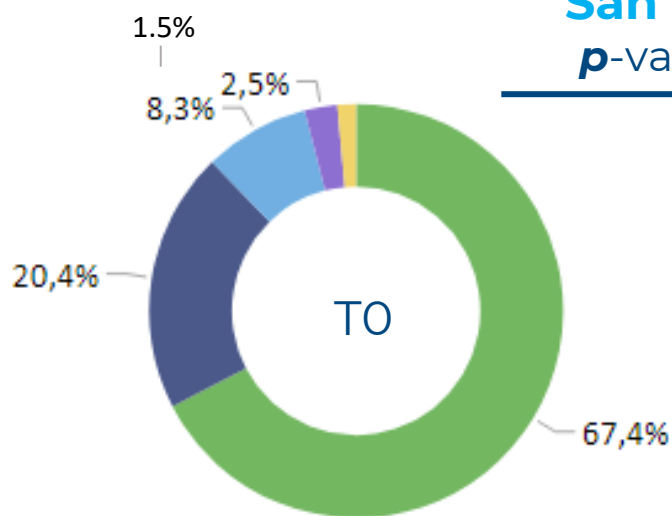
### Ciudad Bolívar

$p$ -value <0.001



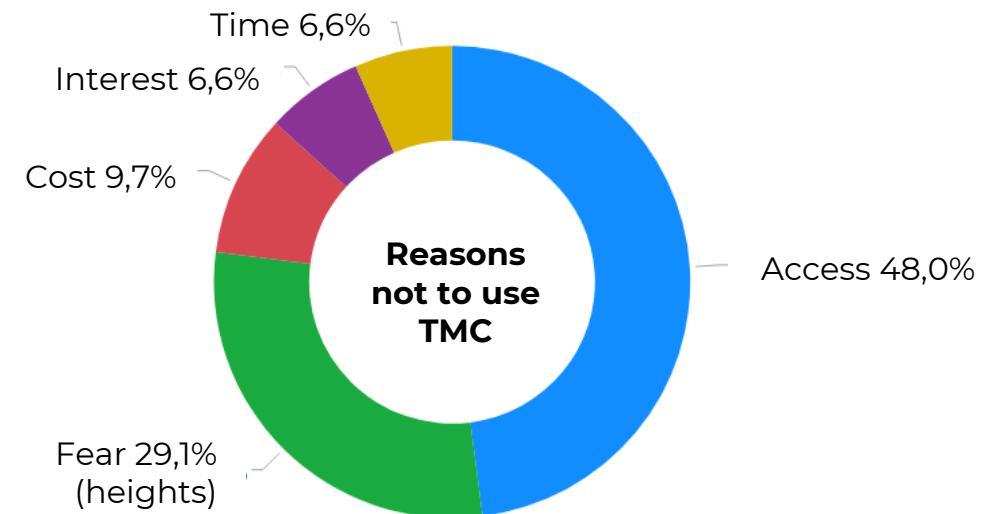
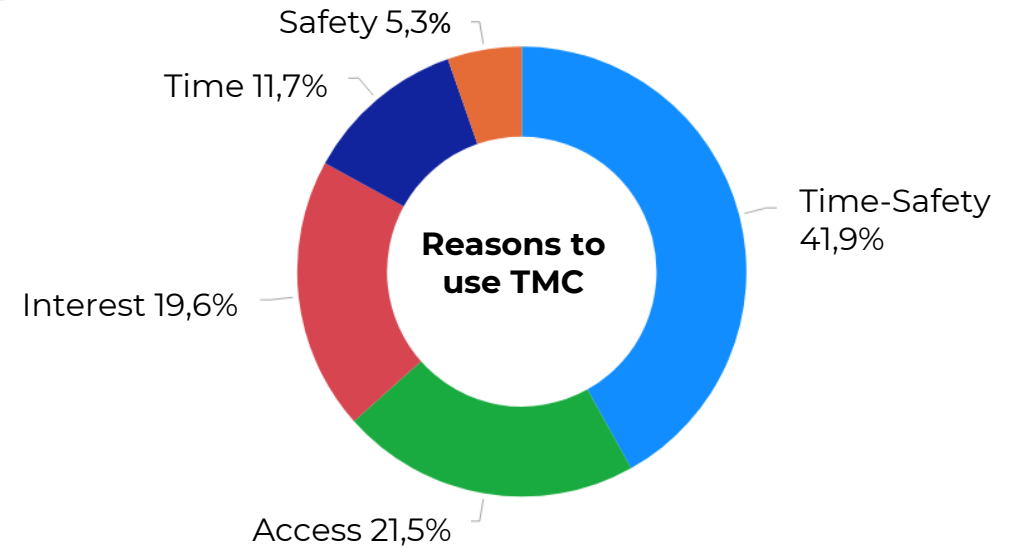
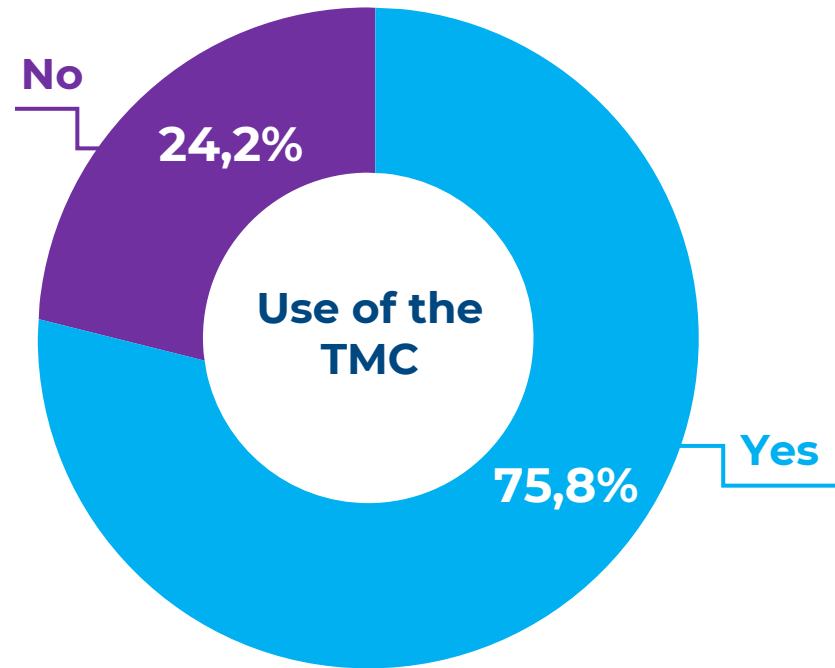
### San Cristóbal

$p$ -value: 0.398



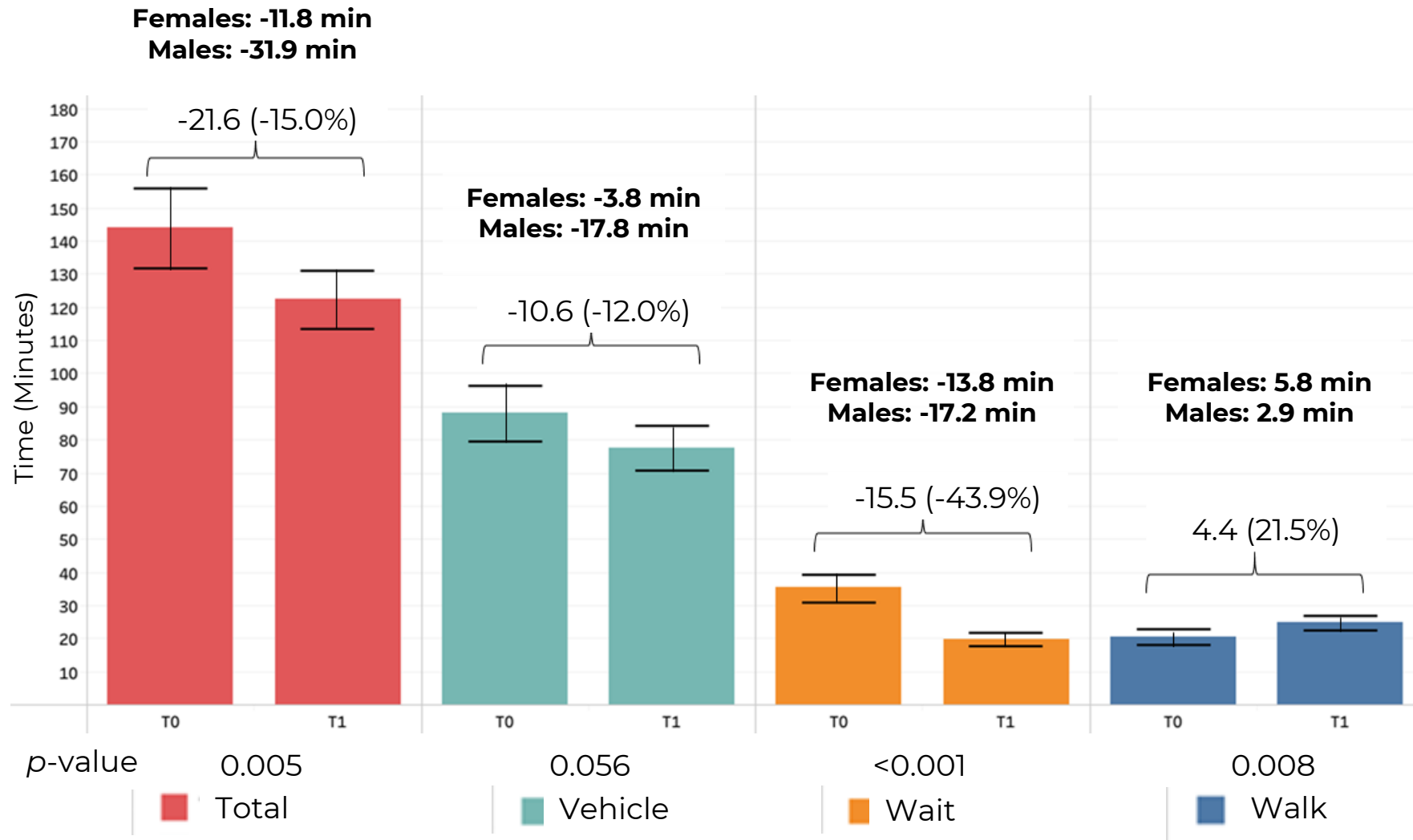


# Reasons for using or not using TransMiCable in Ciudad Bolívar

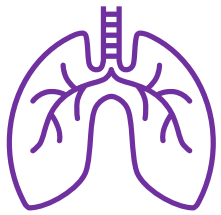




# Average travel time for TransMiCable users decreased



# Air quality





# Methods

99 micro-environment trip measurements on baseline  
112 micro-Environment trip measurements on follow-up



GPS



ACCELEROMETER



DUSTTRAK II  
(PM<sub>2.5</sub>)



MICROAETH  
(eBC)



PEM (PM<sub>2.5</sub>)



DELTAOHM (CO.CO<sub>2</sub>)



Concentrations of PM<sub>2.5</sub>, eBC and CO in transport micro-environments

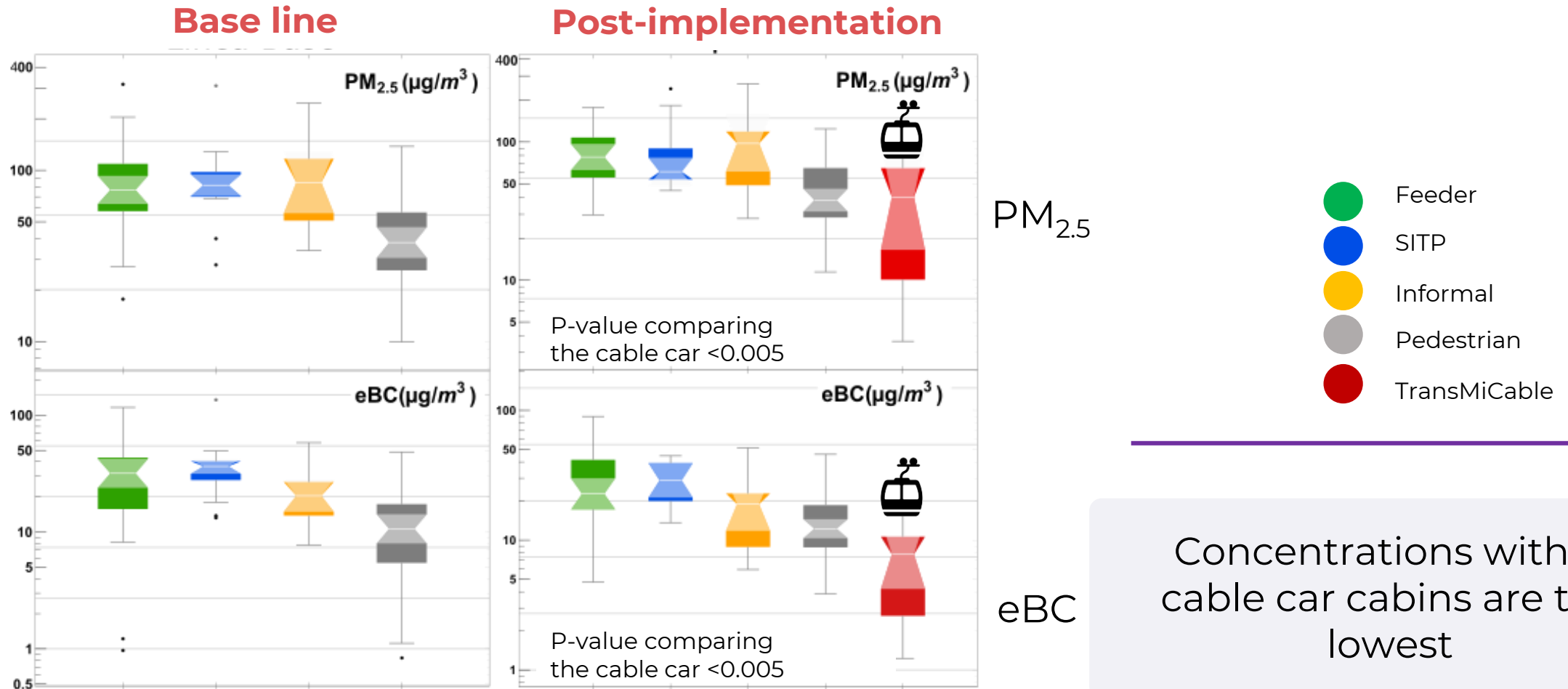


Inhaled dose of PM<sub>2.5</sub> eBC and CO in transport micro-environments



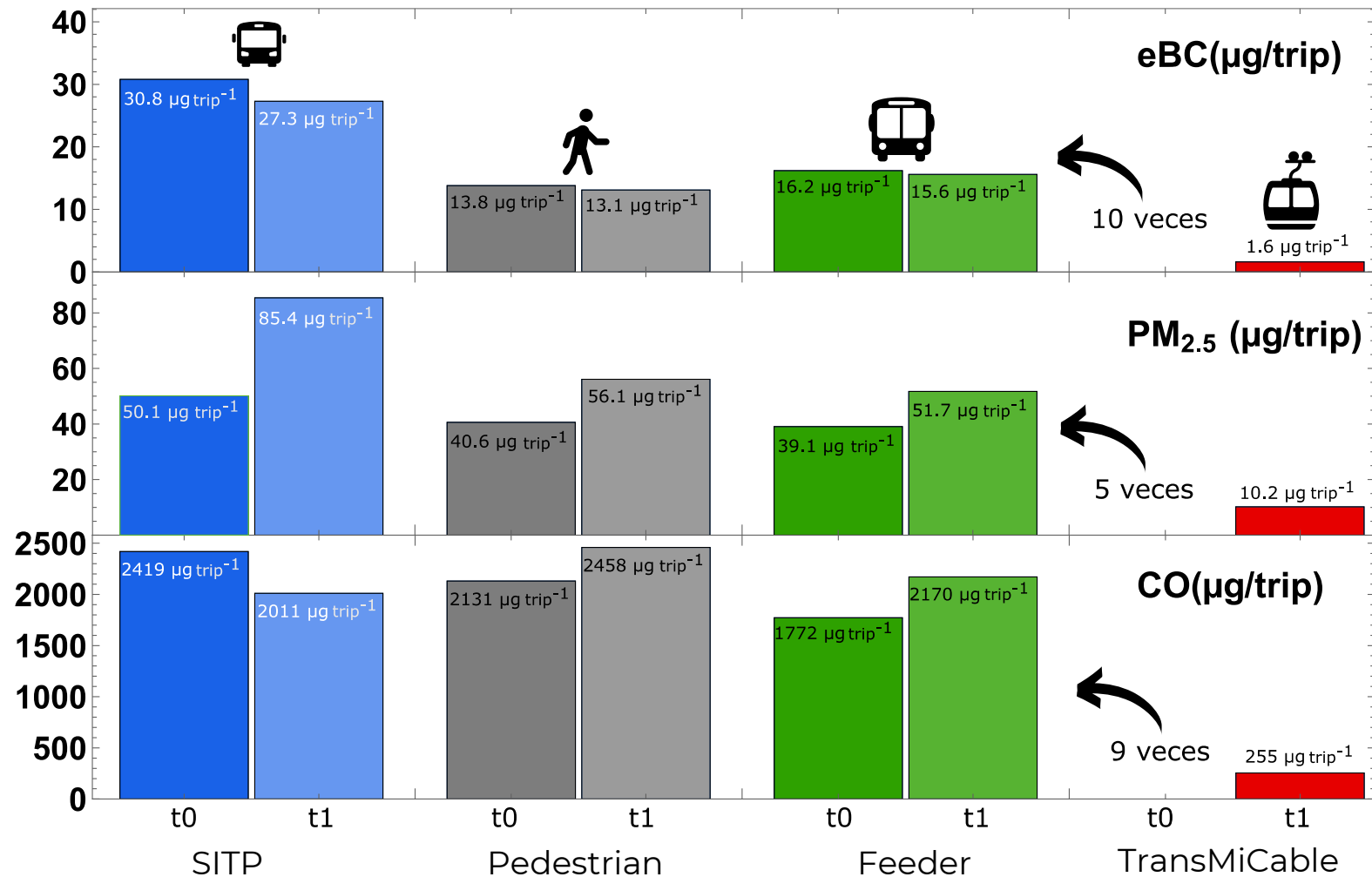
Inhaled dose per trip in transport microenvironments – Monte Carlo simulation

# Personal exposure to contaminants in transport microenvironments in Ciudad Bolívar





# Inhaled dose of PM<sub>2.5</sub> eBC and CO in transport micro-environments



Details: *Morales et al.*  
(2023)

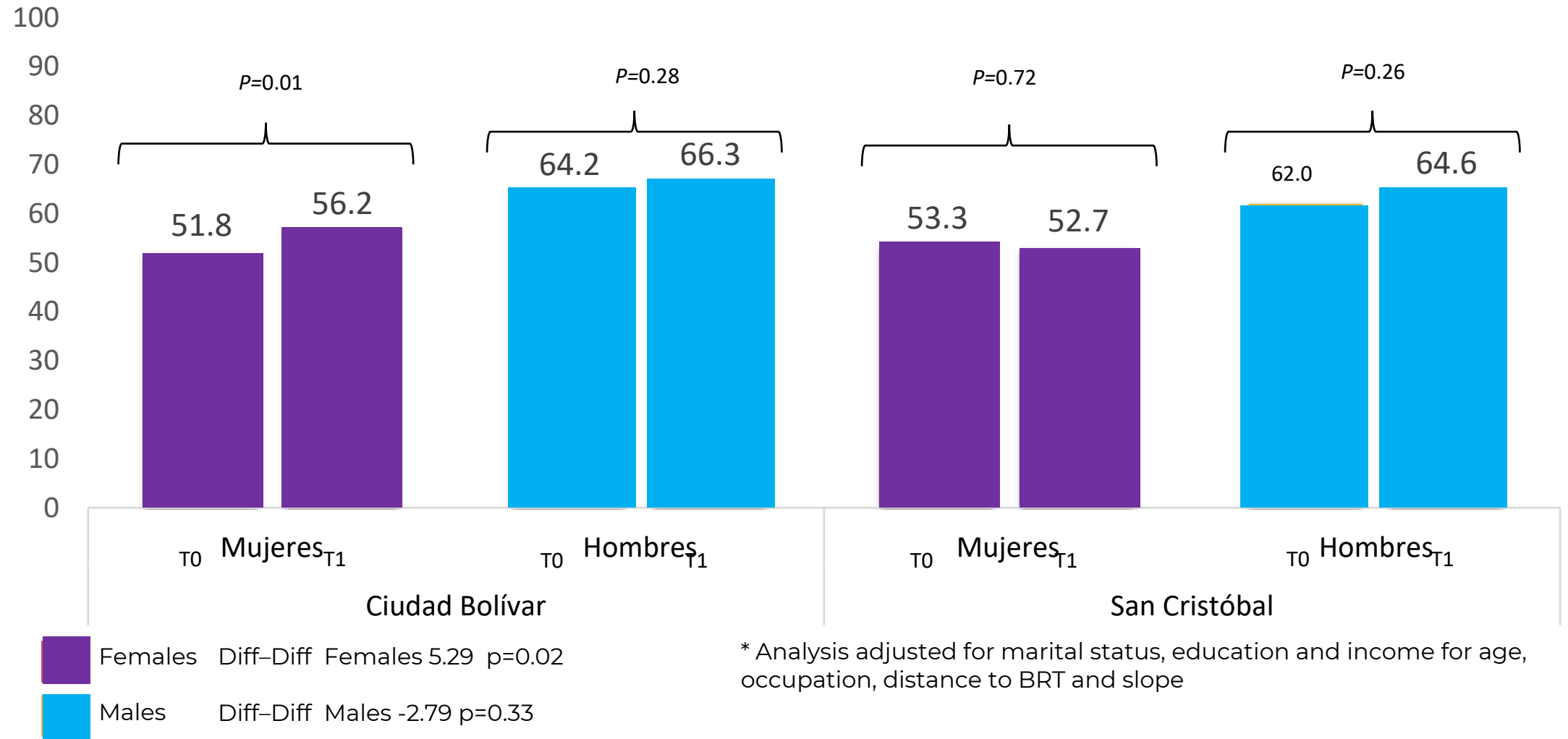




Quality of life and  
well-being



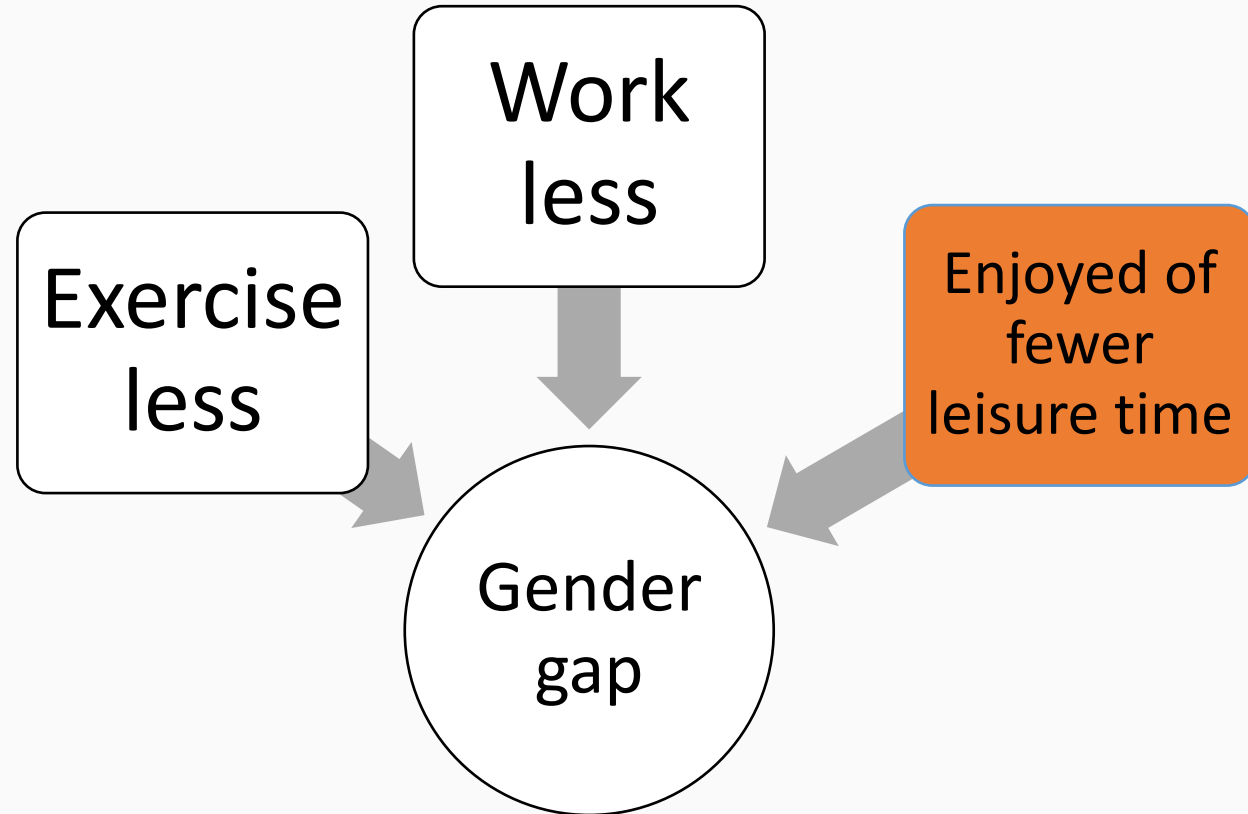
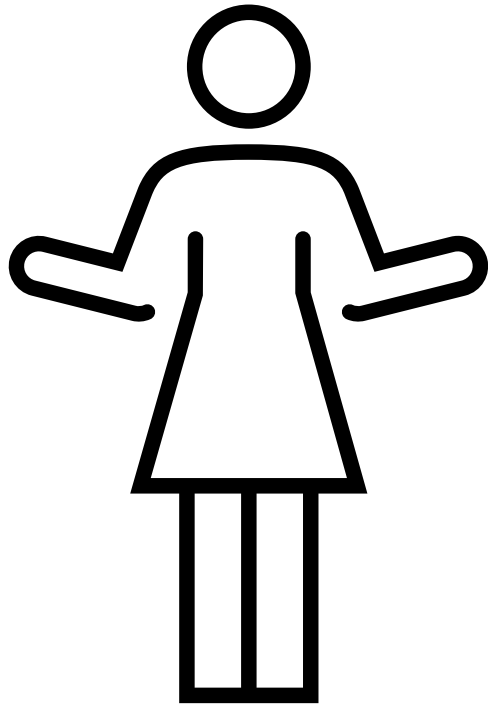
# Health-related quality of life increased in the female population of Ciudad Bolívar



# Time use

## Gender gaps before the project

Compared to man, before the project women tend to:





# Time use

After the project

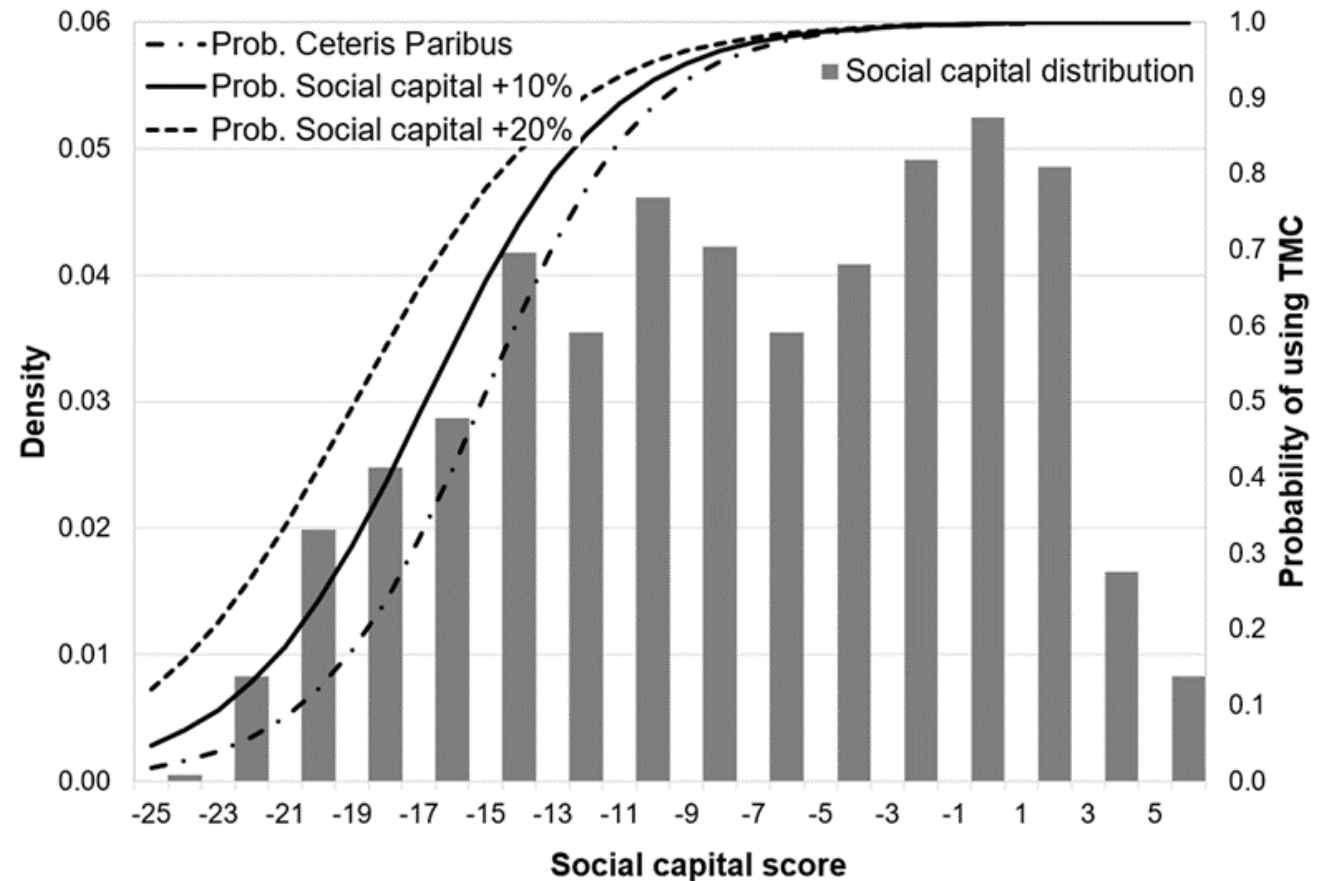
Now,  
women:

Result	Effect on the gap
They participate more in paid work and for longer time	Decrease
They spend more time studying	
They exercise more	No gap
They do more leisure activities	

# Social capital

## Social capital score distribution and probability of using TransMiCable (ceteris paribus)

- Increasing social capital by 10% and 20% increases the mean probability of using TransMiCable by 3.9% and 7.5%, respectively.
- Results suggest that social capital influences the demand of new public transport infrastructure.
- Facilitating the development of social groups and improving the trust on institutions could incentivize the use of the new infrastructure.

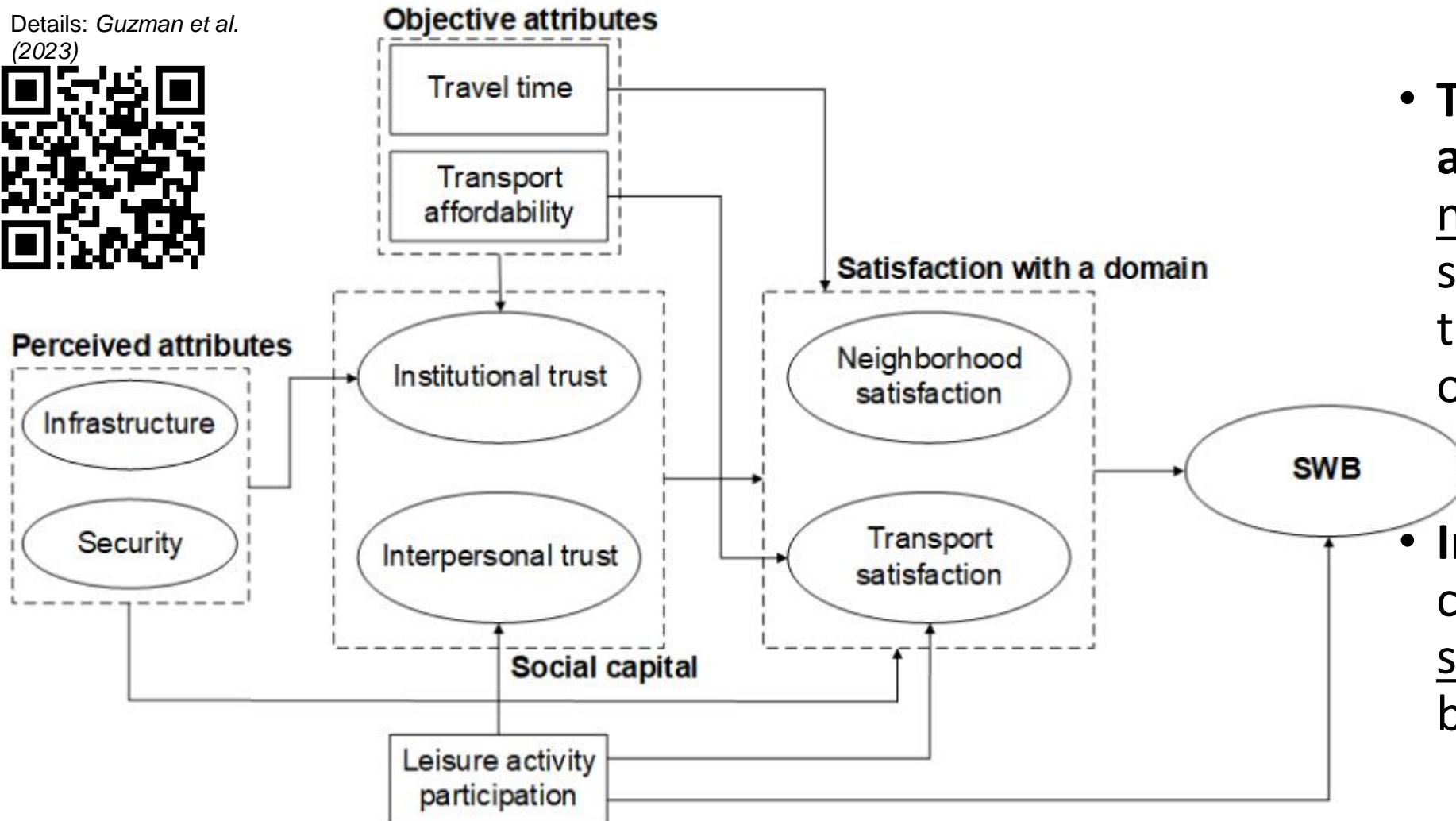




# Subjective well-being

## Findings

Details: Guzman et al.  
(2023)



- **Participation in leisure activities** has the highest positive effect on SWB
- **Transport affordability and travel time** have negative effects on satisfaction with transport and, indirectly, on SWB
- **Interpersonal trust** changed from non-significant to significant between T0 and T1

# Conclusions

TransMiCable and its urban transformations is an example of a potential inclusive, sustainable and healthy intervention

- **Interventions in public transportation generate benefits that go beyond mobility.**
- **TransMiCable had short-term effects on:**
  - Reduction in **travel time**
  - Satisfaction with **transport, well-being** and the **physical environment**
  - The levels of **physical activity** in cable car users are higher than for users of other modes of transport, but no changes of **physical activity** were observed
  - Females observed performing **moderate or vigorous physical activity** increased in the Illimani park
  - **Higher satisfaction** with **parks availability**, but **insecurity and drug use** in parks continues to be a barrier for livability





# Conclusions



- Reduction in exposure and inhaled dose of **PM<sub>2.5</sub>**, **eBC**, and **CO** per trip
- Increased **health-related quality of life** in females
- The implementation of the cable car and its urban transformation could contribute **to reduce stigma of the zone**
- True partnerships between academia, the community and policymakers have the potential to provide a better understanding of programs and will help to replicate urban interventions aimed at sustainability and equity.



# Our team



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