

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

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BACKGROUND

- Urban design features are often studied in relation to health and behavioral outcomes. They can also have major implications for environmental outcomes.
- However, the impact of these features on both health and environmental outcomes (co-benefits) are rarely examined.

Aim

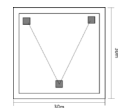
We investigated how **urban landscape and street design profiles are associated to jointly occurring health and environmental outcomes** in Latin American cities.

METHODS



- The **SALURBAL project** has compiled and harmonized data on built environment, environmental exposures, and health outcomes for **370 cities in 11 countries**: Argentina, Brazil, Chile, Colombia, Costa Rica, El Salvador, Guatemala, Mexico, Nicaragua, Panama, and Peru.
- Four urban landscape profiles** were defined measuring patch (contiguous area of urban development) fragmentation, shape, and isolation. Additional **four street design profiles** were defined using street connectivity, length, and directness.
- Multilevel regression models** were used to assess associations between the **city profiles and several health and environmental outcomes**.

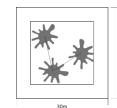
Urban landscape profiles



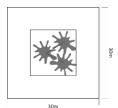
Scattered pixels
low fragmentation
high isolation
compact shape



Proximate stones
moderate fragmentation
moderate isolation
irregular shape

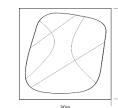


Proximate inkblots
mod-high fragmentation
moderate isolation
complex shape



Contiguous large inkblots
high fragmentation
low isolation
complex shape

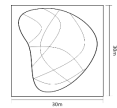
Street design profiles



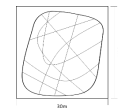
Labyrinthine
low connectivity
moderate length
moderate directness



Semi-hyperbolic grid
moderate connectivity
moderate length
moderate directness



Hyperbolic grid
moderate connectivity
high length
low directness



Spiderweb
high connectivity
low length
moderate directness

RESULTS (preliminary)

Table 1. Regression models assessing associations between urban landscape and street design profiles and environmental and health outcomes, adjusted for all the potential confounders.

	Urban landscape profiles ^a			Street design profiles ^b		
	Proximate stones	Proximate inkblots	Contiguous large inkblots	Semi-hyperbolic grid	Hyperbolic grid	Spiderweb
Environmental outcomes	Coef (95% CI)	Coef (95% CI)	Coef (95% CI)	Coef (95% CI)	Coef (95% CI)	Coef (95% CI)
Green space (% green/unit)	2.55 (-1.23, 6.32)	-5.84 (-10.04, -1.64)*	-12.17 (-19.05, -5.29)*	0.66 (-3.13, 4.44)	4.36 (-0.85, 9.57)	-5.51 (-9.84, -1.18)*
PM _{2.5} (µg/m ³)	1.83 (0.84, 2.82)*	2.06 (0.96, 3.17)*	4.68 (2.88, 6.49)*	1.69 (0.72, 2.66)*	0.75 (-0.59, 2.09)	2.87 (1.75, 3.98)*
NO ₂ (ppb)	0.14 (0.05, 0.24)*	0.17 (0.06, 0.27)*	0.92 (0.75, 1.09)*	0.14 (0.04, 0.24)*	0.24 (0.10, 0.37)*	0.41 (0.30, 0.52)*
Carbon footprint per capita (tCO ₂ /hab)	0.10 (-0.01, 0.21)	0.10 (-0.03, 0.22)	0.32 (0.11, 0.53)*	0.16 (-0.05, 0.17)	0.14 (-0.02, 0.29)	0.06 (-0.07, 0.19)
Heat	-0.02 (-0.80, 0.76)	-0.23 (-1.09, 0.64)	-1.05 (-2.47, 0.37)	-0.48 (-1.23, 0.27)	-1.70 (-2.74, -0.67)*	-0.97 (-1.83, -0.11)*
Health outcomes	Rate ratio/OR (95% CI) ^a	Rate ratio/OR (95% CI) ^a	Rate ratio/OR (95% CI) ^a	Rate ratio/OR (95% CI) ^b	Rate ratio/OR (95% CI) ^b	Rate ratio/OR (95% CI) ^b
All-cause mortality	0.98 (0.95, 1.02)	0.99 (0.95, 1.03)	0.96 (0.90, 1.01)	1.01 (0.98, 1.04)	0.97 (0.93, 1.01)	0.97 (0.94, 1.01)
Non-communicable diseases mortality	1.00 (0.97, 1.03)	1.00 (0.96, 1.03)	0.97 (0.92, 1.03)	1.02 (0.99, 1.05)	0.99 (0.95, 1.03)	1.00 (0.96, 1.03)
Infectious and parasitic diseases mortality	0.99 (0.90, 1.09)	1.02 (0.92, 1.14)	0.95 (0.80, 1.13)	0.95 (0.87, 1.04)	0.88 (0.78, 0.99)*	0.94 (0.84, 1.04)
Vector-borne diseases mortality	0.87 (0.62, 1.24)	0.79 (0.53, 1.17)	0.83 (0.46, 1.49)	0.84 (0.60, 1.18)	0.64 (0.41, 0.99)*	0.75 (0.51, 1.10)
Road traffic accidents mortality	0.88 (0.81, 0.97)*	0.84 (0.75, 0.93)*	0.72 (0.61, 0.85)*	0.93 (0.85, 1.02)	0.89 (0.79, 1.00)	0.78 (0.71, 0.87)*
Violence related deaths	0.86 (0.72, 1.03)	0.99 (0.81, 1.21)	1.06 (0.77, 1.45)	0.99 (0.83, 1.17)	0.86 (0.68, 1.08)	0.96 (0.79, 1.18)
Hypertension prevalence	1.02 (0.91, 1.14)	1.07 (0.95, 1.20)	1.06 (0.90, 1.25)	0.96 (0.87, 1.07)	1.02 (0.85, 1.22)	1.02 (0.91, 1.15)
Diabetes prevalence	1.11 (0.99, 1.23)	1.08 (0.97, 1.21)	1.24 (1.07, 1.43)*	1.07 (0.97, 1.18)	0.99 (0.83, 1.19)	1.08 (0.97, 1.20)
Obesity prevalence	0.88 (0.78, 0.99)*	0.85 (0.75, 0.98)*	0.89 (0.74, 1.07)	0.91 (0.82, 1.01)	0.79 (0.67, 0.94)*	0.85 (0.75, 0.96)*
Depression prevalence	0.80 (0.63, 1.00)	0.80 (0.63, 1.01)	0.82 (0.60, 1.13)	0.99 (0.83, 1.18)	0.91 (0.65, 1.28)	1.01 (0.82, 1.23)

*p<0.05.

^aScattered pixels profile is the referent urban landscape profile. ^bLabyrinthine profile is the referent street design profile. ^cRate ratio for mortality models, OR for prevalence models.

PM_{2.5}, Particulate Matter that have a diameter of less than 2.5 micrometers. NO₂, Nitrogen dioxide. CO₂, Carbon dioxide. OR, Odds Ratio.

Models' adjustment: Environmental outcomes models adjusted by climate zones and country as fixed effects. Health outcomes models adjusted by age, sex, education, SES city index, and climate zones, and country as fixed effects; city as random effects.

CONCLUSIONS

- Identifying how city profiles are related to environment and health outcomes can shed light on the urban policies that could have the greatest environment and health co-benefits.



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



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