Neighbourhood Walkability, Greenness and Associations with Mortality

Paul Villeneuve, PhD

Professor, Department of Neuroscience

Carleton University

Walkability

- Has many different definitions

> "Neighbourhood walkability is a measure of how well a neighbourhood promotes active forms of transportation, such as walking."
>
> *Ontario Public Health*

- Many elements in a neighbourhood can promote walkability

- *Tobin et al, 2022:* Rethinking walkability and developing a conceptual definition of active living environments to guide research and practice
  - Active Living Environments may be more appropriate term

Walk Score®

- Provides a measure the walkability for any address
- Uses a patented system.
- Based on analysis of walking routes to nearby amenities. Points are awarded based on the distance to amenities in each category.
  - Amenities within a 5 minute walk (.25 miles) are given maximum points.
- A decay function is used to give points to more distant amenities (no points given after a 30 m walk)
- Walk Score also measures pedestrian friendliness by analyzing population density and road metrics such as block length and intersection density.
- Data sources include Google, Factual, Great Schools, Open Street Map, Census data and places added by the Walk Score user community.

Walk Score®	Description
90–100	**Walker's Paradise** Daily errands do not require a car.
70–89	**Very Walkable** Most errands can be accomplished on foot.
50–69	**Somewhat Walkable** Some errands can be accomplished on foot.
25–49	**Car-Dependent** Most errands require a car.
0–24	**Car-Dependent** Almost all errands require a car.

Walk Score®

1125 Colonel By Drive

Capital, Ottawa, K1S 5B6

Commute to **Downtown Ottawa**

11 min | 19 min | 18 min | 58 min | View Routes

Favorite | Map | Nearby Apartments

Looking for a home for sale in Ottawa?

Walk Score 11

Car-Dependent

Almost all errands require a car.

Transit Score 62

Good Transit

Many nearby public transportation options.

Bike Score 92

Biker's Paradise

Daily errands can be accomplished on a bike.

About your score

Add scores to your site

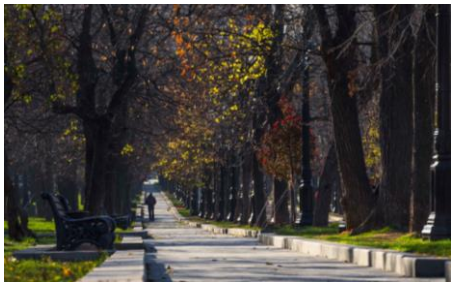
www.walkscore.com

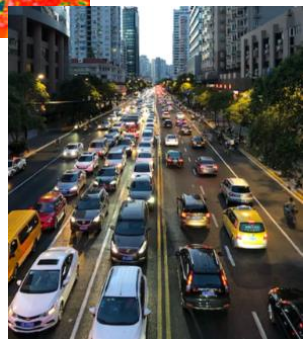
Possible Population Health Benefits

- Promotes physical activity
- Enhances sense of community
- Increased opportunity for social interactions
- Can support cultural experiences and vibrant experiences
- Reduce reliance on cars
  - Safer streets
  - Better air quality and less traffic noise

Relevance of urban built environments

- In 2018, 55% of the global population, lived in urban settings and increasing!
- In Canada, 82% of the population lives in urban areas
- The urban built environment plays a large role in public health.
    - Vehicle emissions, road traffic injuries, air pollution contributes to a large number of deaths and injuries.
    - Living near green spaces in urban settings helps protect individuals from premature mortality.
- The built environment may also play a role in reducing health inequities that result from socioeconomic disparities.

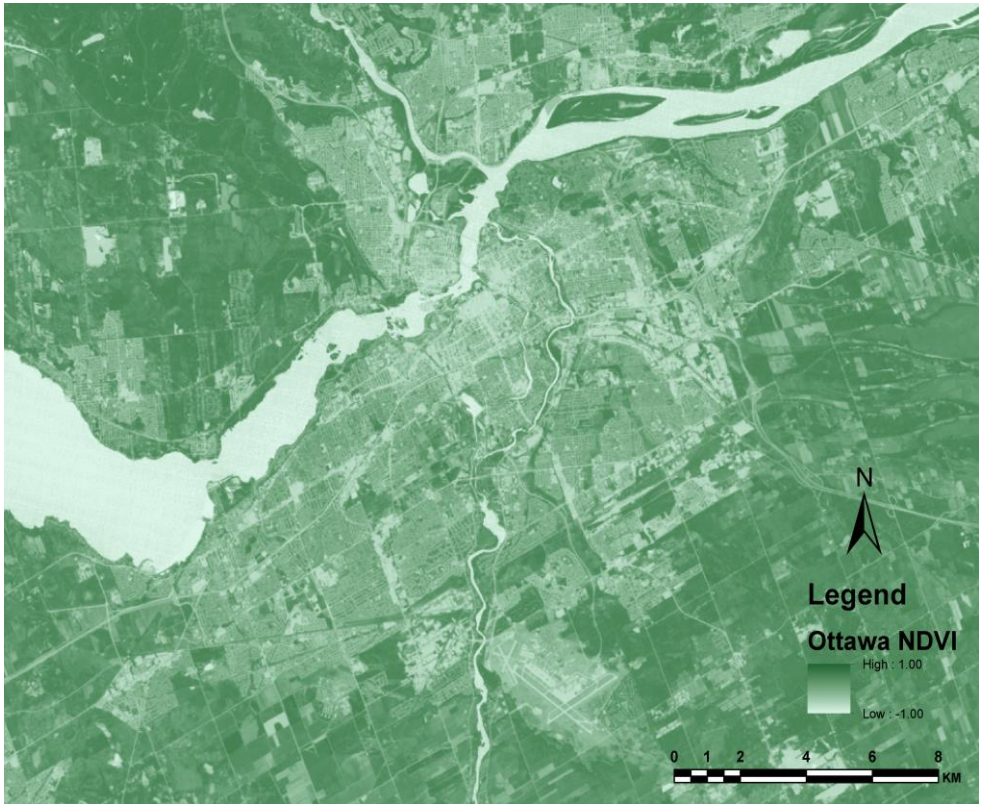




Canadian epidemiological studies of walkability

- Higher rates of childhood obesity in neighbourhoods with lower traffic safety
- Higher levels of walkability and park accessibility were both associated with reduced risks of hypertension, especially for lower income individuals.
- Walkable neighborhoods associated with greater active transportation in school children
- Some associations reported with cancer, diabetes and depression
- Features of built environment may help reduce socio-economic gradients in health

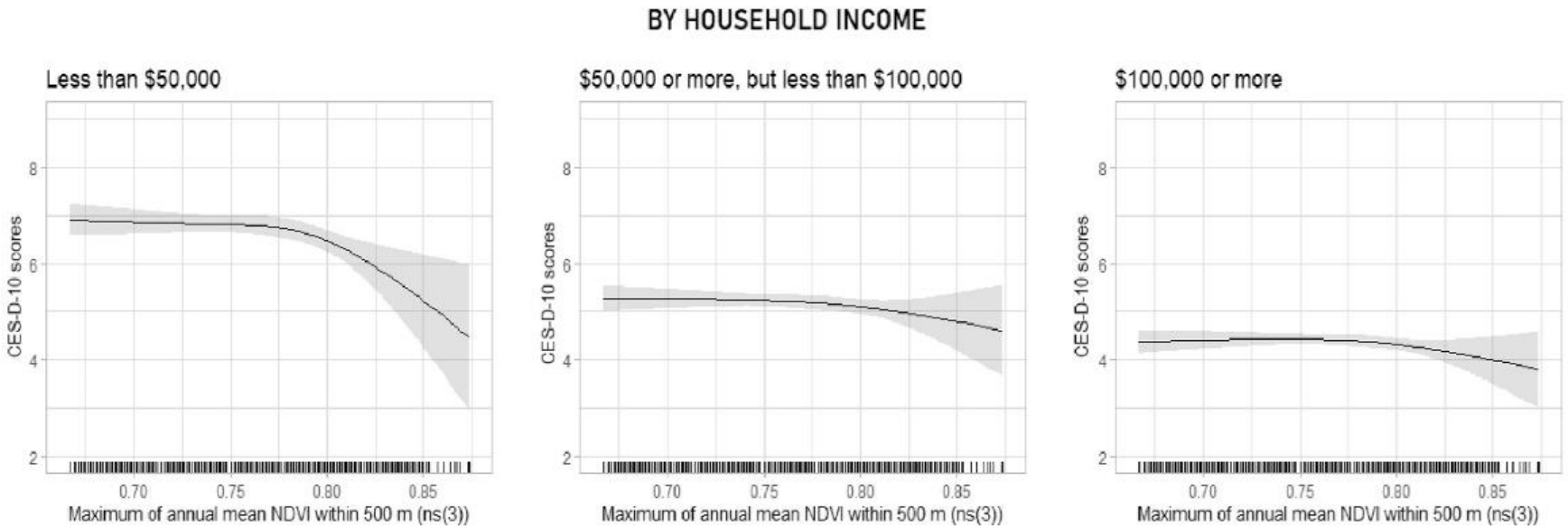
Greenness – Normalized Difference Vegetation Index



Role of Socio-economic Status: Depression

S. Abraham Cottagiri et al.

Environmental Research 206 (2022) 112587



Walkability and mortality

- Relatively few studies
- Most used an ecological study design
- Kooshari et al found lower rates of cardiovascular mortality in Japan (ecological)
- Griffin et al followed ~86,000 women for 7.5 years and found lower rates of cardiovascular mortality in more walkable neighbourhood
- Mah et al followed 250,000 Canadians and found lower rates (22%) of cardiometabolic mortality
  - No association noted in young women
  - Could not account for residential mobility
- Some authors have found stronger associations with neighborhood greenness (Liao et al, 2022)

Contents lists available at ScienceDirect

Environment International

journal homepage: www.elsevier.com/locate/envint

Full length article

Neighbourhood walkability and mortality: Findings from a 15-year follow-up of a nationally representative cohort of Canadian adults in urban areas

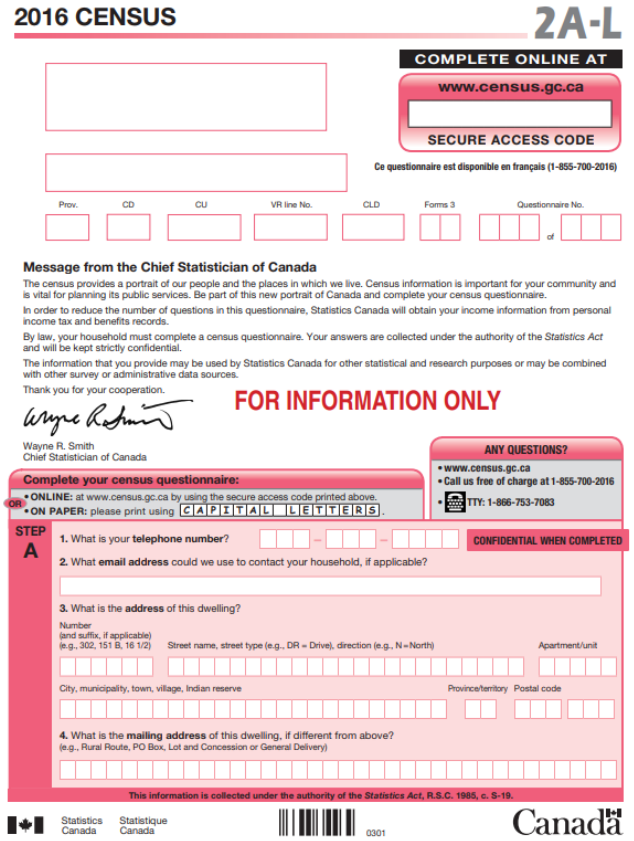
Justin J. Lang [a,b,*], Lauren Pinault [c], Rachel C. Colley [c], Stephanie A. Prince [a,d], Tanya Christidis [c], Michael Tjepkema [c], Dan L. Crouse [e], Margaret de Groh [a], Nancy Ross [f], Paul J. Villeneuve [b,g]

Research Objectives

1. To investigate the association between neighbourhood walkability and mortality using a retrospective cohort of 1.8 million Canadian adults followed over a 15.5 year period.
2. To investigate whether these associations differed
   - By Socio-Economic Status
   - Between men and women

Study Population

- Population based
- Consists of those who completed long form census in 2001 (~20%)
- Collects data on a number of risk factors related to mortality (including socio-economic status, occupational type, marital status, etc)
- Includes 1,786,610 participants with 27,324,330 person-years of follow-up.
    - Exclusions for age, rural dwellers, and recent immigrants



2016 CENSUS 2A-L

COMPLETE ONLINE AT
www.census.gc.ca
SECURE ACCESS CODE

Ce questionnaire est disponible en français (1-855-700-2016)

Prov. CD CU VR line No. CLD Forms 3 Questionnaire No. of

Message from the Chief Statistician of Canada

The census provides a portrait of our people and the places in which we live. Census information is important for your community and is vital for planning its public services. Be part of this new portrait of Canada and complete your census questionnaire.

In order to reduce the number of questions in this questionnaire, Statistics Canada will obtain your income information from personal income tax and benefits records.

By law, your household must complete a census questionnaire. Your answers are collected under the authority of the *Statistics Act* and will be kept strictly confidential.

The information that you provide may be used by Statistics Canada for other statistical and research purposes or may be combined with other survey or administrative data sources.

Thank you for your cooperation.

Wayne R. Smith
Chief Statistician of Canada

FOR INFORMATION ONLY

ANY QUESTIONS?
- www.census.gc.ca
- Call us free of charge at 1-855-700-2016
- TTY: 1-866-753-7083

Complete your census questionnaire:
- **ONLINE:** at www.census.gc.ca by using the secure access code printed above.

OR
- **ON PAPER:** please print using CAPITAL LETTERS.

STEP A

1. What is your **telephone number**? – –

CONFIDENTIAL WHEN COMPLETED

2. What **email address** could we use to contact your household, if applicable?

3. What is the **address** of this dwelling?

Number (and suffix, if applicable) (e.g., 302, 151 B, 16 1/2) | Street name, street type (e.g., DR = Drive), direction (e.g., N = North) | Apartment/unit

City, municipality, town, village, Indian reserve | Province/territory | Postal code

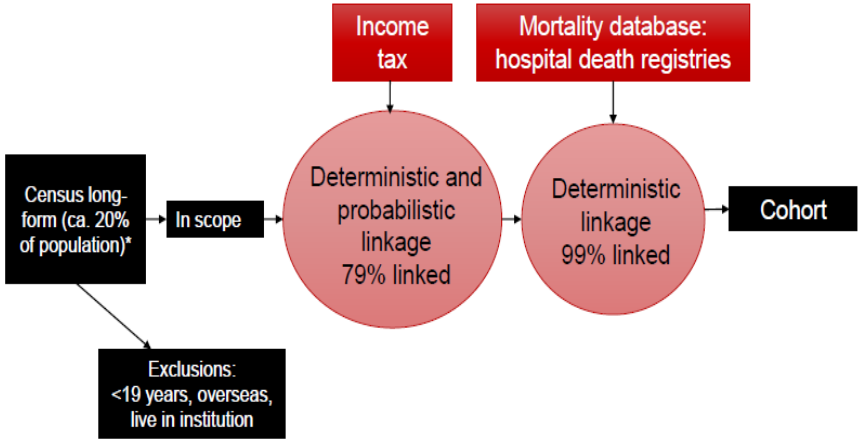
4. What is the **mailing address** of this dwelling, if different from above?
(e.g., Rural Route, PO Box, Lot and Concession or General Delivery)

This information is collected under the authority of the *Statistics Act*, R.S.C. 1985, c. S-19.

Statistics Canada Statistique Canada 0301 Canada

Walkability and Mortality: CANCHEC

- Annual place of residence determined from tax files (6 character PC)
- Mortality follow-up for 15 years
- Measure of walkability assigned to residential address



Ref: Pinault LL, Finès P, Labrecque-Synnott F, Saidi A, Tjepkema M. 2016. The 2001 Canadian Census-Tax-Mortality Cohort: a 10-year follow-up. Analytical Studies: Methods and References. Statistics Canada. Cat No. 11-633-X.

Measure of Neighbourhood Walkability

- 2006 Canadian Active Living Environments (Can-ALE) index.
  - Derived from two local measures:
    - Intersection density
    - Dwelling density
  - Proximity to destinations and transit were added in 2016.
- Organized in quintiles
  - Can-ALE Class 1 = low walkability (reference group)
  - Can-ALE Class 5 = high walkability
- Provides estimates of walkability for every neighbourhood in Canada!
- Attached to CanCHEC using annual residential postal code.

CANUE DATA PORTAL

ADVANCING RESEARCH ON URBAN LIVING AND HUMAN HEALTH

NOVEMBER 25, 2022

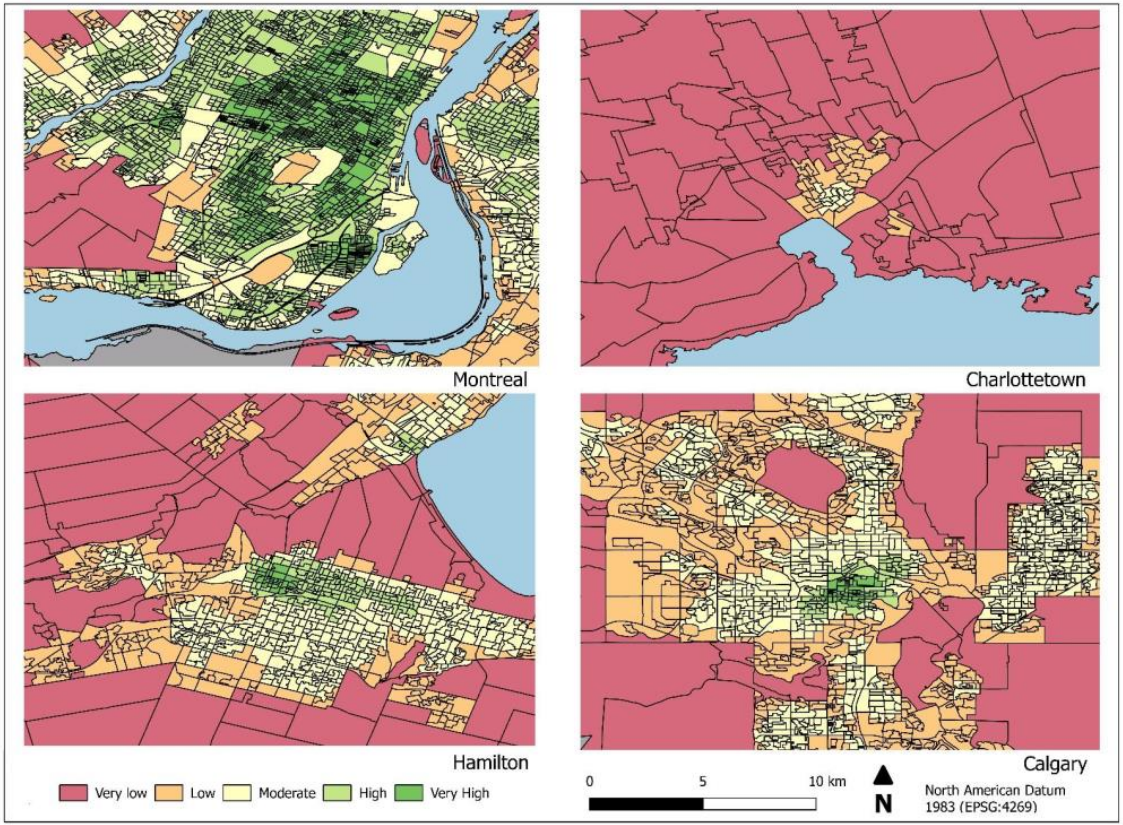
WELCOME TO CANUE DATA PORTAL

Help us improve! Send a report of any issues to info@canue.ca along with browser and computer operating system information

CANUE WEBPAGE

Canadian Active Living Environments

Example Figure of the Can-ALE distribution across four major Canadian cities.



Causes of death evaluated

- Cardiovascular disease mortality (primary outcome)
- All non-accidental causes
- Ischemic heart disease
- Cerebrovascular disease
- Motorized vehicle mortality

Other Risk Factors accounted for

Covariates

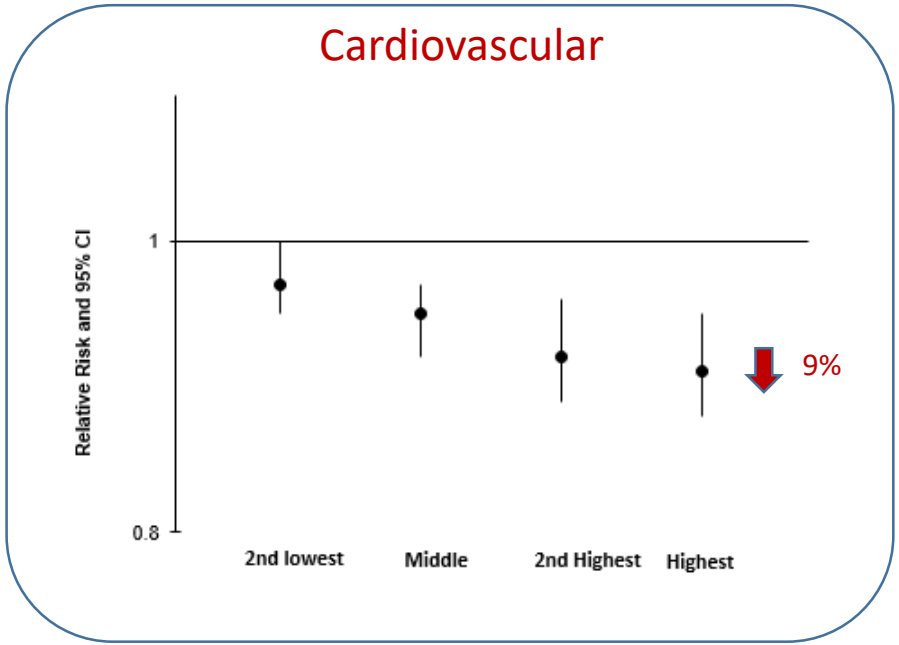
- **Baseline individual**
  - Sex
  - Indigenous identity
  - Immigrant status (>10 years)
  - Highest level of educational attainment
  - Marital status
  - Employment status
  - Household income adequacy quintile

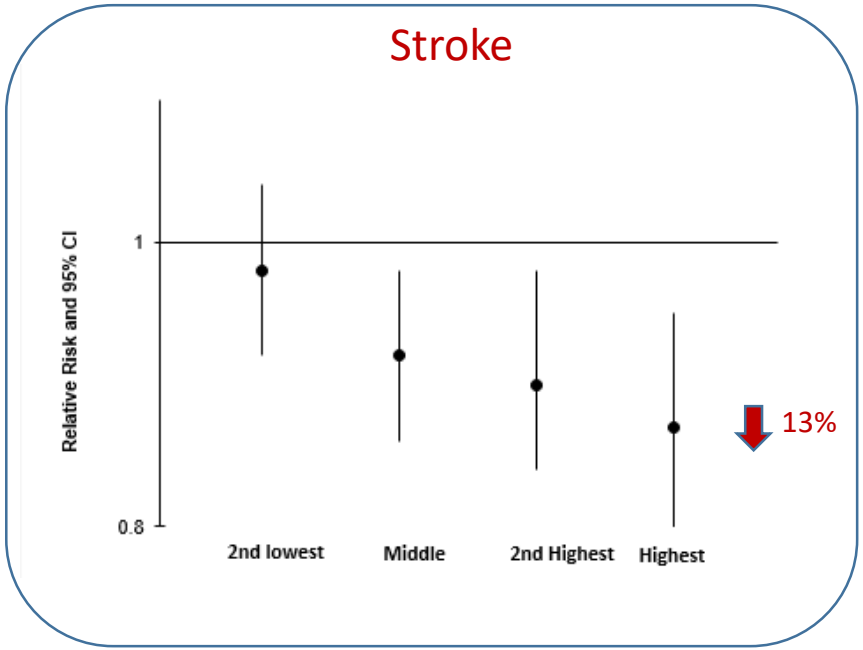
- **Contextual**
  - 2006 Canadian Marginalization (Can-MARG) index
    - Residential instability, material deprivation, dependency, ethnic concentration
  - Ambient air pollution ($PM_{2.5}$)
  - Neighbourhood greenness (Normalized Difference Vegetation Index [NDVI])

Statistical Analysis

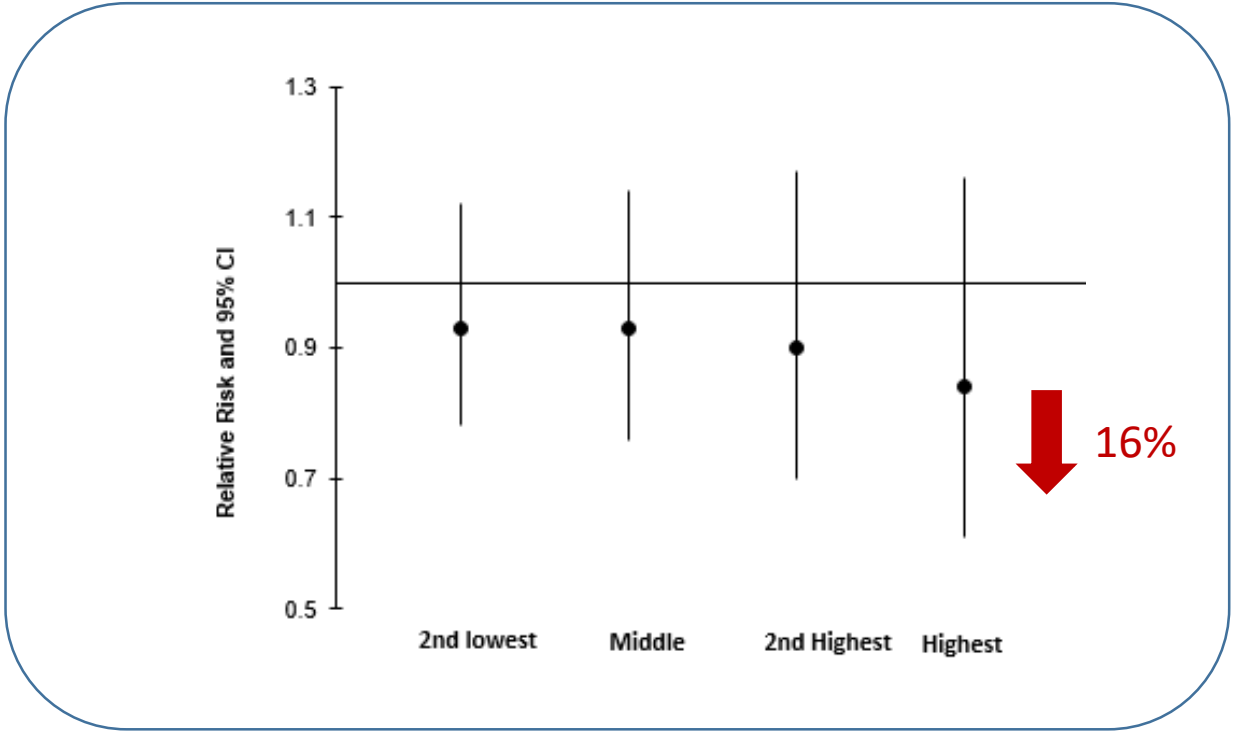
1. Cox Proportional Hazard models (survival analysis)
    - Using follow-up time
    - Right censored at time of death, mobility, end of study
1. Indirect adjustment
    - Obesity and smoking status using CCHS data
1. Effect modification analysis
    - Attained age, sex, education, household income, neighbourhood deprivation

Associations between walkability (CanALE) and mortality

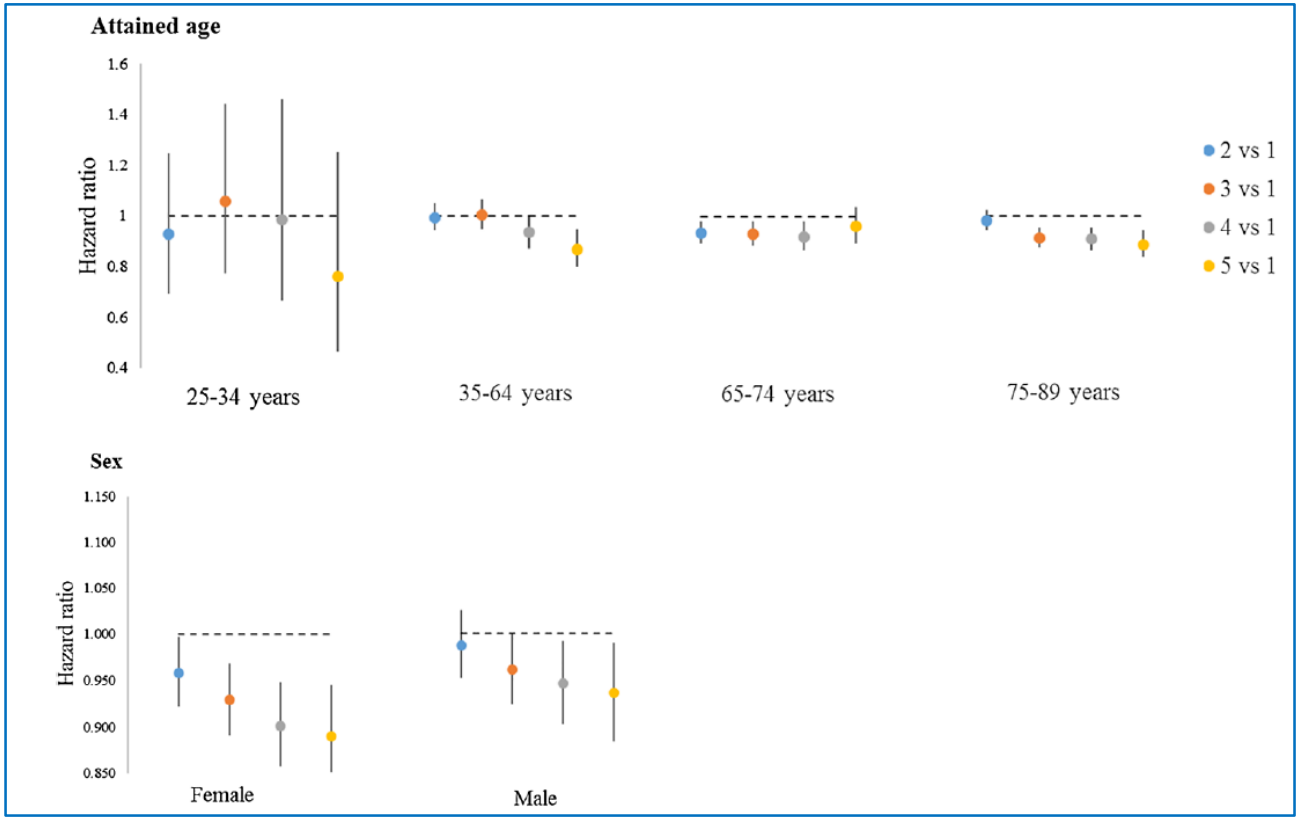




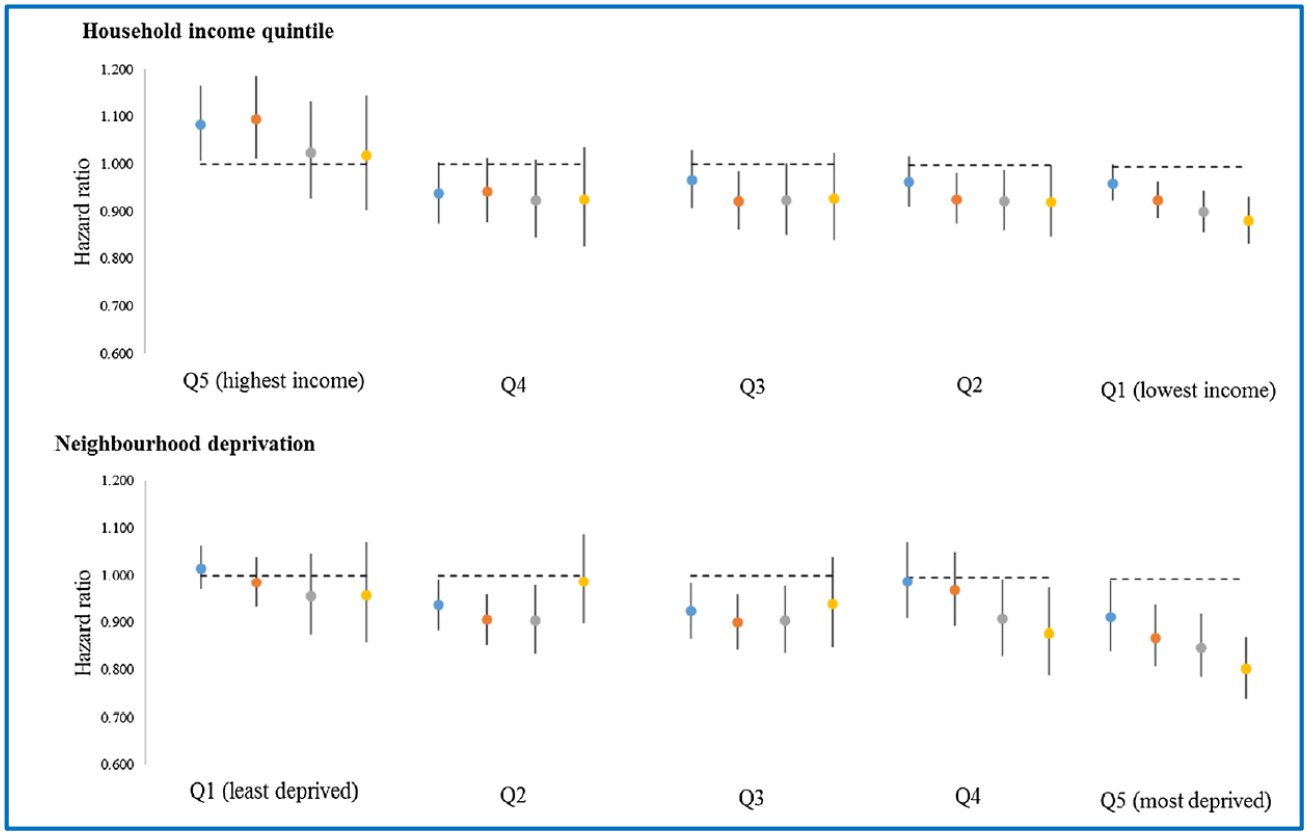
Associations between walkability (CanALE) and traffic mortality



Associations between walkability and cardiovascular mortality by age-group and sex



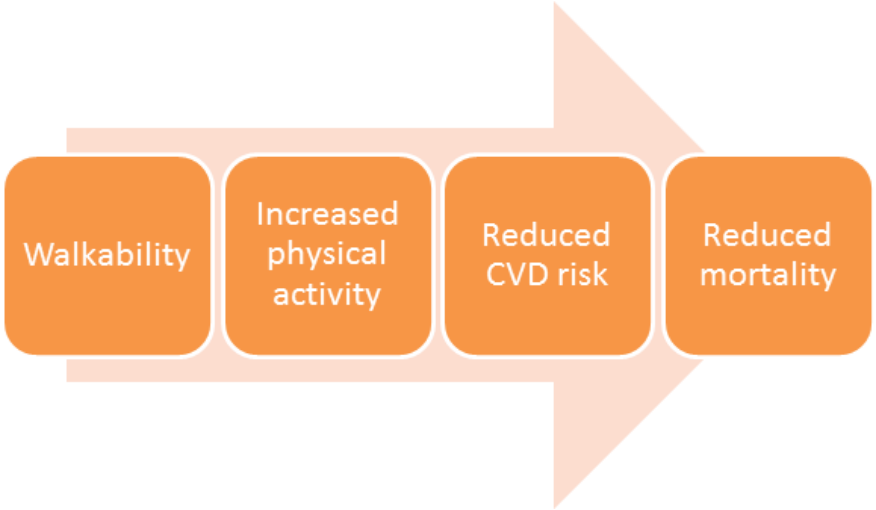
Associations between walkability and cardiovascular mortality by household income and are deprivation



DISCUSSION

Main Findings

- Living in the most walkable neighbourhoods was associated with statistically significant REDUCTIONS in cardiovascular disease (9%) and all non-accidental mortality (3%).
- Associations remained significant after indirectly adjusting for important disease risk factors (i.e., obesity and smoking).
- Those who belong to the lowest socioeconomic groups benefit the most from living in highly walkable neighbourhoods.



Study strengths

- Large sample size
- Relatively long follow-up
- Population based representative population
- Able to track year by year mobility
- Ability to adjust for other environmental exposures (greenness and air pollution)

Study limitations

- Lack of data for some important risk factors – used indirect adjustments
- Possible self-selection bias – healthier individuals may choose to live in more walkable neighbourhoods
- Relied on measure of walkability in 2006 (these could change over time)
- Walkability measure depended on intersection and population density

Highlights

- While protective effects are modest, they impact many people, and having walkable neighbourhoods could produce widespread mortality benefits
- Findings suggest that improving walkability in lower SES neighbourhood may help reduce socioeconomic-related health (mortality) inequalities
- Benefits of walkability are likely to extend to other determinants of health not capture in this study
- Features of the urban built environment are interrelated – efforts to improve greenness may provide even greater benefits

Urban greenness and mortality in Canada's largest cities: a national cohort study

Dan L Crouse, Lauren Pinault, Adele Balram, Perry Hystad, Paul A Peters, Hong Chen, Aaron van Donkelaar, Randall V Martin, Richard Ménard, Alain Robichaud, Paul J Villeneuve

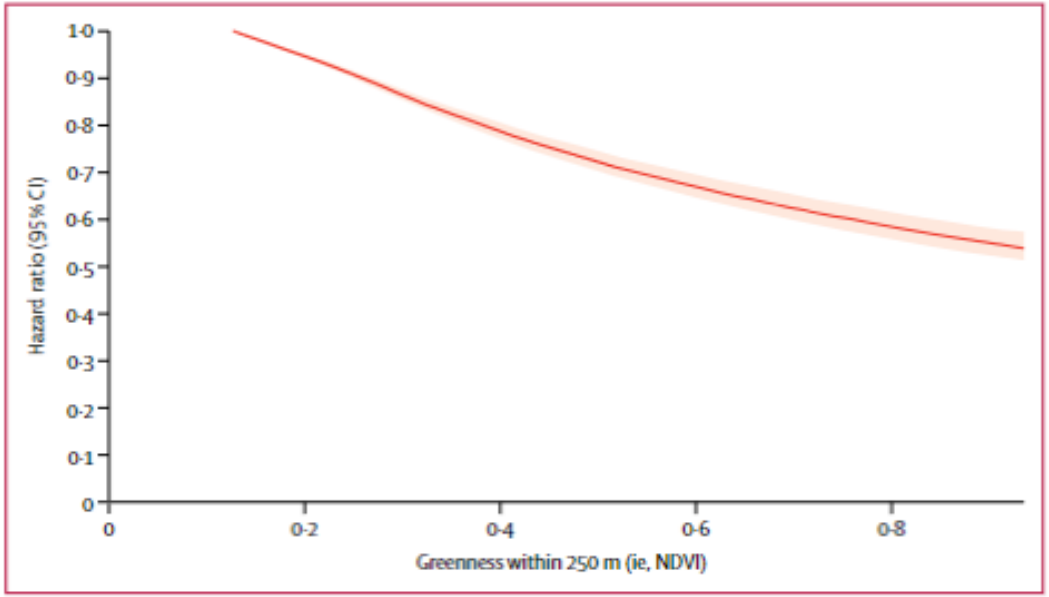


Figure: Concentration–response plot for mortality and greenness
Data are hazard ratios (dark red line) and 95% CIs (light pink shading) for mortality association with greenness within 250 m of participants' residences from model 9 (as described in table 2). NDVI= Normalized Difference Vegetation Index.

Acknowledgements

CIHR IRSC
Canadian Institutes of Health Research
Instituts de recherche en santé du Canada

Public Health Agency of Canada
Agence de la santé publique du Canada

Justin Lang, PHAC
Public Health Agency of Canada

Susanna Cottagiri,
Queen's University

Contact: Paul.Villeneuve@carleton.ca