The webinar, "**Exploring the geography of cognitive function and social support availability: A spatial analysis of the CLSA**" will begin shortly.

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- If you have questions/comments, you can type them into the chat box in the bottom right of the WebEx window. Ensure "All Presenters" is selected from the dropdown menu before you press "send." Mobile users must select "Chat with Everyone." Questions will be visible to all attendees.

- You can type your questions at any point during the session, but they won't be answered until the end of the presentation.

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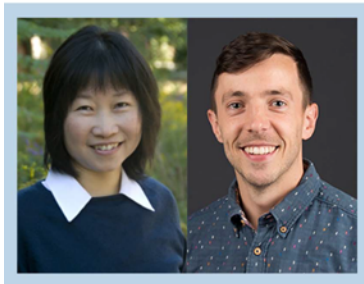
CLSA Webinar Series



Exploring the Geography of Cognitive Function and Social Support Availability

Dr. Jane Law and Matthew Quick

12 to 1 PM ET | MAY 29, 2018

This webinar will explore the geographic dimensions of cognitive functioning and social support availability in the Canadian Longitudinal Support of Aging (CLSA). Focusing on the tracking cohort, a multi-scale spatial model is applied to estimate measures of global cognitive functioning and overall social support availability at the forward sortation area level. Clusters of cognitive functioning and overall social support are identified and approximately ten percent of all areas are found to have both low global cognitive functioning and low social support availability. Focusing on the comprehensive cohort for three Data Collection Sites, spatially interpolated maps of global cognitive functioning and overall social support availability are compared and the relationships between cognitive functioning, social support availability, and area-level census variables are explored. In conclusion, the challenges and limitations of analysing spatial data in the CLSA are discussed.

Register online at bit.ly/clsawebinars

clsa élcv
Canadian Longitudinal Study on Aging
Étude longitudinale canadienne sur le vieillissement

Webinars will be broadcast using WebEx
Further instructions will be sent by email.

www.clsa-elcv.ca

Exploring the geography of cognitive function social support: A spatial analysis of the Canadian Longitudinal Study on Aging

Matthew Quick (mquick@uwaterloo.ca)

Jane Law (jane.law@uwaterloo.ca)

University of Waterloo

Objectives

1. **Understand the "geography" of the CLSA.**

   Geographical data, analytical approaches, challenges,

2. **Is there overlap between clusters of high/low cognitive function with clusters of high/low social support?**

   Do areas with high function also have high support?

3. **How does geography help understand the relationship between cognitive function and social support?**

   What covariates are associated with cognitive function? How much variability is explained by 'location'?

What is spatial analysis?

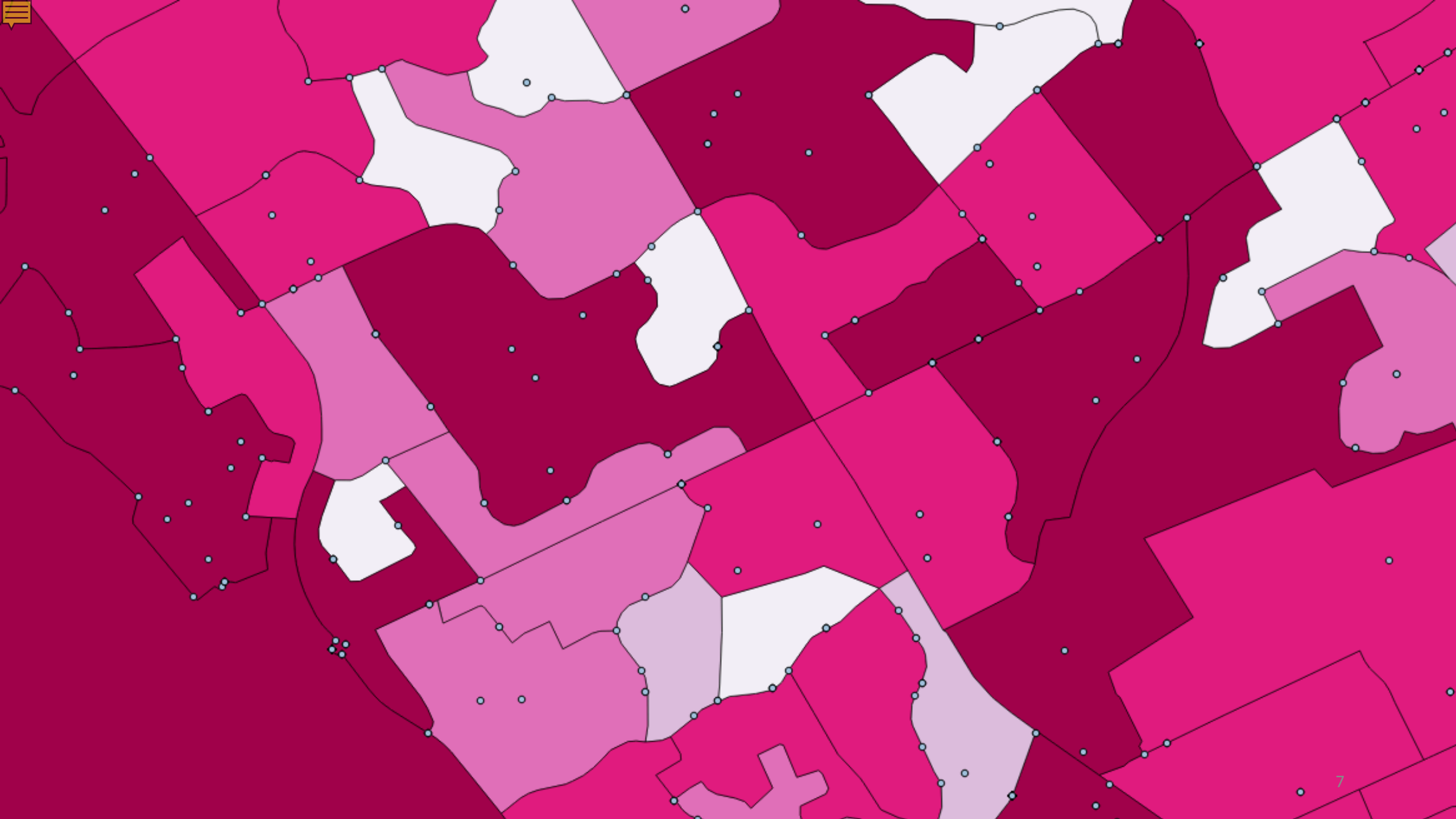
Defining spatial analysis

Spatial data:

- Data where both the attribute of interest and its location on the earth are recorded
- Point data and area data

Analytical framework:

- Techniques and models that explicitly use the spatial referencing associated with data points
- Operationalize assumptions about, or draw on data describing, the spatial relationships between data



Analytical approaches

Exploratory spatial data analysis:

· Identify spatial patterns of data

· Formulate spatially-oriented hypotheses

· Example: Cluster detection

Confirmatory spatial data analysis:

· Model specification, parameter estimation, and inference

· Example: Spatial regression

Multilevel data

Multilevel analyses and health

Multilevel analyses: The study of the effects of collective or group characteristics on individual-level outcomes

“Place” as group membership:

· Participants (level 1) are nested in shared geographical units (level 2)

· Geographical units: state, region, neighbourhood/community, school, family

“Space” of groups:

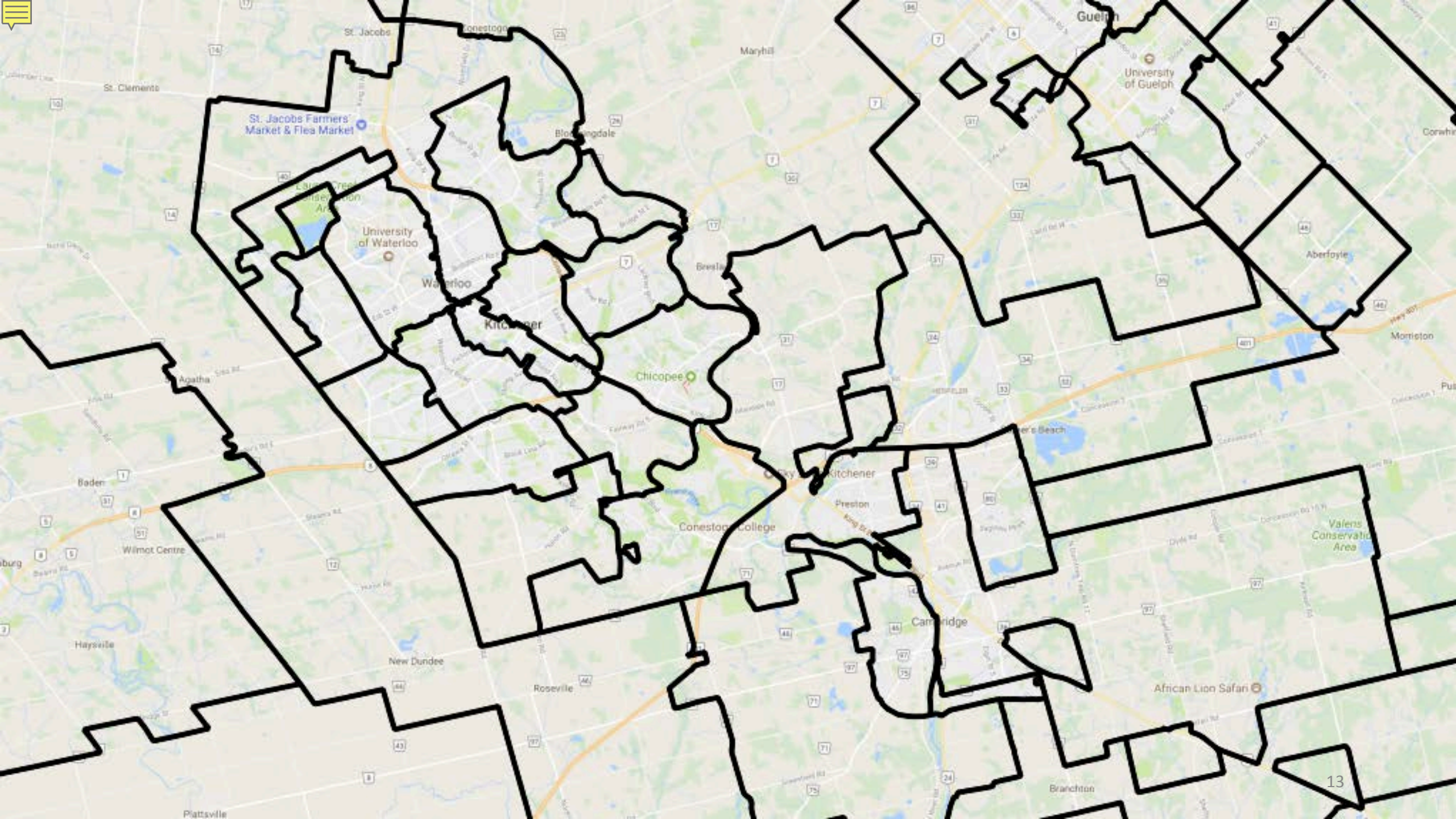
· Consider the absolute and relative locations of Level 2 units

Geography in the CLSA

Geography in the CLSA

Spatial information within the CLSA includes:

- Province
- Census Subdivision
- Data Collection Site
- Forward sortation area (FSA)


St. Jacobs
Maryhill
Guelph
St. Clements
St. Jacobs Farmers' Market & Flea Market
University of Guelph
University of Waterloo
Waterloo
Kitchener
Chicopee
Aberfoyle
Agatha
Baden
Wilmot Centre
Preston
Cambridge
Hayesville
New Dundee
Roseville
African Lion Safari
Branchton
Plattsville

Geography and the CLSA

Tracking assessment:

· Collected for all provinces

· 21,000+ participants over ~ 1,540 FSAs

· ~ 13 participants per FSA

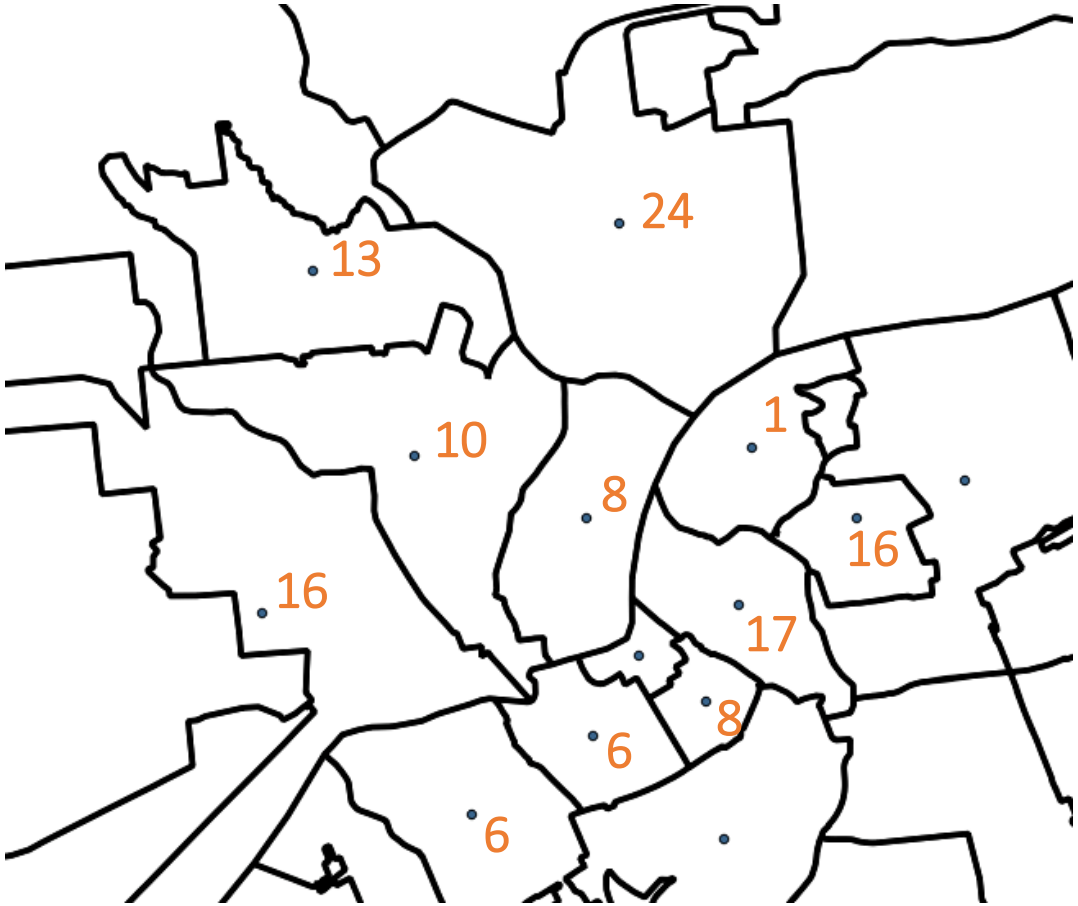
Comprehensive assessment:

· Collected at 11 Data Collection Sites

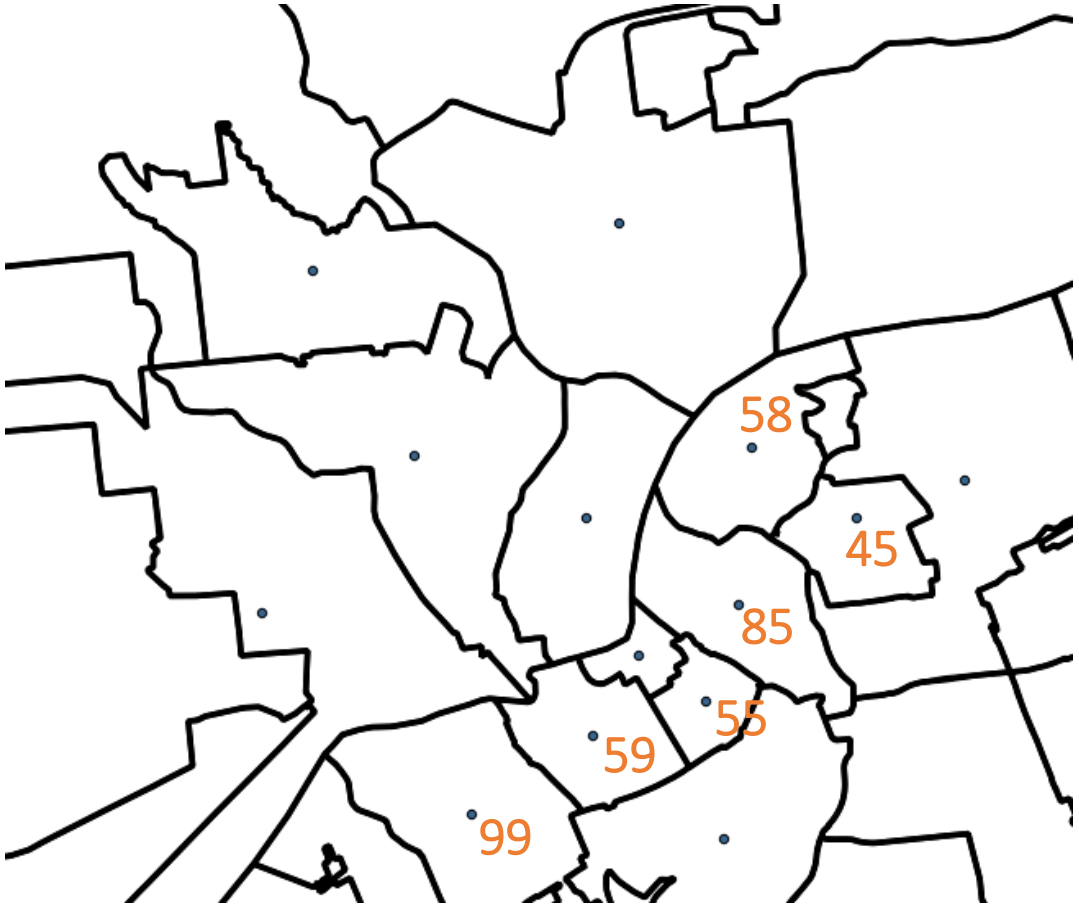
· 30,000+ participants over 505 FSAs

· = ~ 60 participants per FSA

Tracking



Comprehensive



Cognitive function and social support

Cognitive functioning and social support

Social support is positively associated with physical and mental health outcomes, including cognitive function.

Why?

1. Engaging in social activities fosters communication and interpersonal interactions = mental stimulation = synaptogenesis.

2. Positive emotions from social support = protect against stress and anxiety = reduce cardiovascular reactivity.

3. Social network = more physical activity = reduce cardiovascular events = benefits to cognitive function and associated risk factors.

A geographical perspective

The characteristics of one's living environment influence cognitive functioning.

Older adults, in particular:

· Often have mobility constraints

· Spend a significant amount of time within a community

· Are dependent on local resources and services

· May be strongly influenced by local environments

A geographical perspective

1. **Engaging in social activities**

   Socioeconomic and demographic composition shape socializing, social capital.

2. **Access to services**

   Health services, resources, and mentally-stimulating activities are not equally distributed.

3. **Built environment**

   Quality and design of living environment, safety, walkability.

Data: Variables

Global cognitive functioning:

· Memory

· Executive functioning

Overall social support:

· Emotional/informational support

· Tangible support

· Positive social interaction

· Affectionate support

Analysis: Spatial cluster analysis

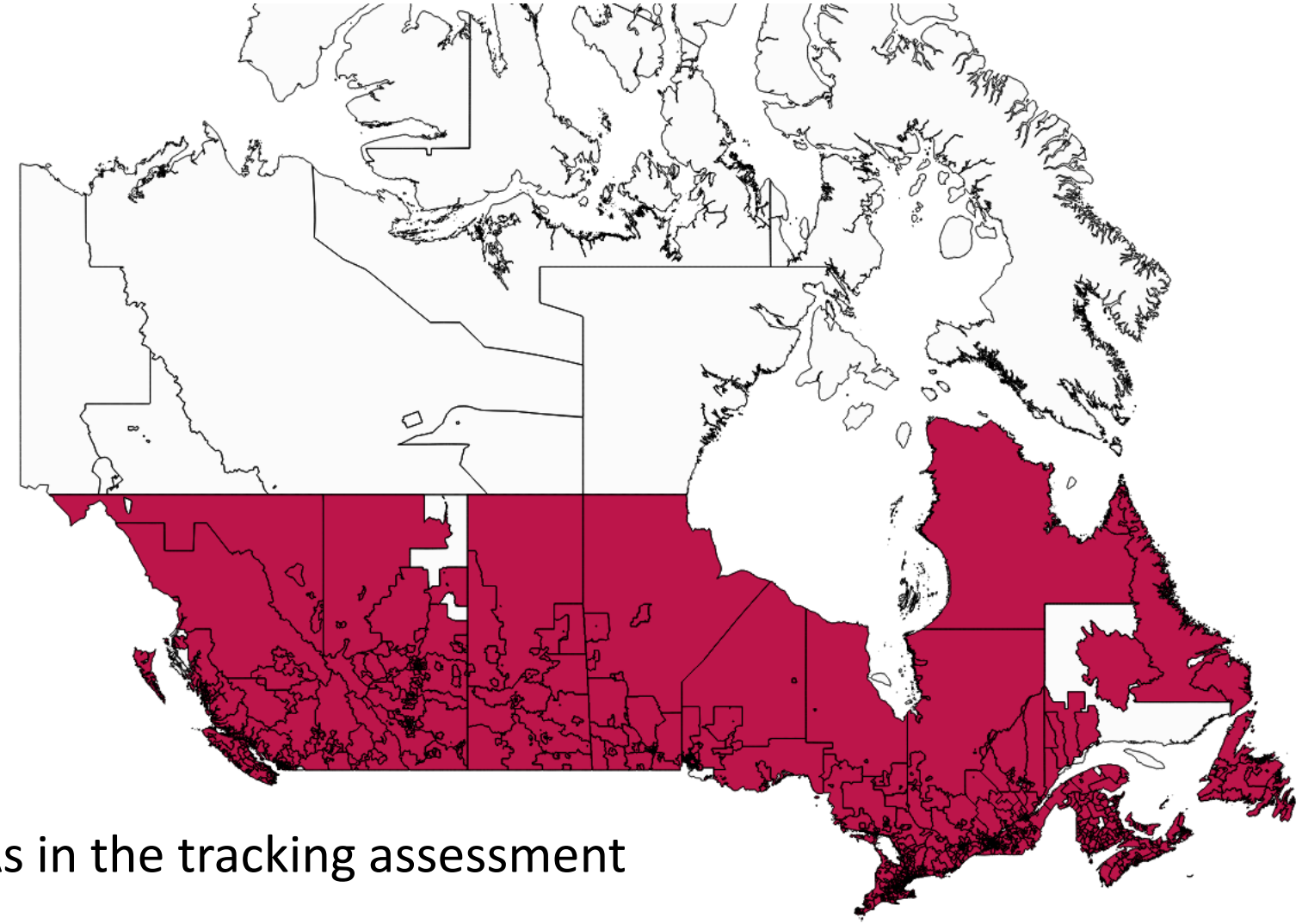
Spatial cluster analysis: Questions

Question 1: How can we generate area-level estimates of cognitive functioning and social support?

Question 2: How important is geography in explaining cognitive function and social support, as per the tracking assessment?

Question 3: Where are high/low clusters located? To what degree do these clusters overlap?

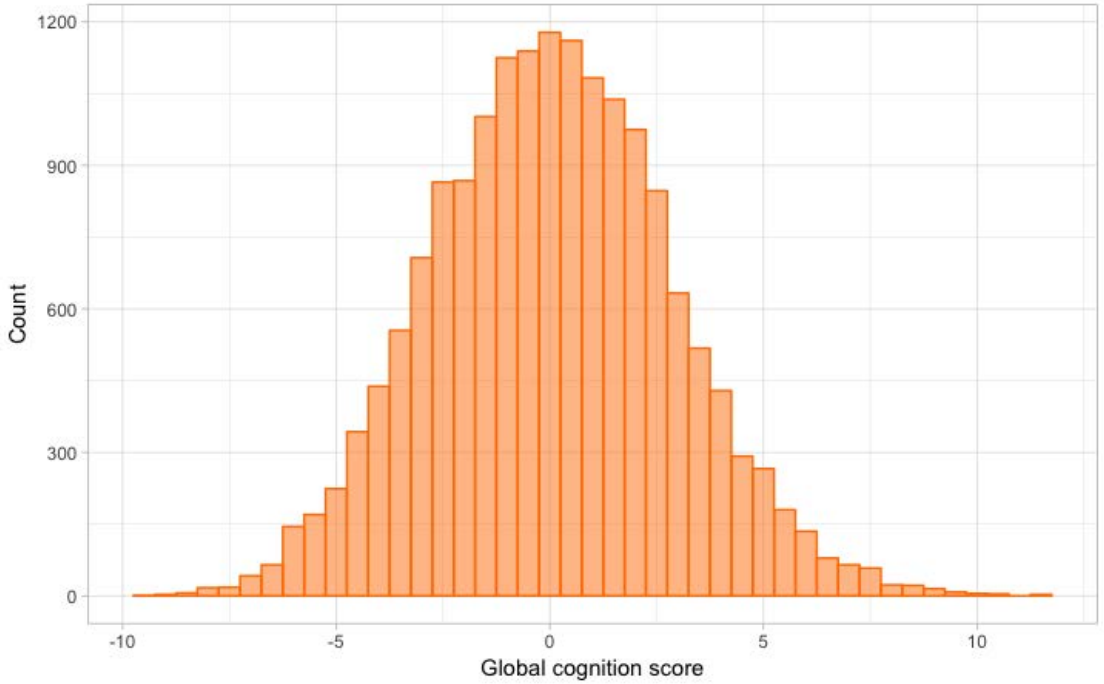
Data



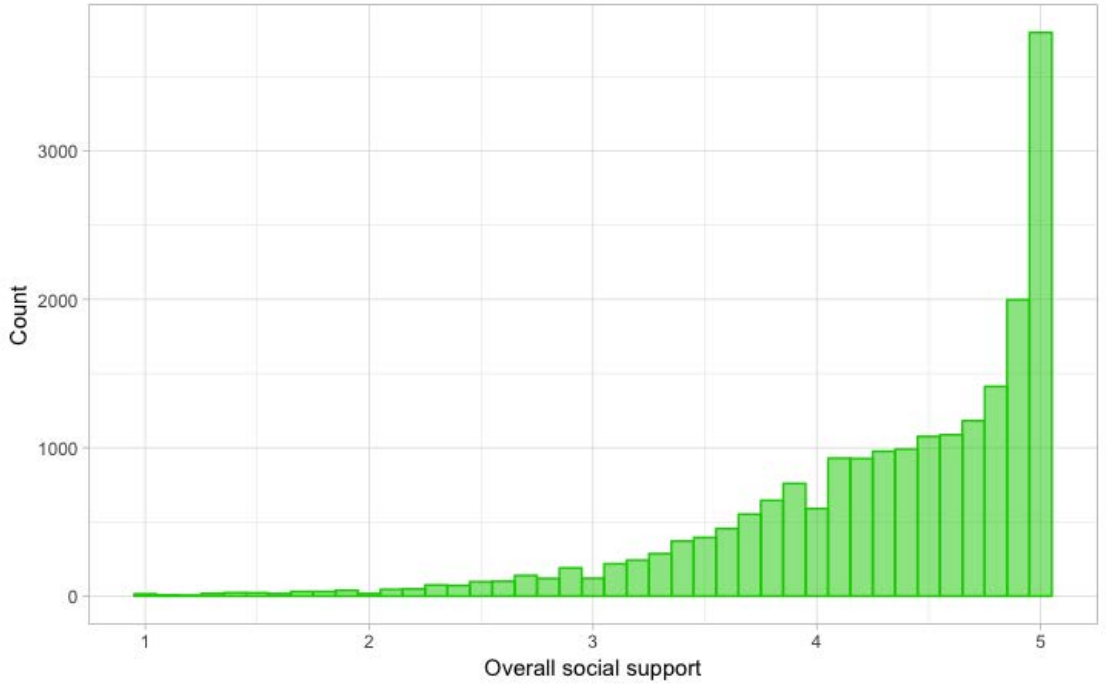
FSAs in the tracking assessment

Data

Global cognition



Overall social support



Modeling

Multilevel model with one individual-level covariate:

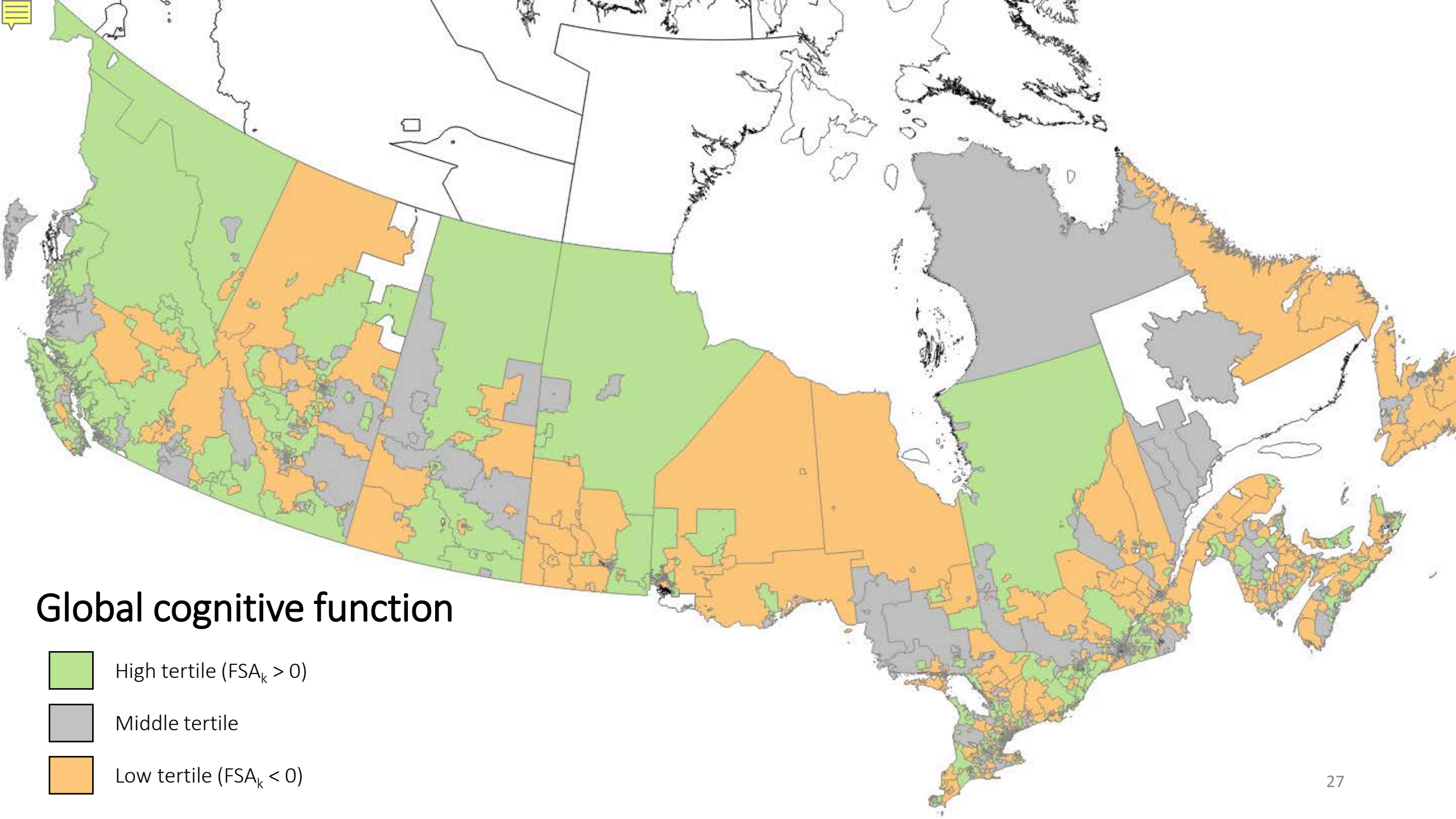
$$Y_i \sim \text{Normal}(\mu_i, \sigma^2_\mu)$$
$$\mu_i = \alpha + (\beta \cdot \text{RURAL}_i) + \text{FSA}_k$$
$$\text{FSA}_k \sim \text{Normal}(0, \sigma^2_F)$$

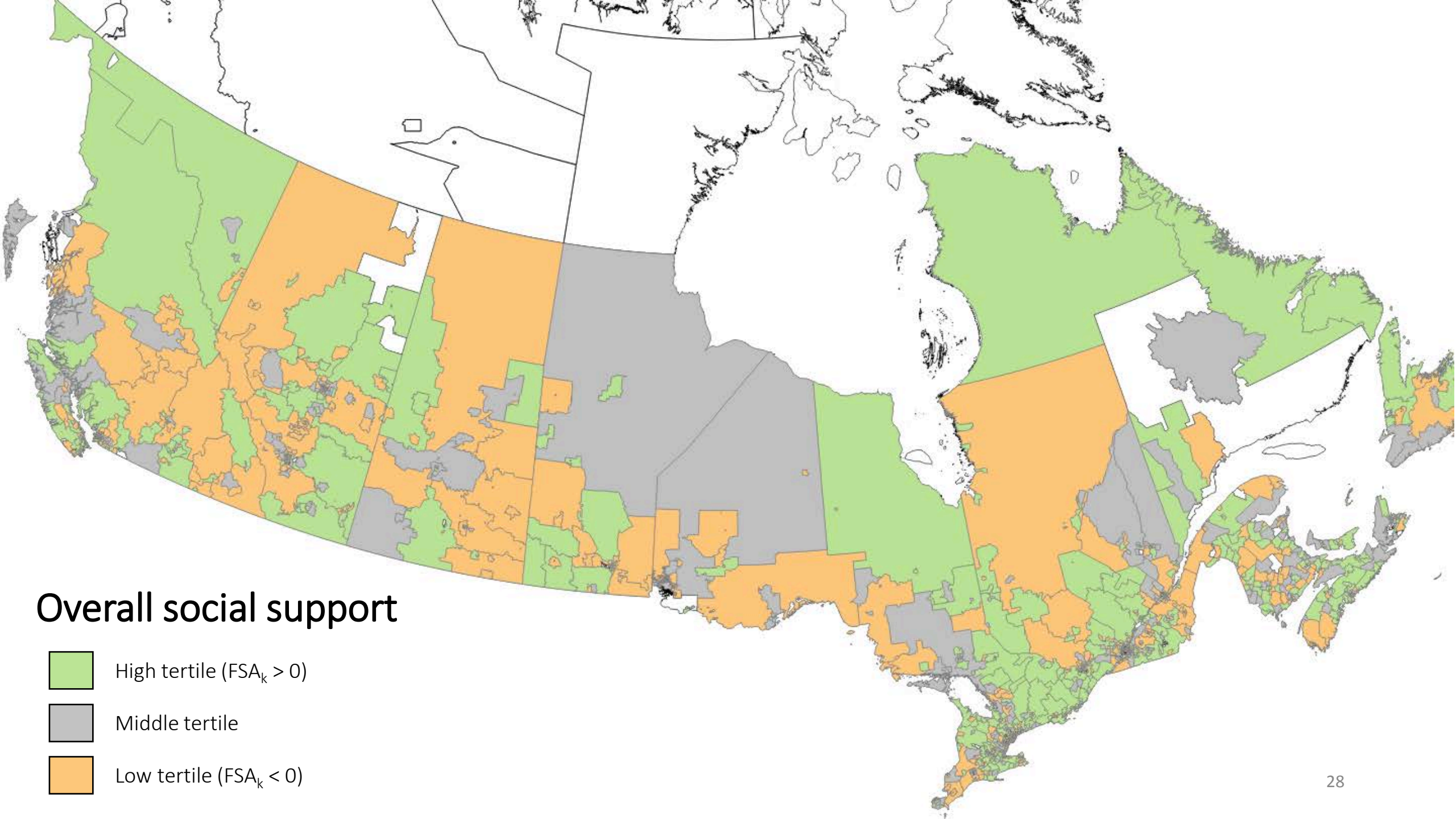
Interpretation: Cognitive functioning or social support for each participant (Y_i) is the sum of an overall intercept (α), a covariate for rurality (binary), and FSA-specific effects (FSA_k). Between-individual variance is σ^2_μ and between-area variance is σ^2_F.

Results

	Global Cognition	Overall social support
Individual:		
Intercept	0.13	4.32
β (RURAL)	-0.08 (-0.16 – -0.01)	0.02 (-0.01 – 0.05)
Forward sortation area:		
Range of FSA_k	-0.51 – 0.63	-0.17 – 0.08
Variance explained (VPC_{FSA})	2.25 %	1.64 %

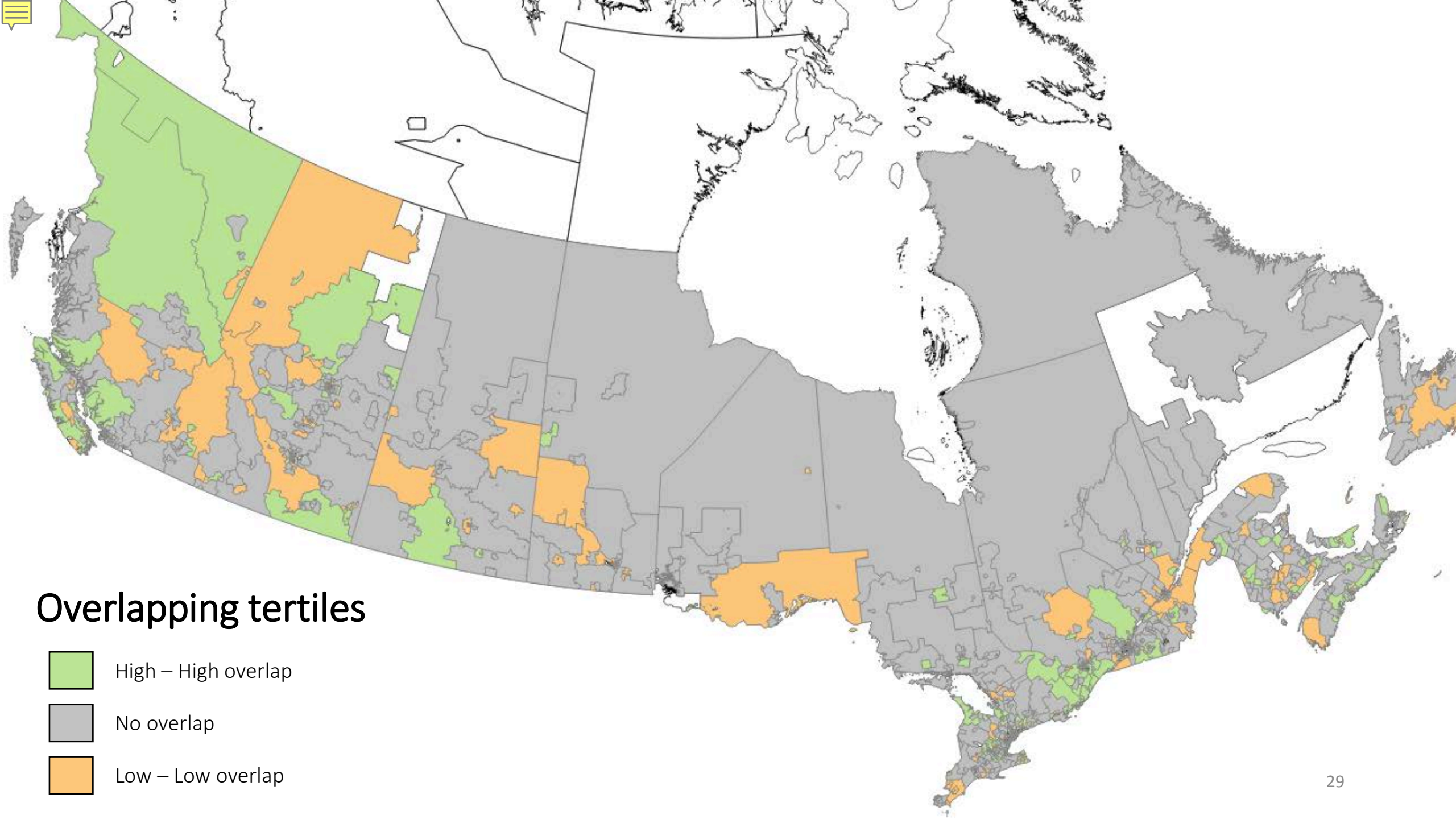
$$VPC_{FSA} = \sigma^2_F / (\sigma^2_\mu + \sigma^2_F)$$


Global cognitive function
High tertile ($FSA_k > 0$)
Middle tertile
Low tertile ($FSA_k < 0$)



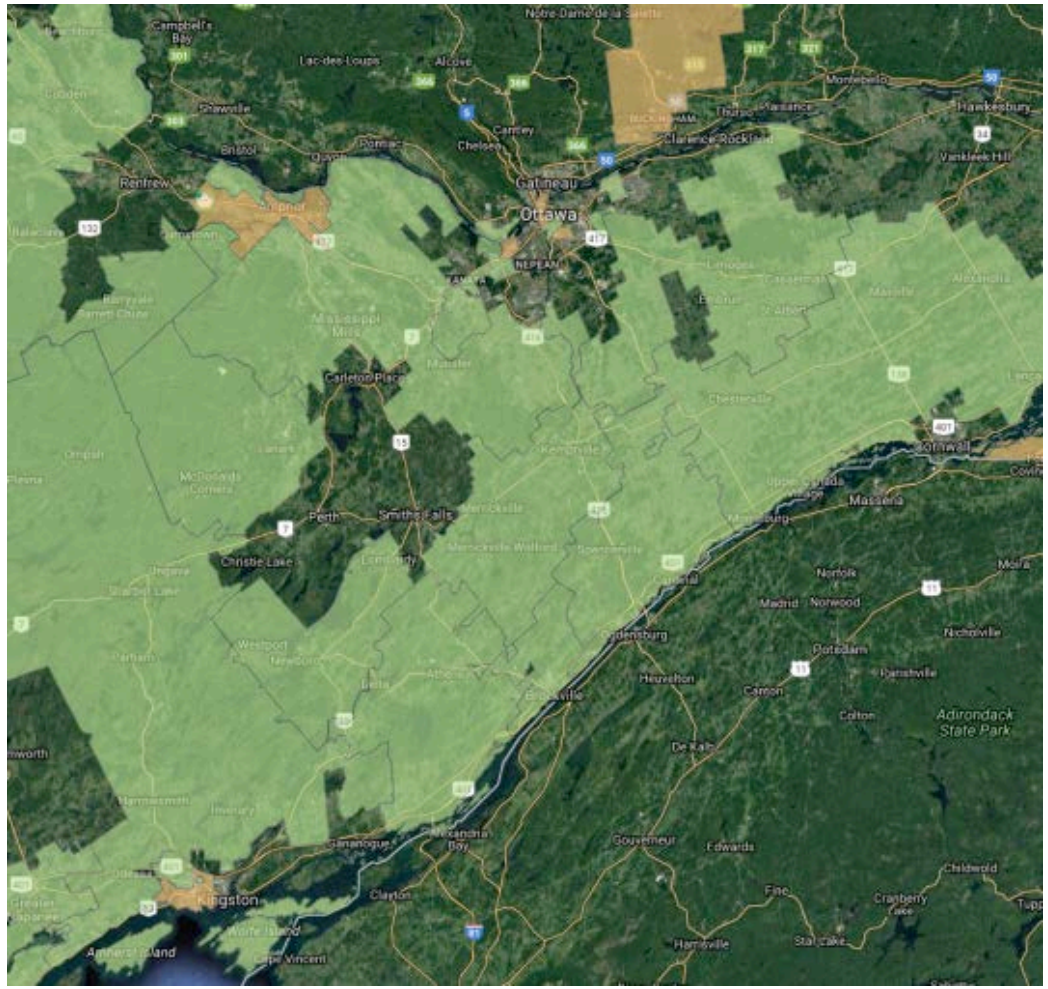
Overall social support

- High tertile ($FSA_k > 0$)
- Middle tertile
- Low tertile ($FSA_k < 0$)

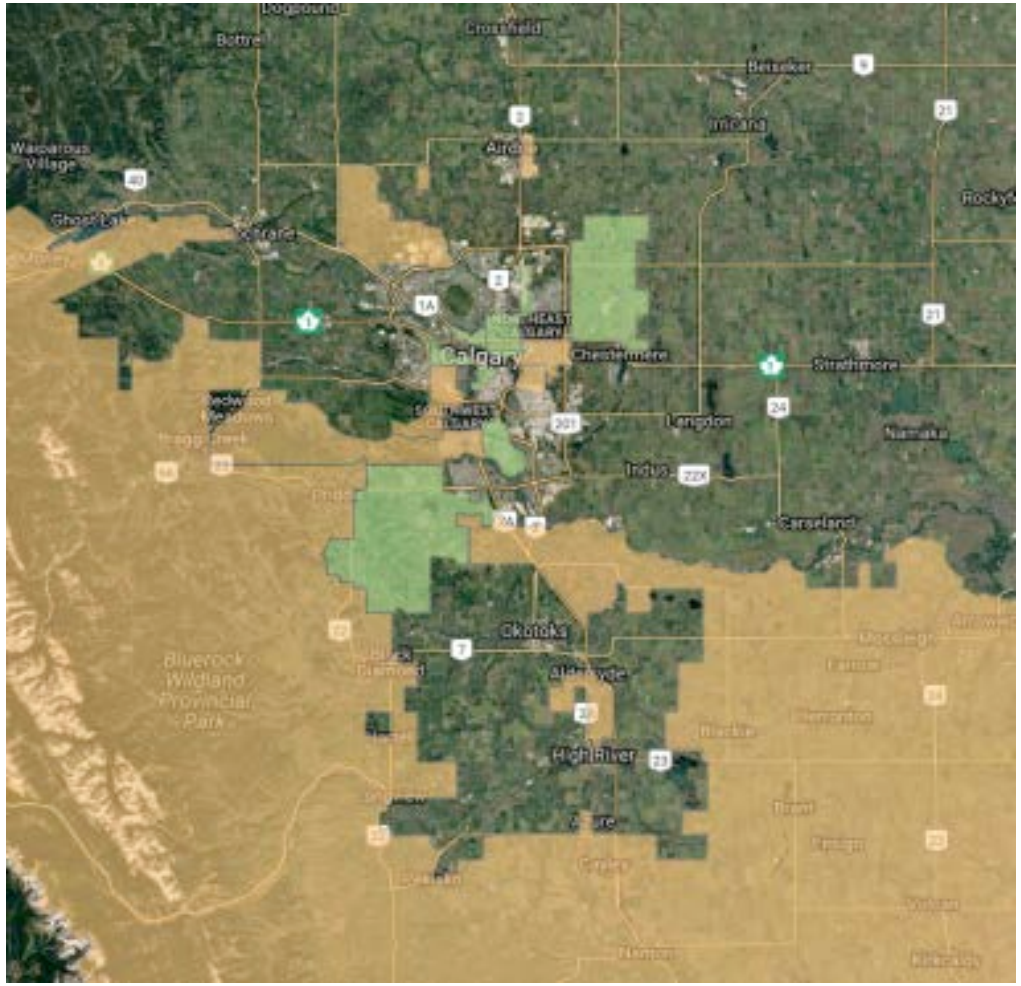

Overlapping tertiles
High – High overlap
No overlap
Low – Low overlap

Vancouver / Victoria

Ottawa / Kingston



Calgary



Quebec City

Spatial cluster analysis

Summary:

1. Area-level effects are relatively more important for cognitive functioning (VPC = 2.25%) than social support (VPC = 1.64%)
2. Two times more areas had different cluster classifications (= 912), than areas with overlapping classifications
3. Amongst the areas with overlapping clusters, about two times as many areas had high–high clusters (= 366) than had low–low clusters (= 197)
4. Challenging to interpret patterns at national-level using tracking dataset (FSA size)

Analysis: Multilevel spatial modeling

Multilevel modeling: Questions

Question 1: Is overall social support associated with global cognitive functioning, as per the comprehensive assessment?

After controlling for additional covariates?

Question 2: How important are FSAs for understanding this relationship?

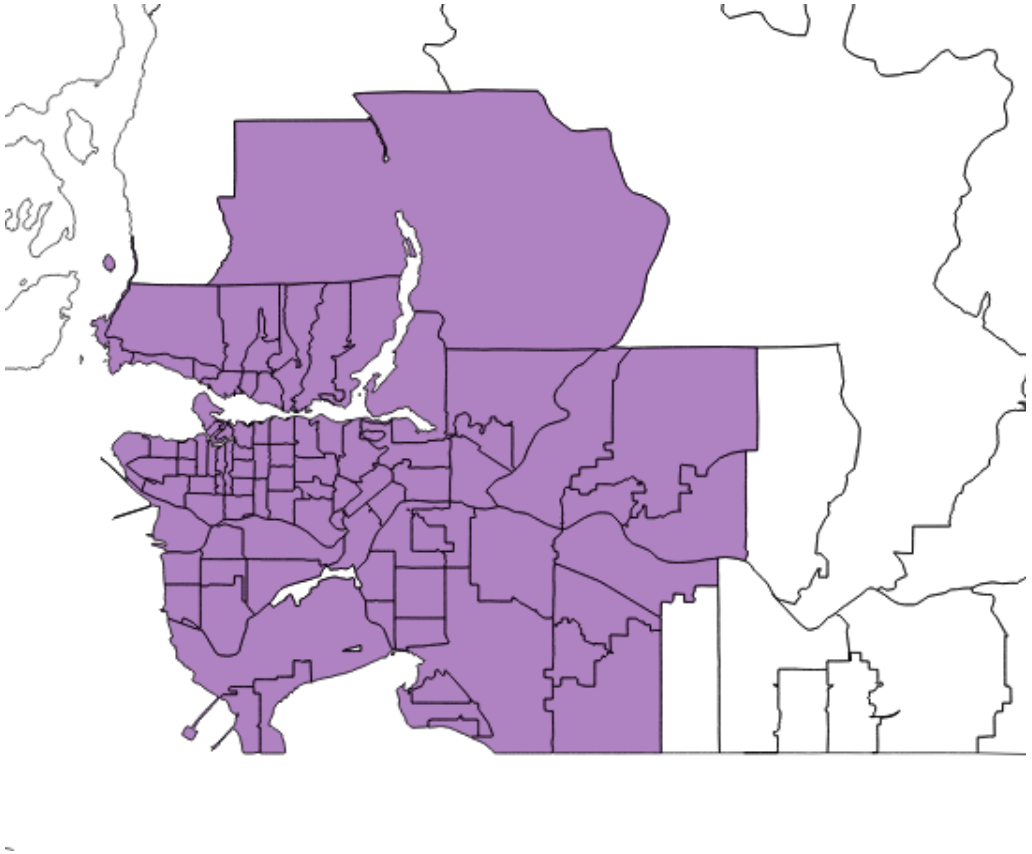
Does including area-level random effects improve model fit?

Question 3: Where are areas with high/low global cognition located within Data Collection Sites?

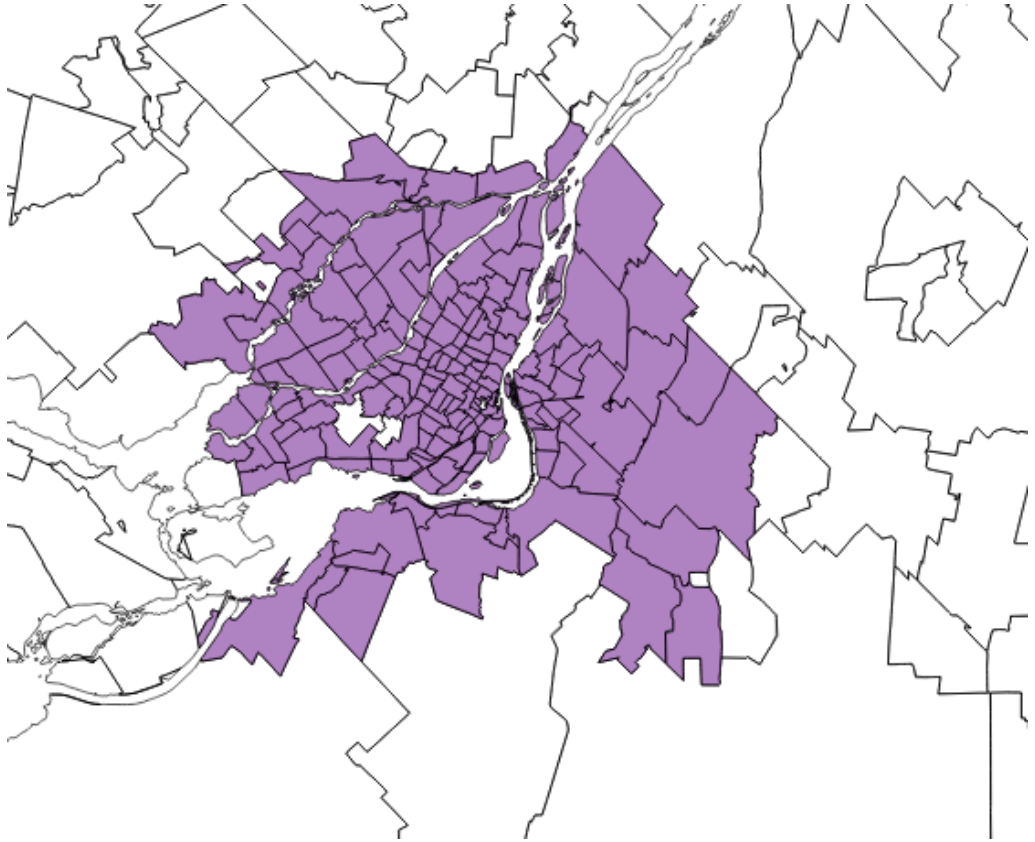
Insights into potential area-level risk factors?

Data

Vancouver

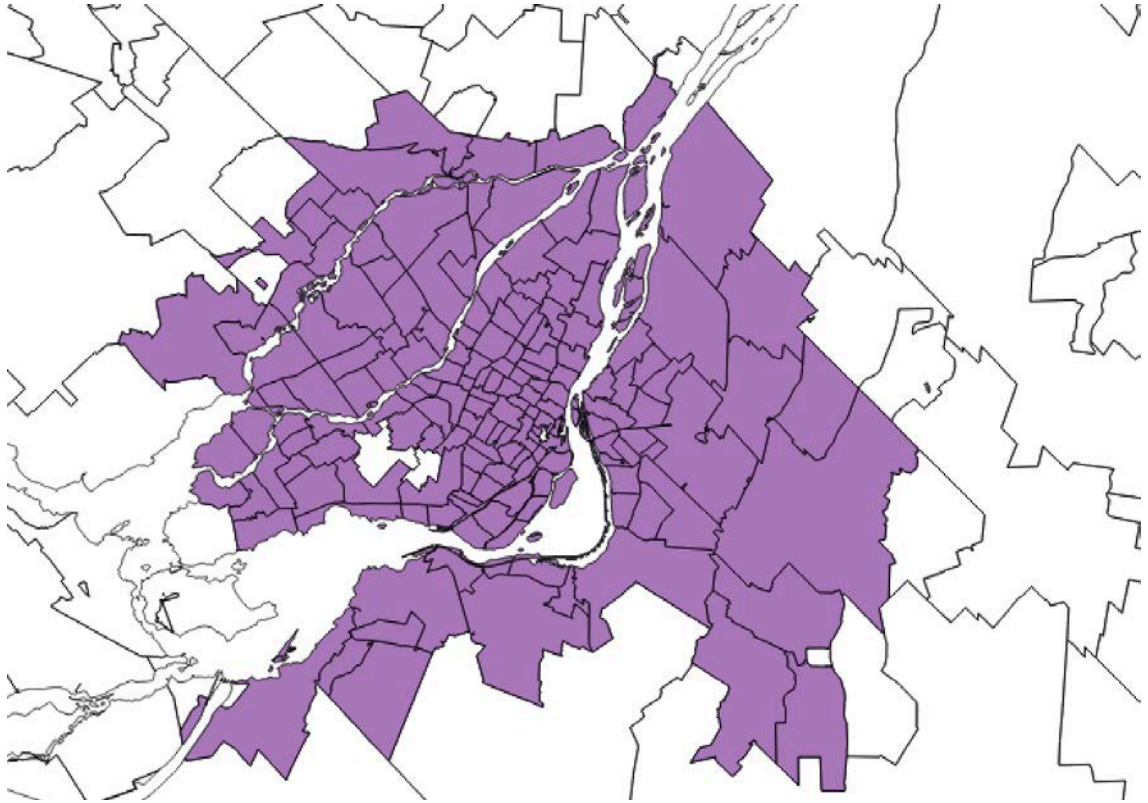


Montreal

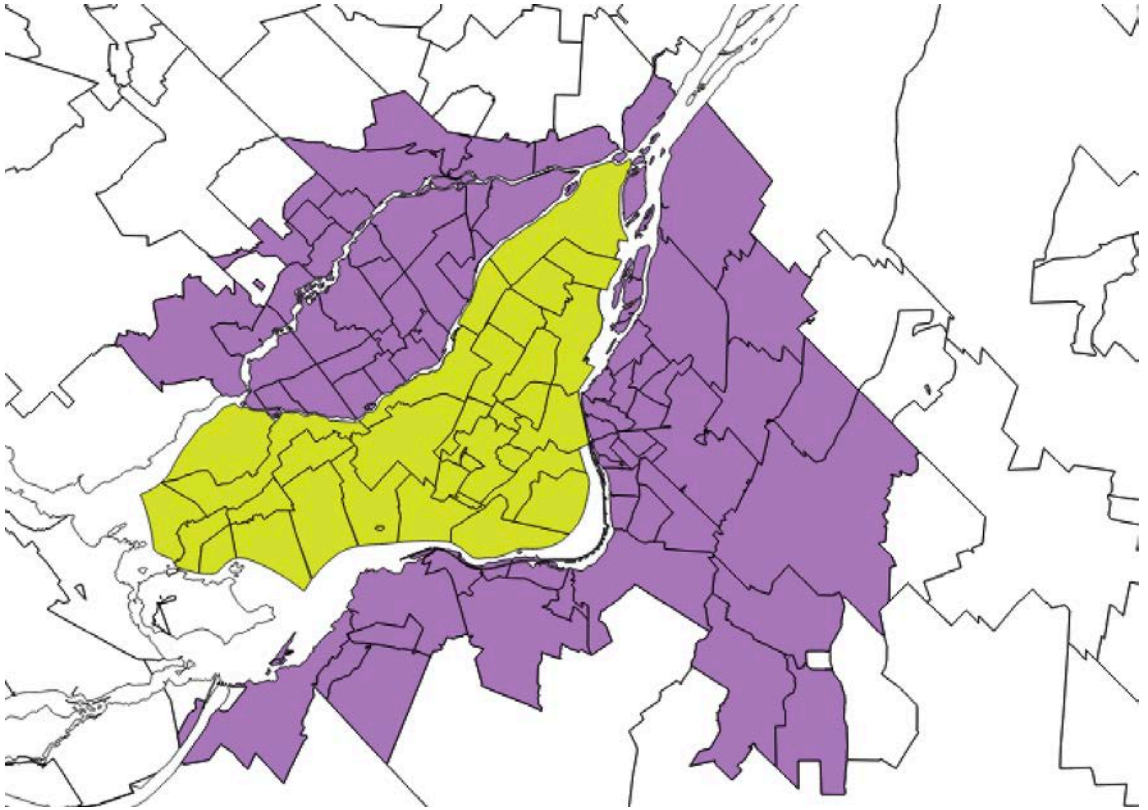


FSA and “Neighbourhoods”

Montreal – FSA

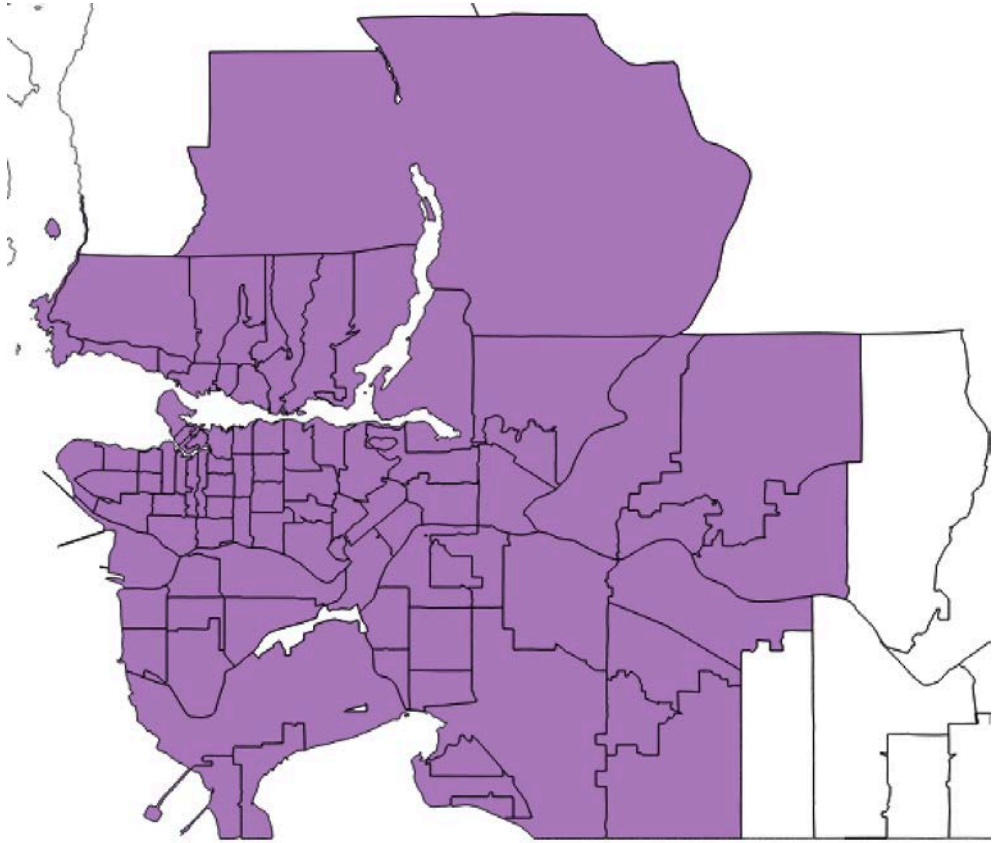


Montreal – Neighbourhood

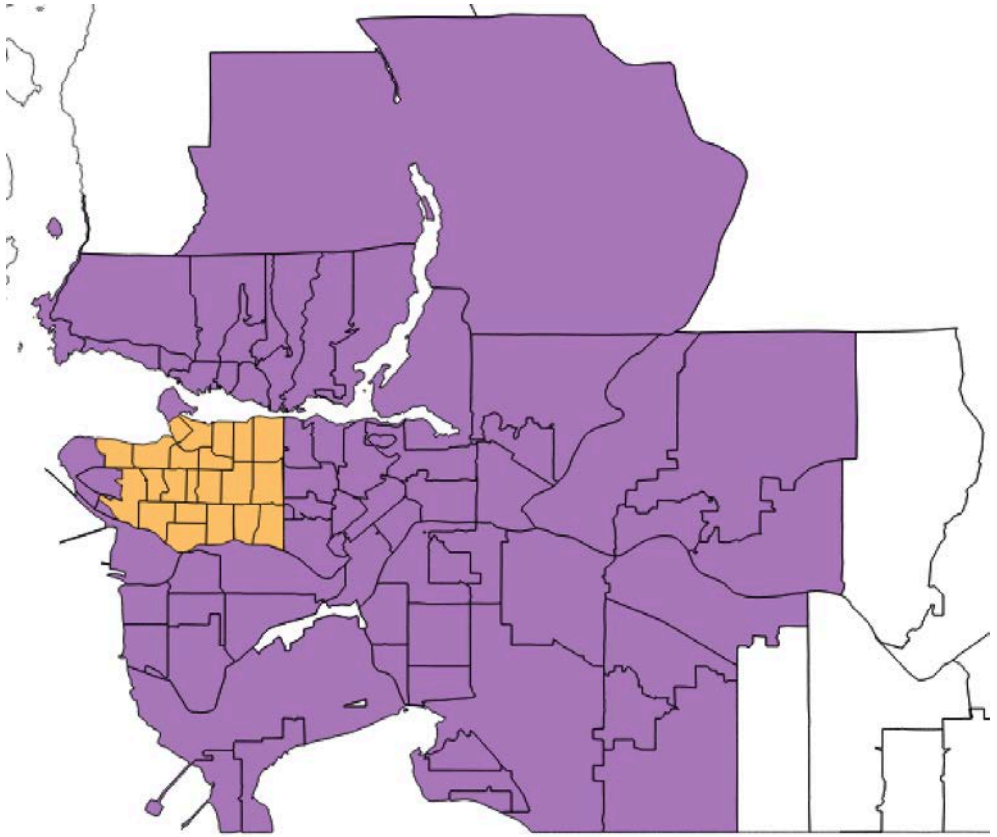


FSA and “Neighbourhoods”

Vancouver – FSA

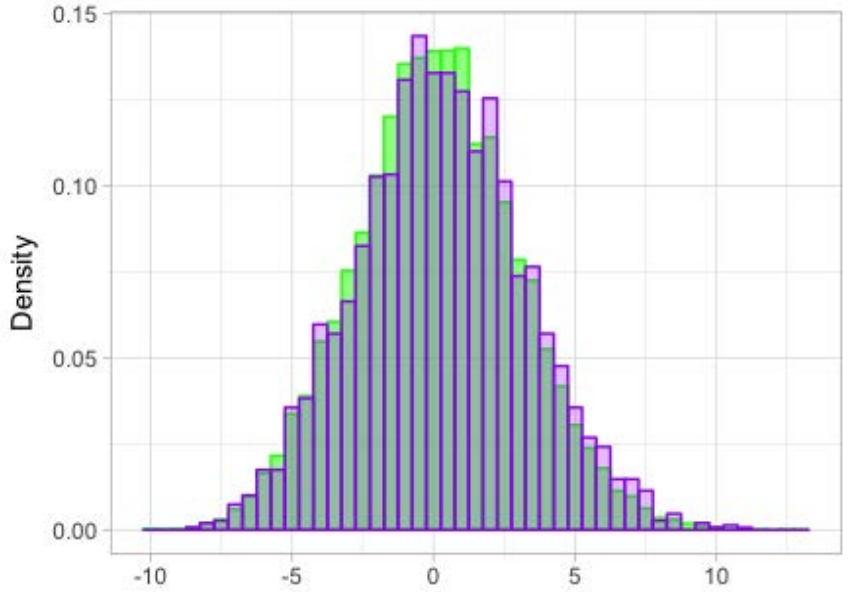


Vancouver – Neighbourhood



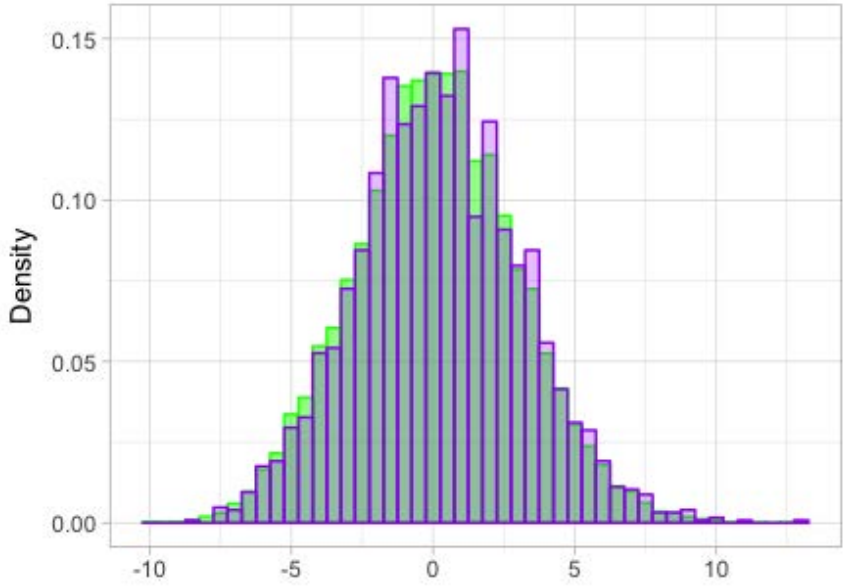
Data: Cognitive functioning

Vancouver



N = 2,984
FSA = 89
Median N per FSA = 31

Montreal



N = 2,510
FSA = 160
Median N per FSA = 14

Data: Covariates

Social support: Overall social support

Risk factors:

Hypertension
Activities of daily living
Smoking
Depressive symptoms
Alcohol
Instrumental activities of daily living
Diabetes

Control variables:

Age (relative to 45 – 54)
Female
Education

Multilevel modeling

Multilevel models with multiple individual-level covariates:

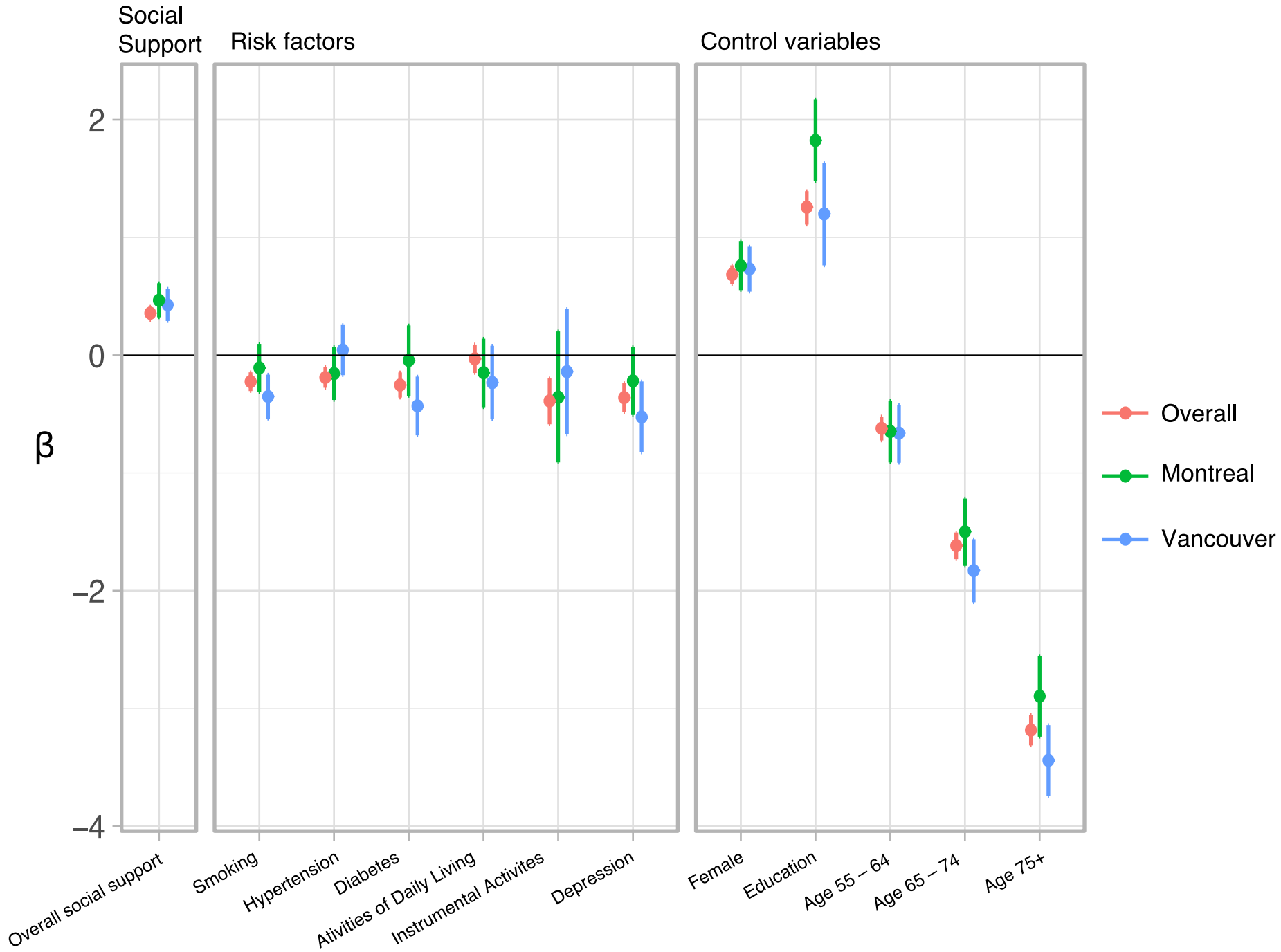
$$Y_i \sim \text{Normal}(\mu_i, \sigma^2_\mu)$$

$$\mu_i = \alpha + \beta_n x_n \quad (1)$$

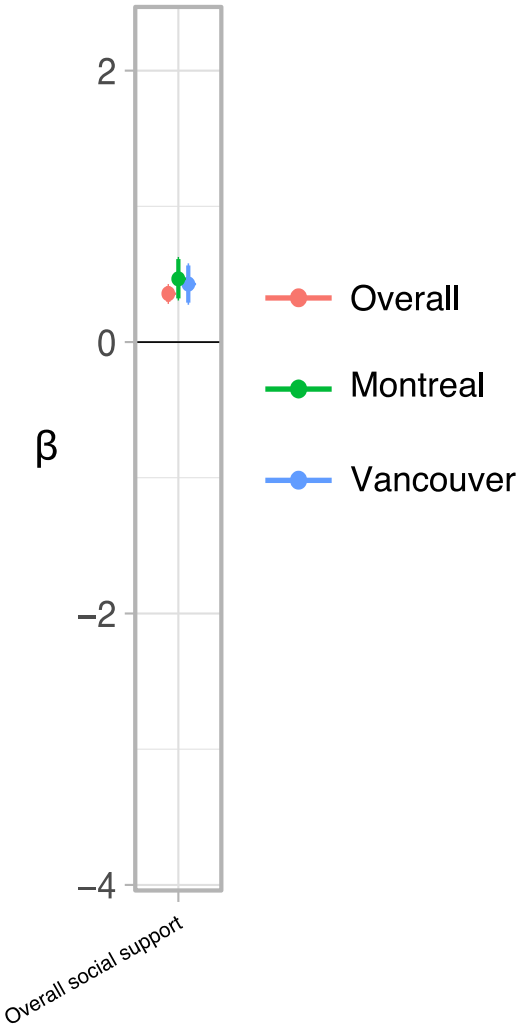
$$\mu_i = \alpha + \beta_n x_n + FSA_k \quad (2)$$

$$FSA_k \sim \text{Normal}(0, \sigma^2_F)$$

Interpretation of (2): Cognitive functioning for each participant (Y_i) is the sum of an overall intercept (α), individual-level covariates, and FSA-level random effects. Between-individual variance is σ^2_μ and between-area variance is σ^2_F.


Social Support
Risk factors
Control variables
2
0
−2
−4
β
Overall social support
Smoking
Hypertension
Diabetes
Ativities of Daily Living
Instrumental Activites
Depression
Female
Education
Age 55 – 64
Age 65 – 74
Age 75+
Overall
Montreal
Vancouver

Results

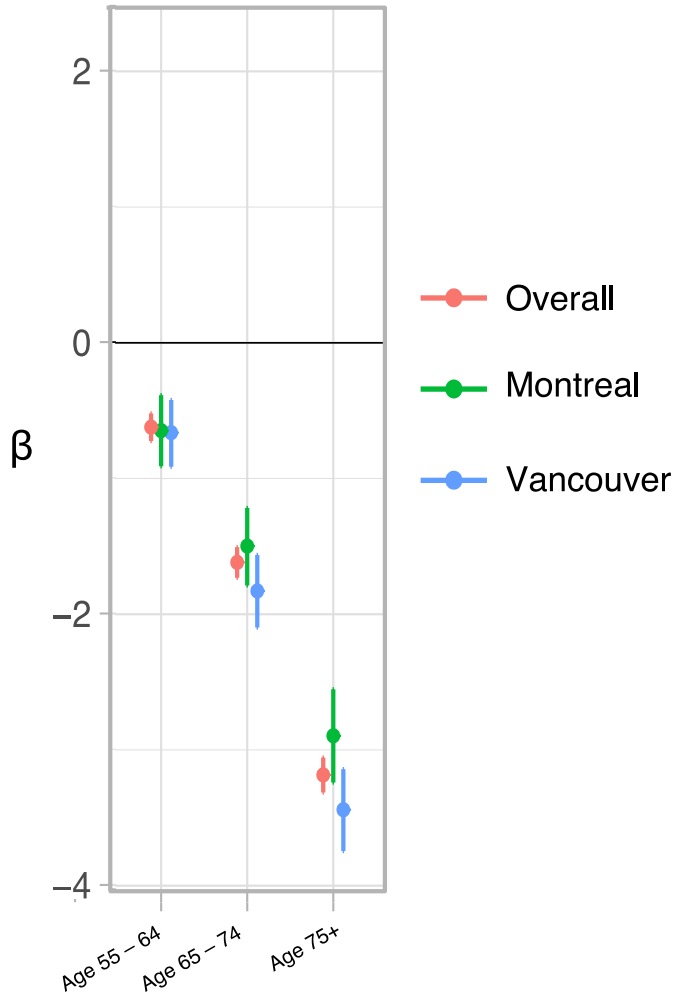


Is overall social support associated with cognitive functioning ?

- $\beta_{Overall}$ = 0.36 (0.30 – 0.41)
- $\beta_{Montreal}$ = 0.46 (0.32 – 0.61)
- $\beta_{Vancouver}$ = 0.42 (0.29 – 0.56)

- Individuals with greater overall social support have higher cognitive functioning
- Confirms existing research.
- Overlapping posterior distributions between locations.

Results

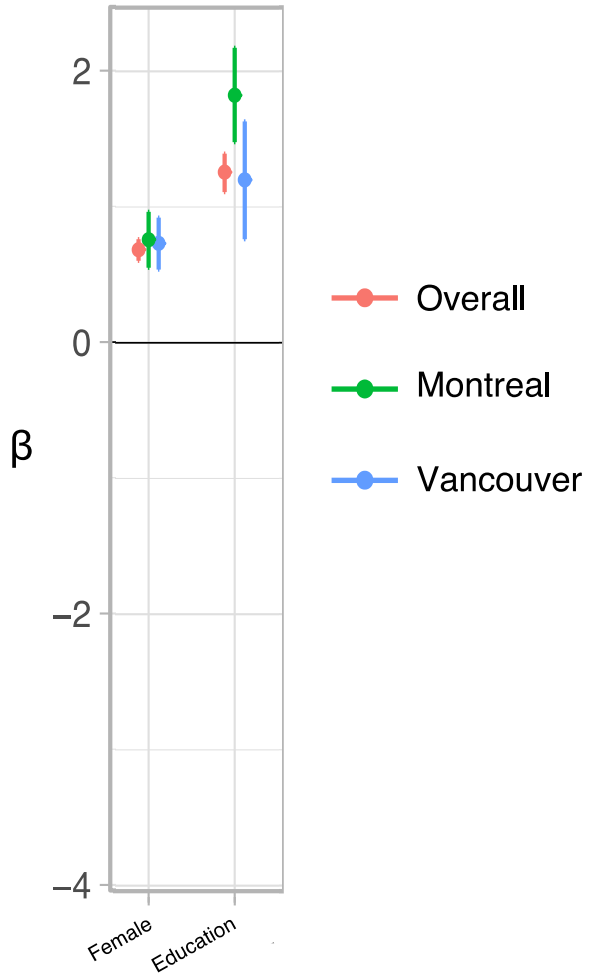


Age (relative to 45 to 54):

- $\beta_{Overall}$ 55 to 64 = -0.62 (-0.72 – -0.52)
- $\beta_{Overall}$ 65 to 74 = -1.62 (-1.73 – -1.51)
- $\beta_{Overall}$ 75+ = -3.19 (-3.31 – -3.06)

- Cognitive function decreases as age increases.
- Similar coefficient estimates across all locations.

Results



High school education:

- $\beta_{Overall}$ = 1.26 (1.11, 1.39)
- Greatest positive association with cognitive functioning of all covariates.
- Consistent across all locations.

Female:

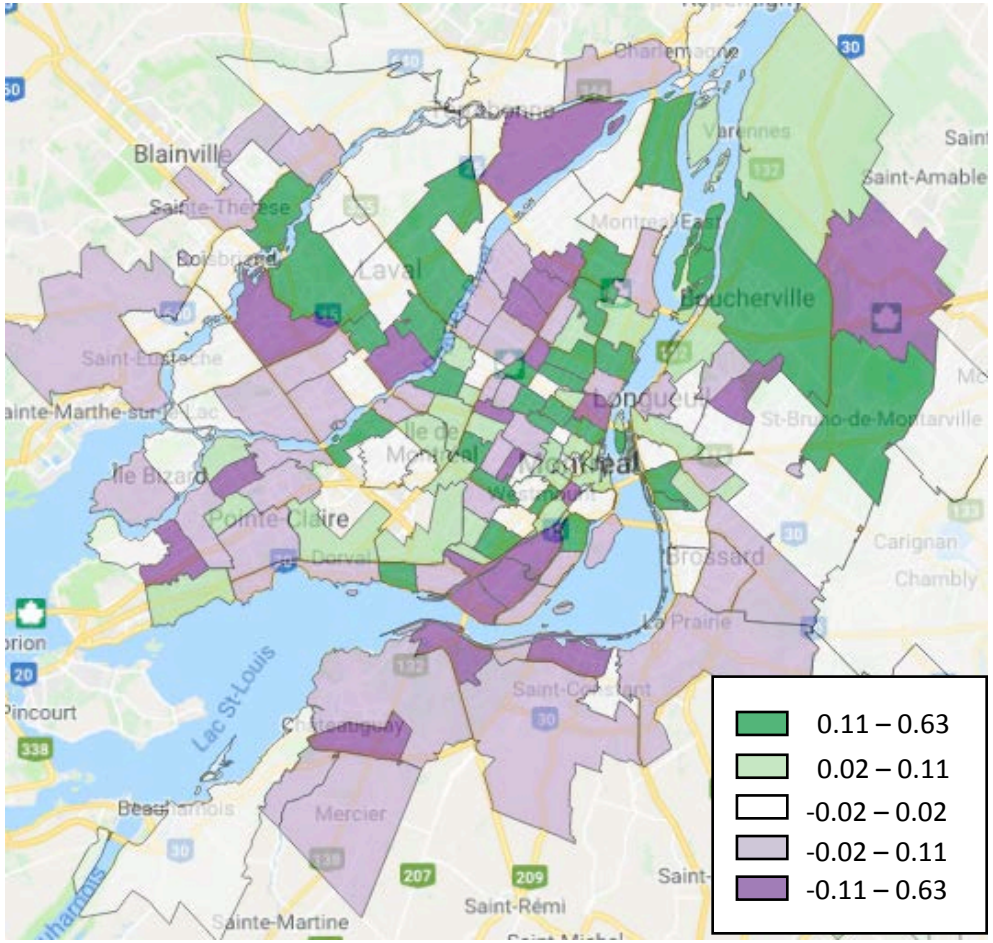
- $\beta_{Overall}$ = 0.68 (0.60, 0.76)
- Higher cognition in females than in males. Contradicts some past research.

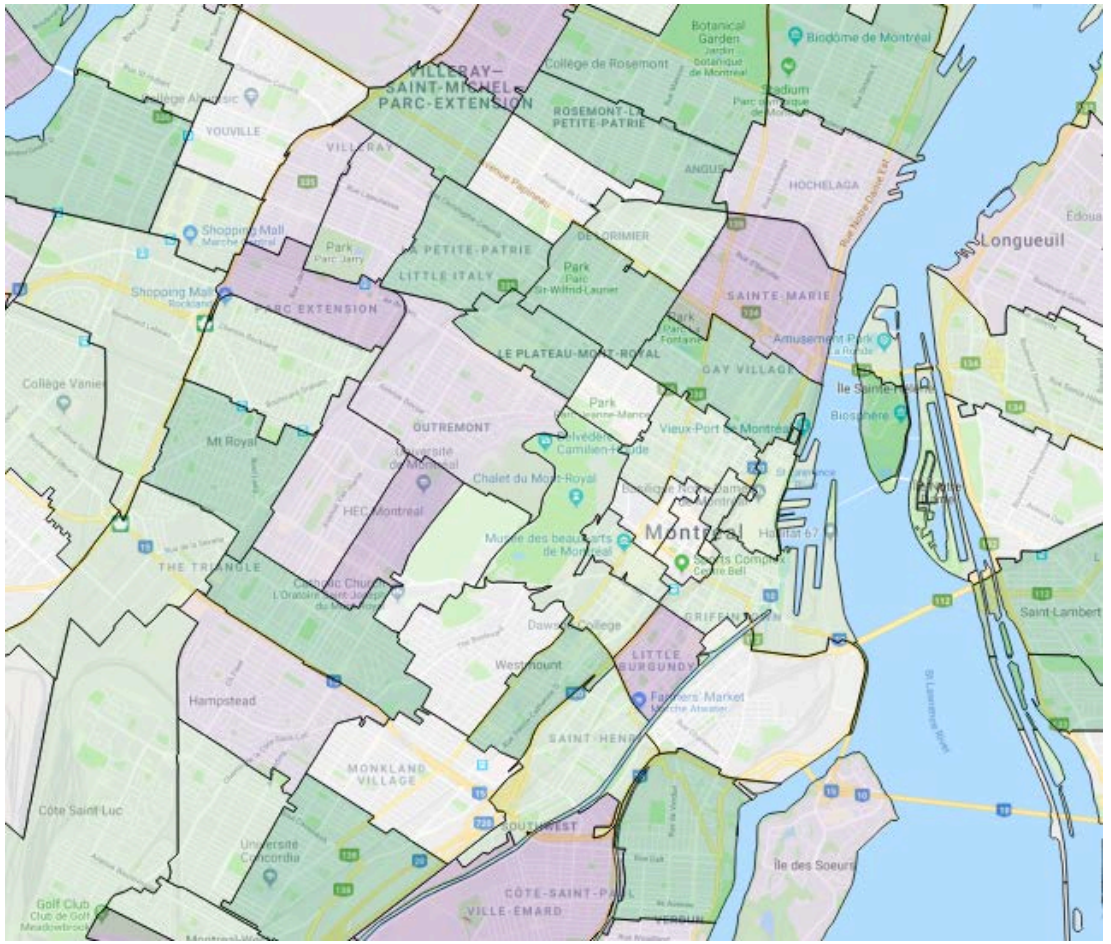
Results: Model fit

Does analyzing area-level effects improve model fit?

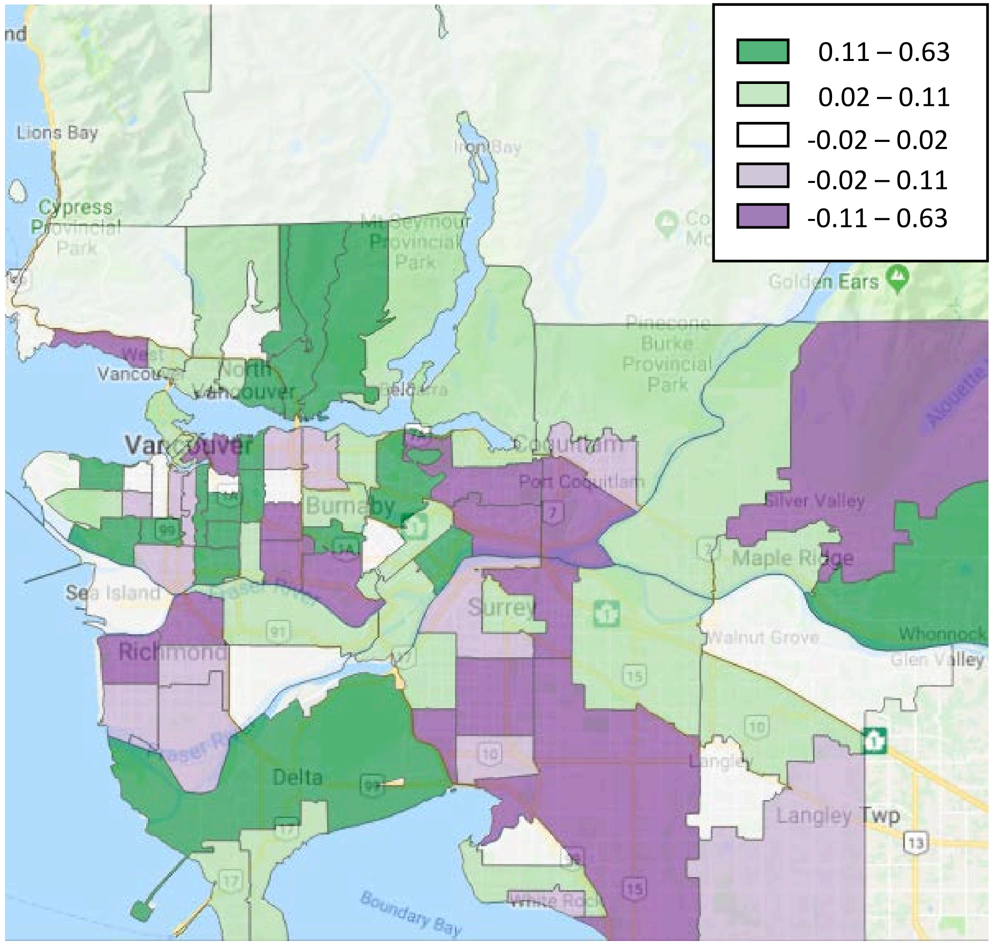
	Description	$\overline{D}$	pD	DIC
Overall	(1) Individuals	77,037	15	77,052
	(2) Individuals + FSA	76,810	132	76,942
Montreal	(1) Individuals	11,893	15	11,906
	(2) Individuals + FSA	11,859	41	11,900
Vancouver	(1) Individuals	14,161	15	14,174
	(2) Individuals + FSA	14,155	20	14,175

Montreal

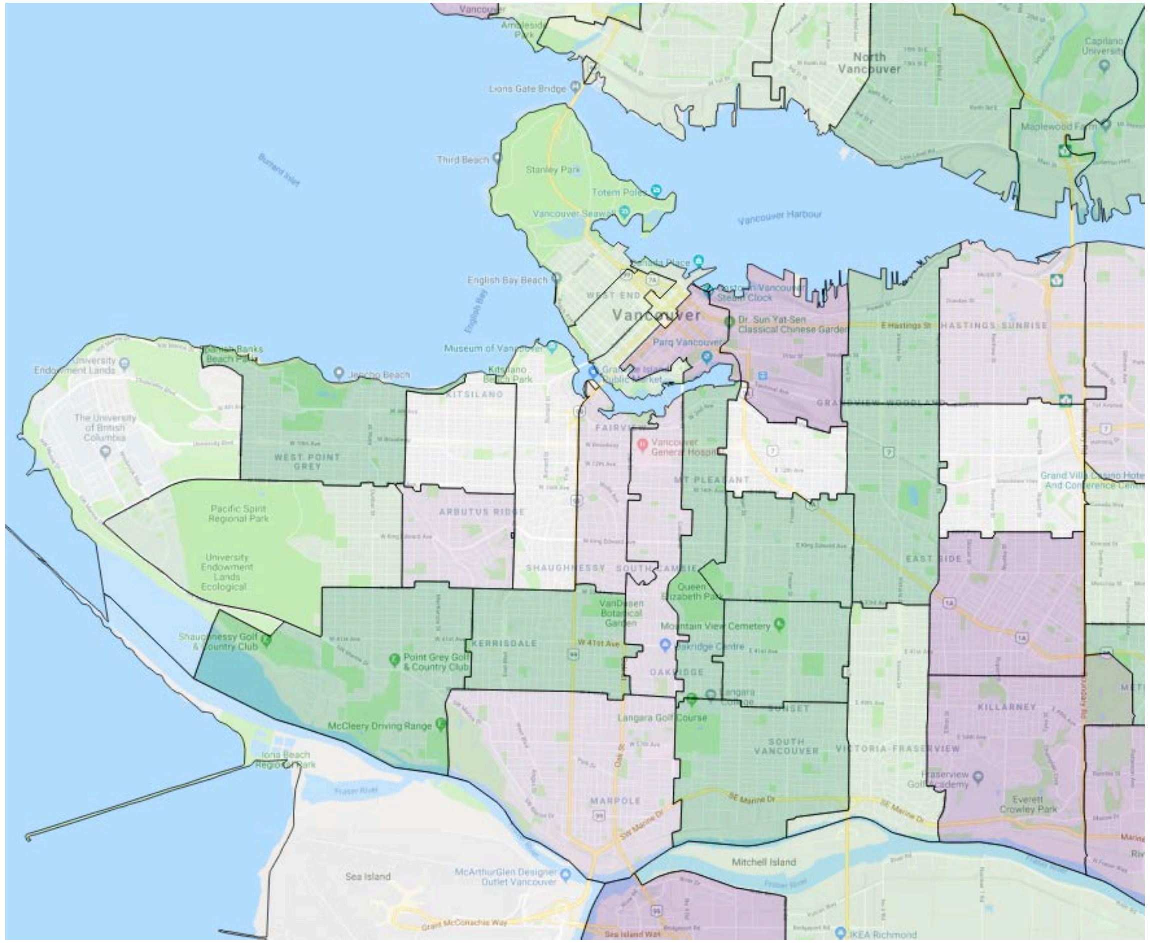

Blainville
Sainte-Thérèse
Boisbriand
Laval
Saint-Eustache
Sainte-Marthe-sur-le-Lac
Île Bizard
Pointe-Claire
Dorval
Montréal
Longueuil
Boucherville
Saint-Amable
Varennes
Saint-Bruno-de-Montarville
Carignan
Chambly
Brossard
La Prairie
Saint-Constant
Châteauguay
Lac St-Louis
Pincourt
Beauharnois
Mercier
Sainte-Martine
Saint-Rémi
0.11 – 0.63
0.02 – 0.11
-0.02 – 0.02
-0.02 – 0.11
-0.11 – 0.63


Botanical Garden
Biodôme de Montréal
Collège de Rosemont
VILLERAY–SAINT-MICHEL-PARC-EXTENSION
ROSEMONT–LA PETITE-PATRIE
YOUVILLE
HOCHELAGA
Shopping Mall
Park
LA PETITE-PATRIE
LITTLE ITALY
PARC EXTENSION
SAINTE-MARIE
LE PLATEAU-MONT-ROYAL
GAY VILLAGE
Longueuil
Collège Vanier
Mt Royal
OUTREMONT
Vieux-Port
Montréal
Chalet du Mont-Royal
HEC Montréal
Musée des beaux-arts de Montréal
THE TRIANGLE
Hampstead
Westmount
LITTLE BURGUNDY
Farmers' Market
SAINT-HENRI
MONKLAND VILLAGE
Côte Saint-Luc
Université Concordia
SOUTHWEST
Île des Sœurs
CÔTE-SAINT-PAUL
VILLE-ÉMARD
Golf Club
Saint-Lambert

Vancouver



0.11 – 0.63
0.02 – 0.11
-0.02 – 0.02
-0.02 – 0.11
-0.11 – 0.63
Lions Bay
Cypress Provincial Park
Mt Seymour Provincial Park
Golden Ears
Pinecone Burke Provincial Park
West Vancouver
North Vancouver
Burnaby
Port Coquitlam
Silver Valley
Maple Ridge
Sea Island
Richmond
Surrey
Walnut Grove
Whonnock
Glen Valley
Delta
Langley Twp
Boundary Bay



North Vancouver
Lions Gate Bridge
Stanley Park
Vancouver Harbour
English Bay Beach
Vancouver
KITSILANO
WEST POINT GREY
Pacific Spirit Regional Park
ARBUTUS RIDGE
SHAUGHNESSY
MT PLEASANT
KERRISDALE
OAKRIDGE
MARPOLE
SUNSET
SOUTH VANCOUVER
VICTORIA-FRASERVIEW
KILLARNEY
HASTINGS-SUNRISE
EAST SIDE
Sea Island
Mitchell Island

Limitations

Size, delineation, and internal homogeneity of FSA's

· FSAs constructed for postal delivery, not for representing health-related processes.

What area-level mechanisms influence cognitive function?

· Few studies investigate how neighbourhoods influence cognitive functioning using multilevel models.

Sampling approach for CLSA

· Representativeness within Data Collection Sites? Within smaller units?

· Use of weights in future research

Challenges of geographical analyses

Geographical information for participants.

· More likely to identify spatial effects for smaller areas (e.g., census tracts).

How to interpret variance explained?

· Model results (random effects) not directly transferrable to interventions.

· Add covariates at FSA-level to improve understanding.

Broader social, economic, political forces influence residential location.

· Compositional vs. contextual characteristics for areas.

· Does tenure / mobility influence social support and cognitive functioning?

Future Research

Longitudinal data: How does change in cognitive function interact with area-level changes? Does the rate of cognitive decline vary geographically?

Correlation structures between multiple cognitive function indicators: Are specific variables more correlated in some areas than others?

Complex variance: How do area characteristics influence the variability of cognitive functioning, as well as the mean, of individuals?

Objectives revisited

1. **Understand the "geography" of the CLSA.**

   Spatial analysis, spatial information in the CLSA, challenges.

2. **Is there overlap between clusters of high/low cognitive function with clusters of high/low social support?**

   About 1/4 of all areas in the tracking assessment had both high cognitive function and high social support.

3. **How does geography help understand the relationship between cognitive function and social support?**

   Cognitive function is positively associated with overall social support. About 2% of cognitive function is explained at the FSA-level.

Acknowledgements

Dr. Mark Oremus

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Questions

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UPCOMING CLSA WEBINARS

“Age of menopause and its relation to frailty and biological age in the CLSA comprehensive cohort”

Dr. Chris Verschoor

June 21, 2018 | 12 p.m. EST

Register: bit.ly/clsawebinars