SALUD URBANA EN AMÉRICA LATINA

Health and environmental co-benefits of city urban form in Latin America: an ecological study

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wellcome

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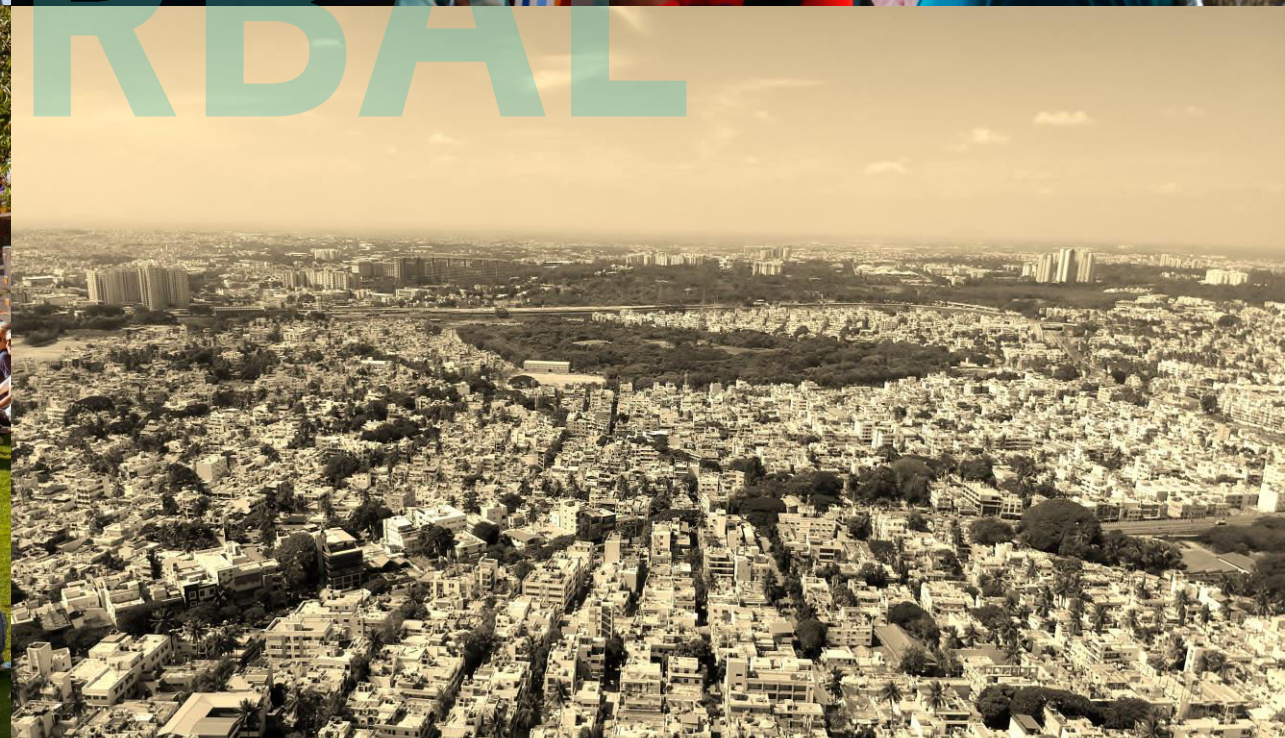
Salud Urbana en América Latina

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


By 2050 almost 70% of world's population will live in urban environments
CRIME SCENE
CRIME SCENE
CRIME SCENE


LA VIEILLE AUBERGE
Hôtel ** Restaurant
LA VIEILLE AUBERGE
Hôtel ** Restaurant
Glacier
BAR
BOLS


CAROLINE GARDNER Design



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Research questions

1. Are certain urban landscape profiles at the city level associated with environmental outcomes in Latin American cities?

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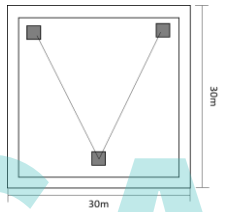
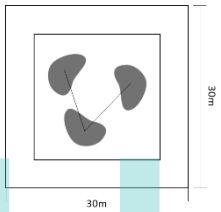
2. Are certain urban landscape profiles at the city level associated with health outcomes in Latin American cities?
3. What urban landscape profiles maximize environmental and health co-benefits in Latin America?

Exposure

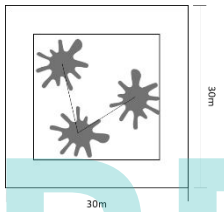
Urban landscape profiles



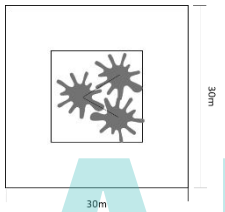
Scattered pixels
low fragmentation
high isolation
compact shape



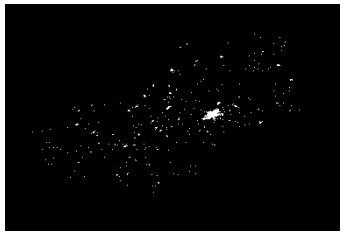
Proximate stones
moderate fragmentation
moderate isolation
irregular shape



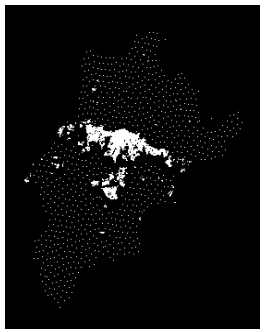
Proximate inkblots
mod-high fragmentation
moderate isolation
complex shape



Contiguous large inkblots
high fragmentation
low isolation
complex shape

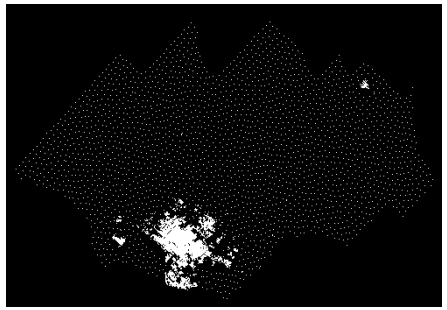


Fresnillo
(Mexico)



Pocos de Caldas
(Brazil)

Cartagena
(Colombia)



Buenos Aires
(Argentina)

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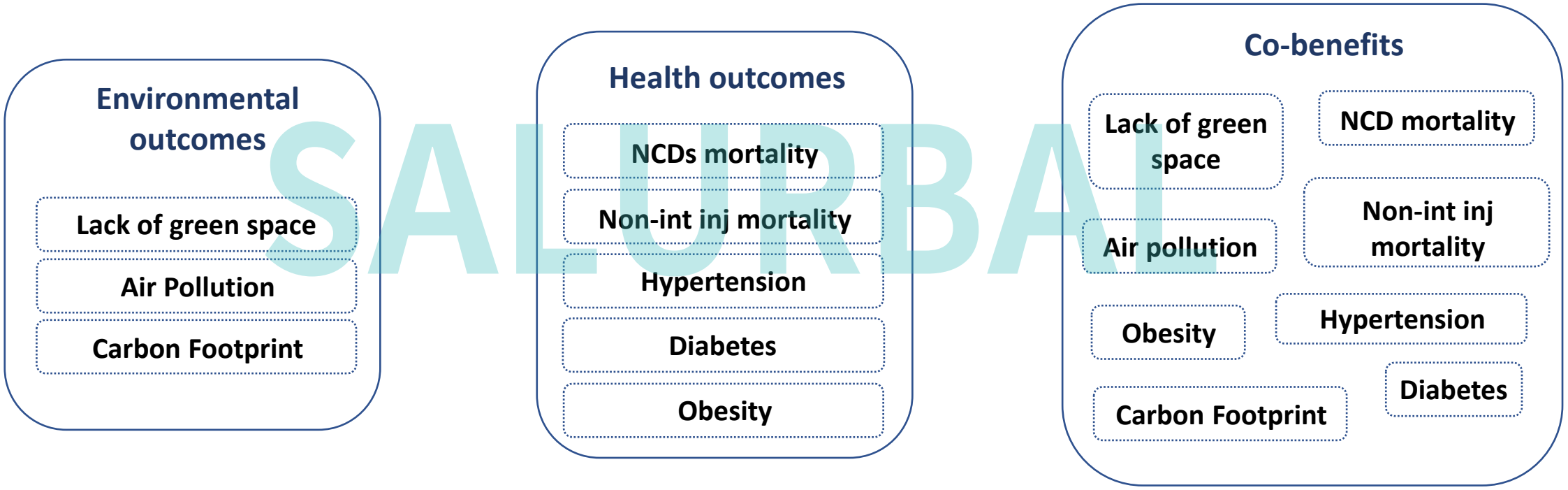
Outcomes

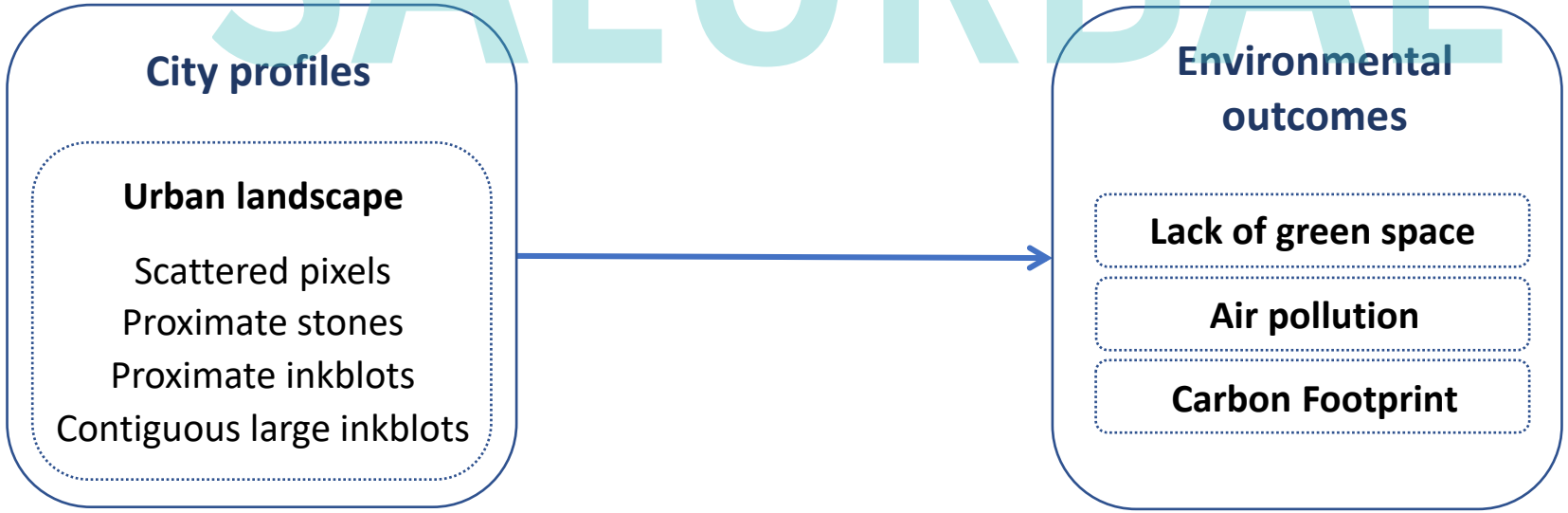


Covariates

- Age
- Sex
- Social Environment index
- Climate zones
- City size (total population)
- Country

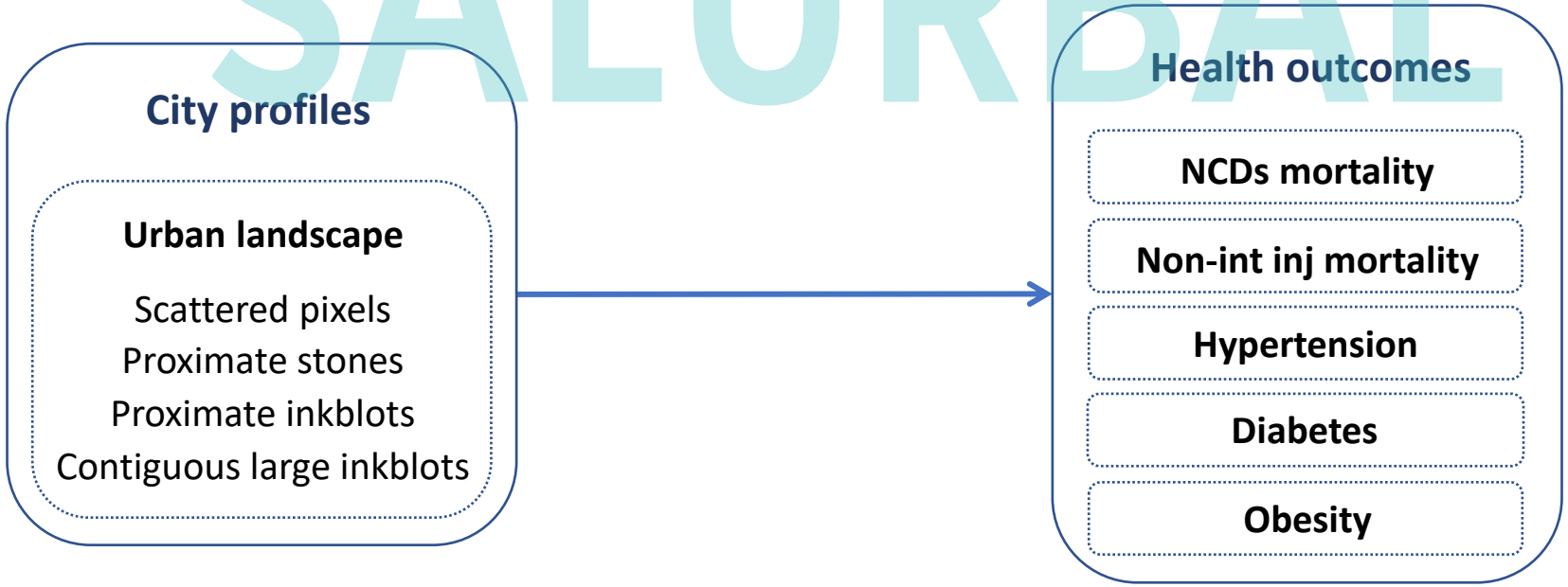
Methods

1. Linear regression models.



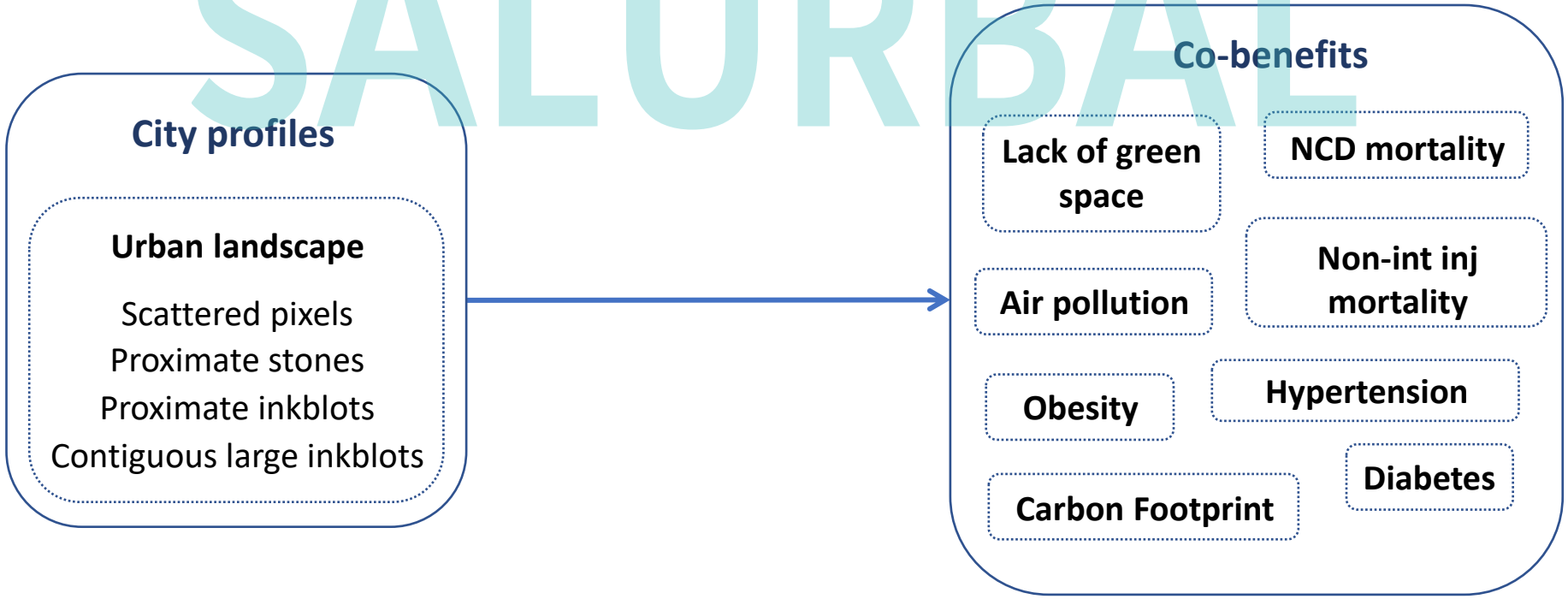
Methods

1. Linear regression models.
2. Multilevel Poisson and logistic regression models with random intercepts at the city level.



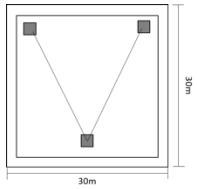
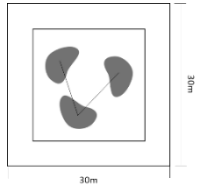
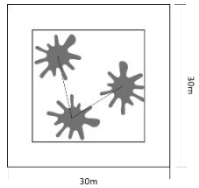
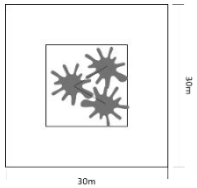
Methods

1. Linear regression models.
2. Multilevel Poisson and logistic regression models with random intercepts at the city level.
3. Latent Class Analysis creating 5 classes.



Results

Table 1. Characteristics of the study cities by Urban Landscape Profiles

VARIABLE	Total	Scattered pixels	Proximate stones	Proximate inkblots	Contiguous large inkblots	p-value*
	p50(iqr)	p50(iqr)	p50(iqr)	p50(iqr)	p50(iqr)	
Number of cities	370	91	168	90	21	
Number of surveys	238630	22911	42854	96448	76206	
City characteristics						
Total population (hab)	280918 (398129)	176213 (113555)	229962 (186198)	827328.50 (554430.30)	3697687 (5459527)	<0.001
Population density (hab/km2)	6454.003 (3519.5)	7063.435 (5628.069)	6142.93 (3435.09)	6068.10 (2646.38)	7442.44 (3760.13)	0.0226
Census age >=65years (%)	10.69 (3.42)	10.93 (3.58)	11 (3.56)	10.08 (2.87)	10.44 (1.83)	0.0391
Census females (%)	51.05 (1.43)	50.87 (1.46)	50.94 (1.44)	51.16 (1.44)	51.51 (1.19)	0.0132
Adults aged >=25 years who completed secondary education or above (%)	38.59 (10.79)	35.87 (10.17)	38.55 (11.35)	40.37 (8.89)	43.72 (7.84)	<0.001
Social Environment Index	0.12 (0.78)	-0.17 (1.13)	0.10 (0.73)	0.29 (0.67)	0.38 (0.30)	0.0012
Major climate zone						0.054
Tropical	43.78%	44.0%	43.5%	45.6%	38.1%	
Arid	20.27%	28.6%	14.9%	24.4%	9.5%	
Temperate & Polar	35.95%	27.5%	41.7%	30.0%	52.4%	

*Chi test for categorical variables, Kruskal Wallis test for continuous variables

Results

City profiles → Environmental outcomes

Table 2. Adjusted single exposure and single outcome regression models with urban landscape profiles.

Urban landscape profiles	Scattered pixels	Proximate stones	Proximate inkblots	Contiguous large inkblots
Environmental outcomes		**Coef (95% CI)**	**Coef (95% CI)**	**Coef (95% CI)**
Lack of green space (% lack green/unit)	referent	0.25 (-3.23, 3.73)	8.07 (4.06, 12.08)*	12.74 (6.39, 19.10)*
$PM_{2.5}$ (µg/m^3)	referent	2.17 (1.12, 3.22)*	2.47 (1.25, 3.68)*	4.81 (2.89, 6.73)*
NO_2 (ppb)	referent	0.09 (0.00, 0.19)	0.12 (0.01, 0.23)*	0.82 (0.64, 0.99)*
Per capita carbon footprint (CO_2 emissions/hab)	referent	0.02 (-0.09, 0.13)	-0.05 (-0.18, 0.07)	0.08 (-0.12, 0.28)

*p<0.05

$PM_{2.5}$, Particulate Matter that have a diameter of less than 2.5 micrometers. NO_2, Nitrogen dioxide. CO_2, Carbon dioxide. IRR, Incidence Rate Ratio. OR, Odds Ratio.

Environmental outcomes models: Linear regression models adjusted by climate zones, social environment index, country.

Mortality outcomes models: Multilevel Poisson regression models adjusted by age, sex, social environment index, climate zones, country as fixed effects; city as random intercept.

Risk factors outcomes models: Multilevel logistic regression models adjusted by age, sex, education, social environment index, climate zones, country as fixed effects; city as random intercept.

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Results

City profiles → Health outcomes

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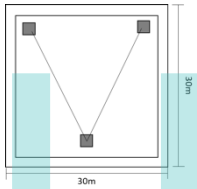
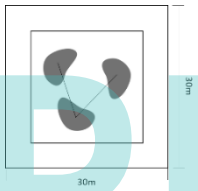
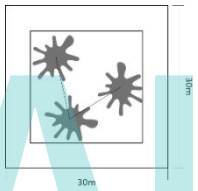
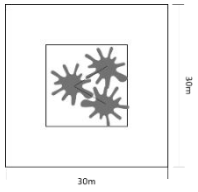

Urban landscape profiles	Scattered pixels	Proximate stones	Proximate inkblots	Contiguous large inkblots
Health outcomes		**Rate ratio/OR (95% CI)**	**Rate ratio/OR (95% CI)**	**Rate ratio/OR (95% CI)**
NCDs mortality	referent	0.93 (0.86, 1.01)	0.93 (0.85, 1.01)	0.77 (0.67, 0.87)*
Non-intentional injuries mortality	referent	0.88 (0.76, 1.03)	1.02 (0.86, 1.21)	1.00 (0.77, 1.30)
Hypertension	referent	1.02 (0.91, 1.14)	1.07 (0.95, 1.21)	1.06 (0.90, 1.24)
Diabetes	referent	1.11 (0.99, 1.23)	1.08 (0.97, 1.21)	1.24 (1.07, 1.43)*
Obesity	referent	0.90 (0.79, 1.01)	0.87 (0.76, 0.99)*	0.91 (0.76, 1.09)

*p<0.05

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Results

Table 3. Description of co-benefits class

Co-benefits class	Description of co-benefits class	Number of cities
Positive co-benefits	Positive health & environmental co-benefits	57
Environmental benefits	Environmental benefits, negative health outcomes, except diabetes & obesity	75
Health benefits	Lack GS & high PM2.5, health benefits except obesity	12
High emissions & risk factors	High NO2 & carbon footprint, high hypertension & diabetes	40
Negative co-benefits	Negative health & environmental co-benefits, except hypertension	161

Results

City profiles → Co-benefits

Table 4. Characteristics of the study cities by co-benefits class

Co-benefits class	Number of cities	Total population (hab)	Population density (hab/km2)	Census >=65years (%)	Census females (%)	Adults with completed secondary education or above (%)	Social Environment Index
		p50(iqr)	p50(iqr)	p50(iqr)	p50(iqr)	p50(iqr)	p50(iqr)
Positive co-benefits	57	274607 (308438)	12529.02 (7153.94)	10.45 (3.33)	52.87 (1.94)	39.5 (8.57)	0.19 (0.63)
Environmental benefits	75	273161 (739029)	7407.16 (3219.59)	10.06 (3.51)	52.72 (2.36)	37.74 (12.48)	-0.32 (0.72)
Health benefits	12	344036.5 (572823)	11159.88 (3441.41)	9.83 (1.81)	51.11 (2.57)	66.52 (8.99)	0.26 (0.23)
High emissions & risk factors	40	318650.5 (426626.5)	5209.07 (2069.43)	13.08 (4.1)	52.45 (1.31)	38.32 (5.25)	0.38 (0.39)
Negative co-benefits	161	299828 (397711)	5557.85 (1680.28)	10.65 (3.52)	52.21 (1.29)	36.87 (10.67)	0.23 (0.78)

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Results

City profiles → Co-benefits

Table 5. Co-benefits class distribution by city profiles

	Scattered pixels	Proximate stones	Proximate inkblots	Contiguous large inkblots
	%	%	%	%
Positive co-benefits	**26.8**	16.7	9.3	5
Environmental benefits	23.2	18.6	23.3	**35**
Health benefits	6.1	2.6	2.3	5
High emissions & risk factors	17.1	8.3	9.3	20
Negative co-benefits	**26.8**	**53.8**	**55.8**	**35**

Summary of results

1. **Environmental Outcomes**
   - All the different profiles were associated with higher % of lack of green space and higher levels of PM2.5, NO2, and carbon footprint compared to the scattered pixels profile.

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   - Mortality outcomes: lower risk of mortality outcomes, being only significant NCDs for the contiguous large inkblots profile
   - Risk factors:
     - Higher odds of hypertension and diabetes
     - Lower odds of obesity

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1. **Environmental outcomes**
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2. **Health outcomes**
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   - Risk factors:
     - Higher odds of hypertension and diabetes
     - Lower odds of obesity
3. **Co-benefits**
   - The Negative co-benefits class is the most frequent class in all the different profiles
   - The Positive co-benefits is mostly frequent in the scattered pixels profile

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Thank you!

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