Residential Street Trees and Cardiovascular Disease Among Urban-Dwelling Mexican Adults

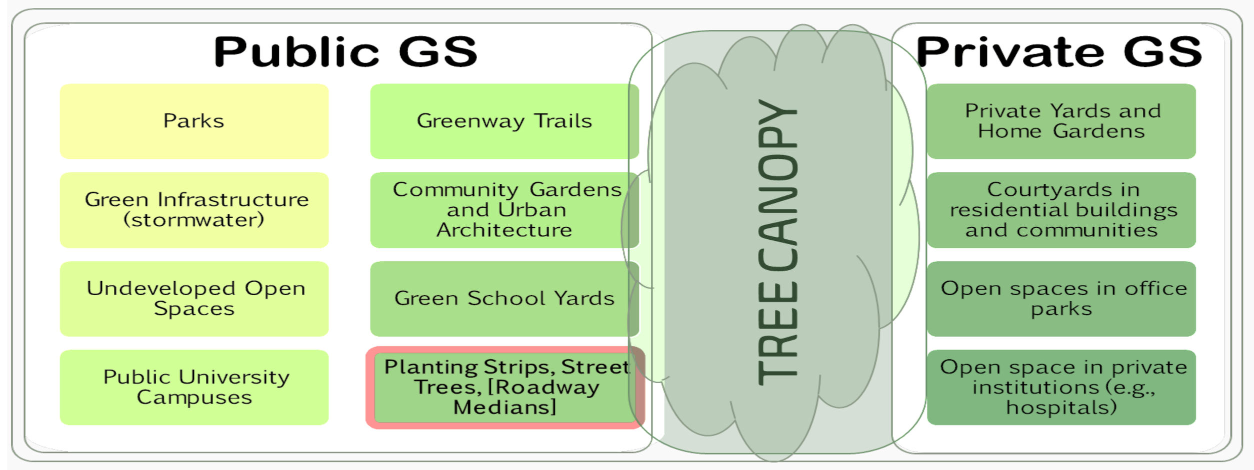
FRI_276

Chris Campbell, Ph.D.,* and Harrison Ndetan, Ph.D., M.D., MPH

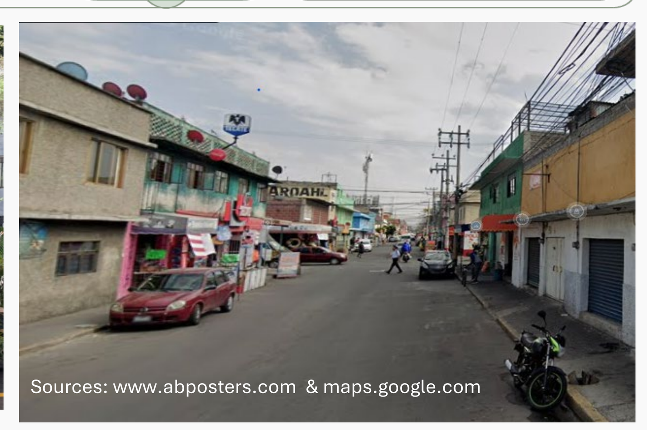
Walden University, Minneapolis, United States

INTRODUCTION & BACKGROUND

Residential green space, particularly in urban environments, is emerging as a potential protective factor against cardiovascular disease (CVD). Large forms of urban green space include parks, playgrounds, and greenways; small green space include roadside vegetation and street trees, trees located in sidewalks, lining streets, and in public rights-of-way. Urban areas typically experience reduced green spaces, higher pollution levels, and lifestyle factors that contribute to cardiovascular risk.



Adapted from (Jennings et al., 2017)



Sources: www.abposters.com & maps.google.com

In Mexico, CVDs are a significant public health burden despite national efforts to address traditional risk factors. Mexico is facing a potential future epidemic of CVD. Recent data indicate that more than 20.5 million individuals in Mexico (approximately 26% of the adult population) are affected by myocardial infarction, atrial fibrillation, and heart failure.

Environmental risk factors such as air and noise pollution are increased in cities. These environmental factors are is noteworthy in Mexico's public health landscape, with its rising rates of obesity, hypertension, and metabolic disorders occurring alongside rapid urbanization.

This research investigated the potential cardiovascular health benefits of street trees in Mexican urban areas. By exploring the relationship between street tree presence and cardiovascular disease rates, the study sought to inform urban planning and health equity initiatives in rapidly developing metropolitan regions.

OBJECTIVE

The objective was to examine the relationship between street trees in urban neighborhoods of Mexico and self-reported prior diagnoses of heart attack, angina, heart failure, heart disease, and stroke among adults over the age of 40 living in these urban neighborhoods while adjusting for different combinations of individual and neighborhood risk factors.

MATERIALS & METHODS

DATA SOURCES:

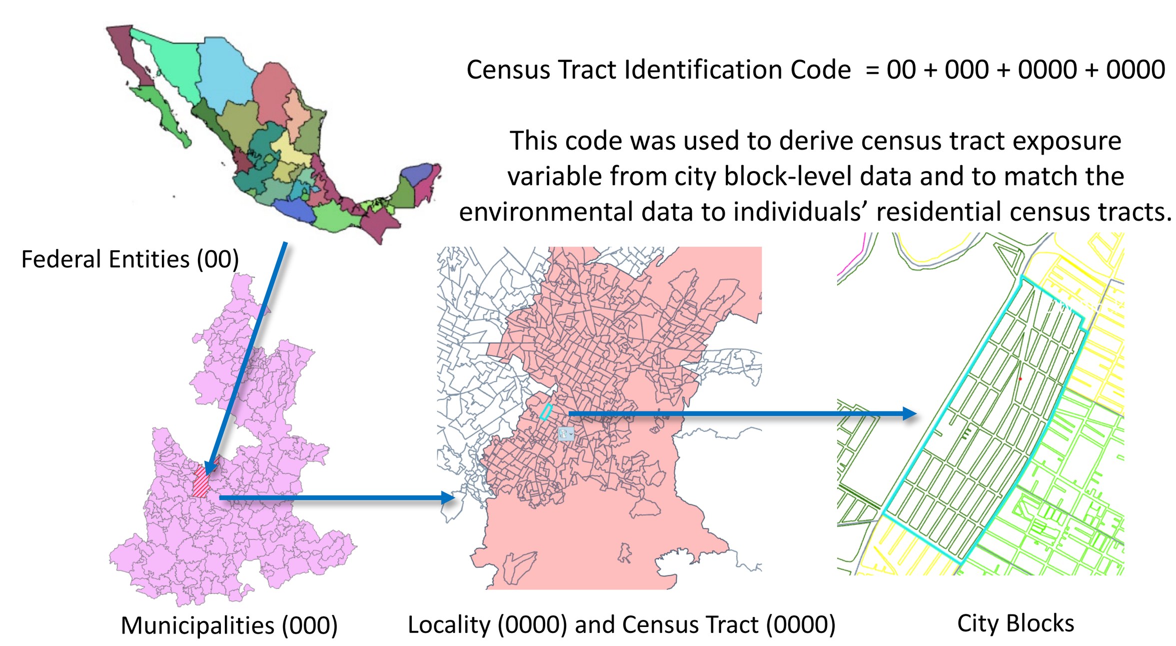
This study used secondary data from several publicly available datasets from the Mexican government. Individual-level data, including self-reported prior diagnosis of CVD and related risk factors, were sourced from the 2012 Mexican National Health and Nutrition Survey. ENSANUT 2012 is a national probabilistic survey of over 55,000 Mexican households representing both urban and rural census tracts.

Census tract- and municipality-level data providing information on elements of the local environment was sourced from separate governmental datasets published between 2010 and 2011.

VARIABLES:

Level	Variable	Coding
Individual	**Prior CVD diagnosis (outcome)**	**No / Yes**
Census tract	Proportion of streets with trees	From 0 to 1
Individual	Age	40+
Individual	Sex	Male / Female
Individual	Prior hypertension diagnosis	No / Yes
Individual	Prior diabetes diagnosis	No / Yes
Individual	Prior depression diagnosis	No / Yes
Individual	Family history of infarction	No / Yes
Individual	Excessive alcohol use	No / Yes
Individual	High triglycerides	No / Yes / Never Tested
Individual	High cholesterol	No / Yes / Never Tested
Individual	Hypertension-yrs since diagnosis	(0 = No diagnosis)
Individual	Diabetes-years since diagnosis	(0 = No diagnosis)
Individual	Smoking status	Never / Not currently / Monthly or less / Weekly or Daily
Household	Cookstove-gas stove	No / Yes
Census tract	Social lag index/GRS	Low / Medium / High
Census tract	Altitude (m)	0 to 3560
Municipality	Road network density (km2)	0.0 to 2.02

DERIVING THE STREET TREE EXPOSURE VARIABLE:

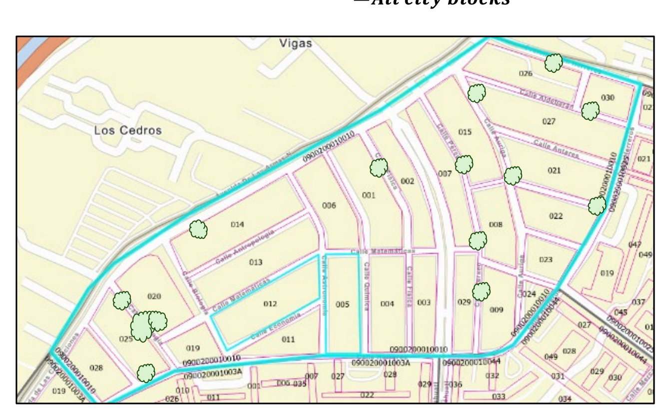


$$\textbf{Proportion of streets in a census tract} = \frac{\sum_{All\ city\ blocks} Streets\ with\ Street\ Trees}{\sum_{All\ city\ blocks} Total\ Streets}$$

Blue: Census tract 0901000010010 boundary

Pink: City block boundaries within census tract

Green: Street tree



RESULTS

The data were analyzed first to determine whether multilevel modeling techniques were needed to account for cluster effects on the dependent variable. No cluster effects were identified.

Subsequently, three analyses were conducted, each adjusting for different combinations of individual and environmental risk factors using single-level logistic regression analyses and appropriate weighting techniques to account for the ENSANUT 2012 complex sampling plan.

Results were based on data from 10,798 adults over 40 living in metropolitan neighborhoods. The weighted count for the analysis was 20,115,385 individuals, with 9.8% having self-reported a prior diagnosis of CVD.

The unadjusted model implied that street trees were associated with a higher risk of CVD (OR = 1.09), but the results were not statistically significant (p = .67).

In the adjusted models, there was marked trend of reduced likelihood of CVD as the number of streets with street trees increased, but the results did not yield sufficient evidence to reject the null hypothesis of no significant relationship between street trees and CVD (p > .05).

Model Covariate combinations	**OR (95% CI) for CVD** Proportion of streets within a census tract with street tree(s)	***p* value**
Crude *No covariates*	**1.09** (0.74, 1.60)	*.67*
Model 1 *Individual- and household-level covariates*	**0.84** (0.56, 1.28)	*.43*
Model 2 *Neighborhood- and census tract / municipality-level covariates*	**0.95** (0.59, 1.54)	*.83*
Model 3 *Individual, household, neighborhood-, and census tract / municipality-level covariates*	**0.87** (0.55, 1.38)	*.56*

Previous research on street trees and health outcomes have demonstrated varied results depending on how exposures to trees and/or green spaces are defined, as well as the statistical methods employed. Other methods of defining green space exposure include NDVI (greenness), land cover percentages, and park proximity. The varied results highlight the sensitivity of these associations to methodological approaches and the influence of other factors on health outcomes. There were limitations in this study, including measuring street tree exposure and a post-hoc analysis indicating insufficient statistical power.

INTERPRETATION

Although this study did not find a statistically significant association between street trees and reduced CVD, the directional change in the ORs when CVD-related covariates were included in the statistical models was intriguing. Despite the study's limitations, the concepts probed may be valuable for public health practitioners, urban planners, and political leaders interested in strategies to promote health equity and reduce CVD prevalence in urban areas.

Promoting the multifaceted benefits of green spaces can lead to positive change by enhancing individual health, supporting family well-being, and informing policies that prioritize public health through environmental sustainability.

REFERENCES

CEDRUS. (2019). Densidad de carreteras y redes viales en los municipios de México.

Centro de Estudios del Desarrollo Regional y Urbano Sustentable. CONEVAL (El Consejo Nacional de Evaluacion de la Politica de Desarrollo Social). (n.d.). What is social lag? (¿Que es el resago social?).

Esparza Rios, L. G. (2017). National geostatistical framework, as an example of success in Mexico for the linking of statistical and geographic information.

Fajardo Dolci, G. E., Anda, F. J. V., Ortiz-Vázquez, P., & Olaiz-Fernández, G. (2023). The burden of cardiovascular disease in Mexico 1990-2021. Summary of the Global Burden of Disease 2021 study. Gac Med Mex, 159(6), 557-564.

Instituto Nacional de Estadística y Geografía. (2015). Características de las localidades y del entorno urbano 2014.

Instituto Nacional de Estadística y Geografía. (2015). Catálogo único de claves de áreas geoestadísticas estatales, municipales y localidades. Consulta y descarga. https://www.inegi.org.mx/app/ageeml/

Instituto Nacional de Salud Pública. (2012). Encuesta Nacional de Salud y Nutrición 2012: Aspectos Methológicos.

Jennings, V., Floyd, M. F., Shanahan, D., Coutts, C., & Sinykin, A. (2017). Emerging issues in urban ecology: Implications for research, social justice, human health, and well-being. Population and Environment, 39(1).

Münzel, T., Hahad, O., Sørensen, M., Lelieveld, J., Duerr, G. D., Nieuwenhuijsen, M., & Daiber, A. (2022). Environmental risk factors and cardiovascular diseases: A comprehensive expert review. Cardiovascular Research, 118(14), 2880–2902.

Romero-Martínez, M. (2012). Guía para el análisis de la ENSANUT 2012. Instituto Nacional de Salud Pública.

World Health Organization. (2017). Urban green space interventions and health: A review of impacts and effectiveness. WHO Regional Office for Europe.

FOR FURTHER INFORMATION

Connect with me on LinkedIn

View full study on ProQuest