Examining the social environment and its relevance to healthy aging in the CLSA

CLSA Webinar
November 26, 2024

Daiva E. Nielsen, PhD
Associate Professor
McGill University

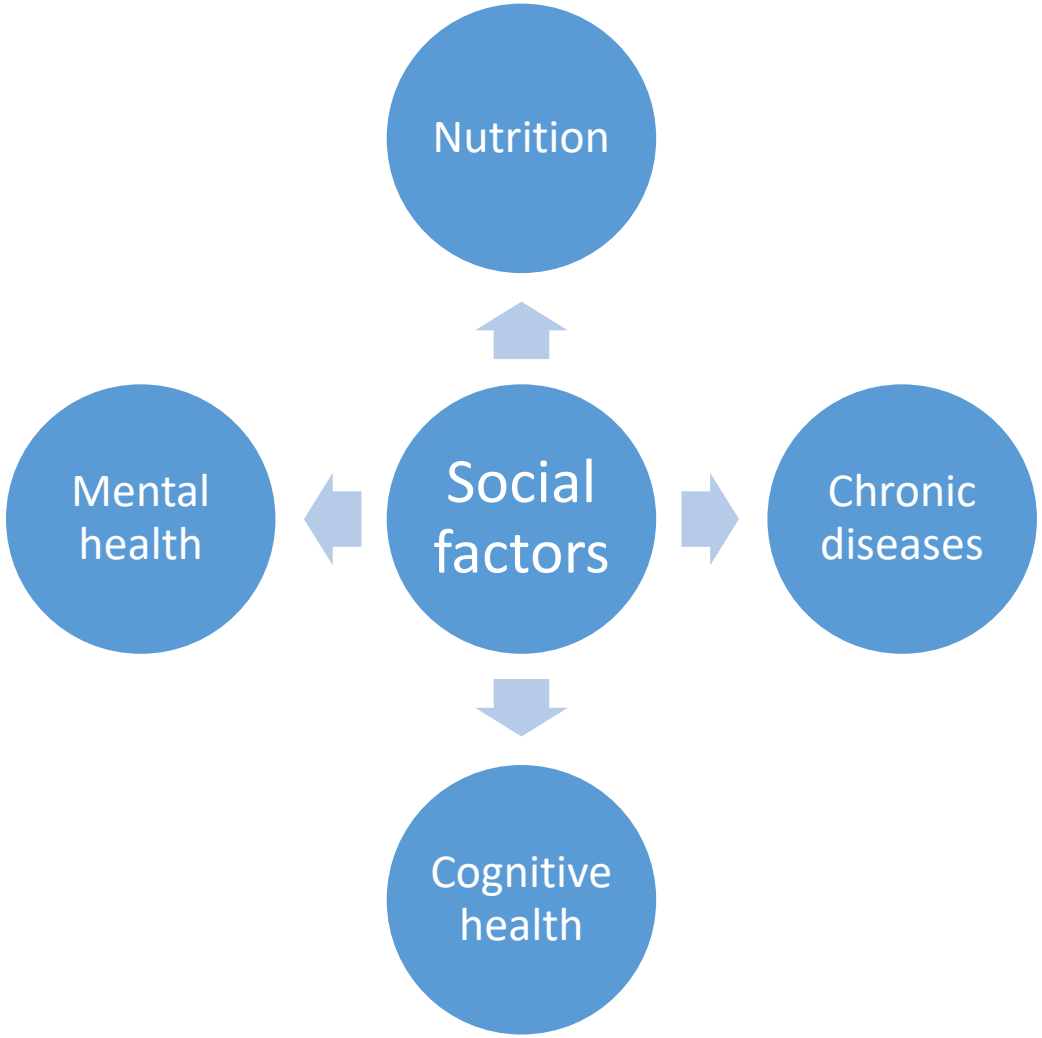
Katherine Labonté, PhD
Research Professional
Université Laval

McGill

Outline

- Overview of social factors and health-related outcomes
- Conceptualizing a social environment
  - Latent class analysis
  - CLSA social variables
- Associations with nutritional risk and dietary intake
- Associations with cognitive outcomes
- Discussion and Conclusions

The importance of social factors in aging



"Our physical and social environments are major influences on how we experience ageing and the opportunities it brings."

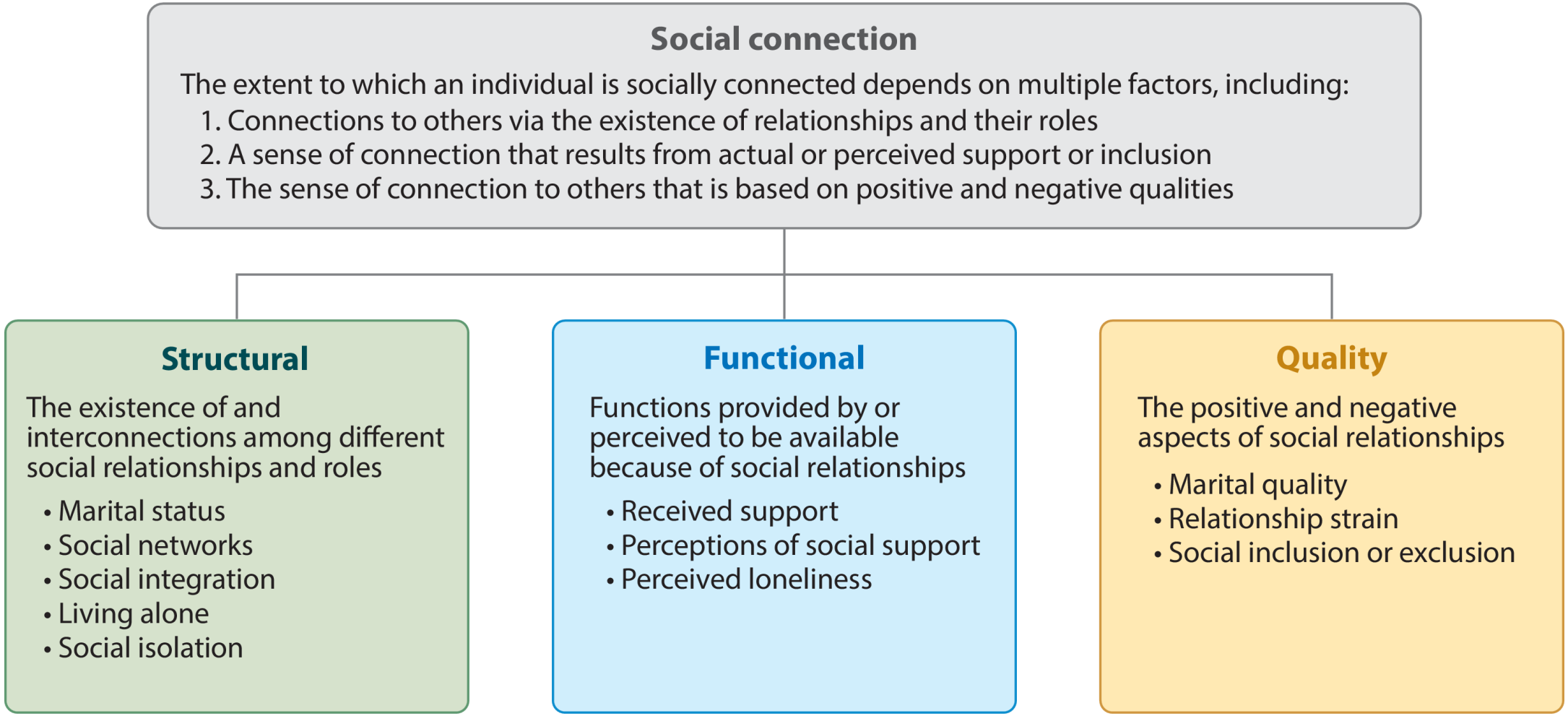
https://www.who.int/teams/social-determinants-of-health/demographic-change-and-healthy-ageing/age-friendly-environments/national-programmes-afcc

"Lack of social connection carries an equivalent, or even greater, risk of early death as other better-known risk factors – such as smoking, excessive drinking, physical inactivity, obesity, and air pollution."

https://www.who.int/news/item/15-11-2023-who-launches-commission-to-foster-social-connection

World Health Organization (WHO)

Multifactorial nature of social connection



Holt-Lunstad J. 2022
Annu. Rev. Public Health 43:193–213

Social Environment and Nutritional Risk Project

- Nutritional risk: risk factors and determinants of poor food intake that can lead to malnutrition (Keller, https://olderadultnutritionscreening.com/).

- Older-aged individuals more vulnerable to nutritional risk due to physiological changes associated with aging and also social factors.
  - E.g. weakened senses, reduced appetite, assistance with food preparation.

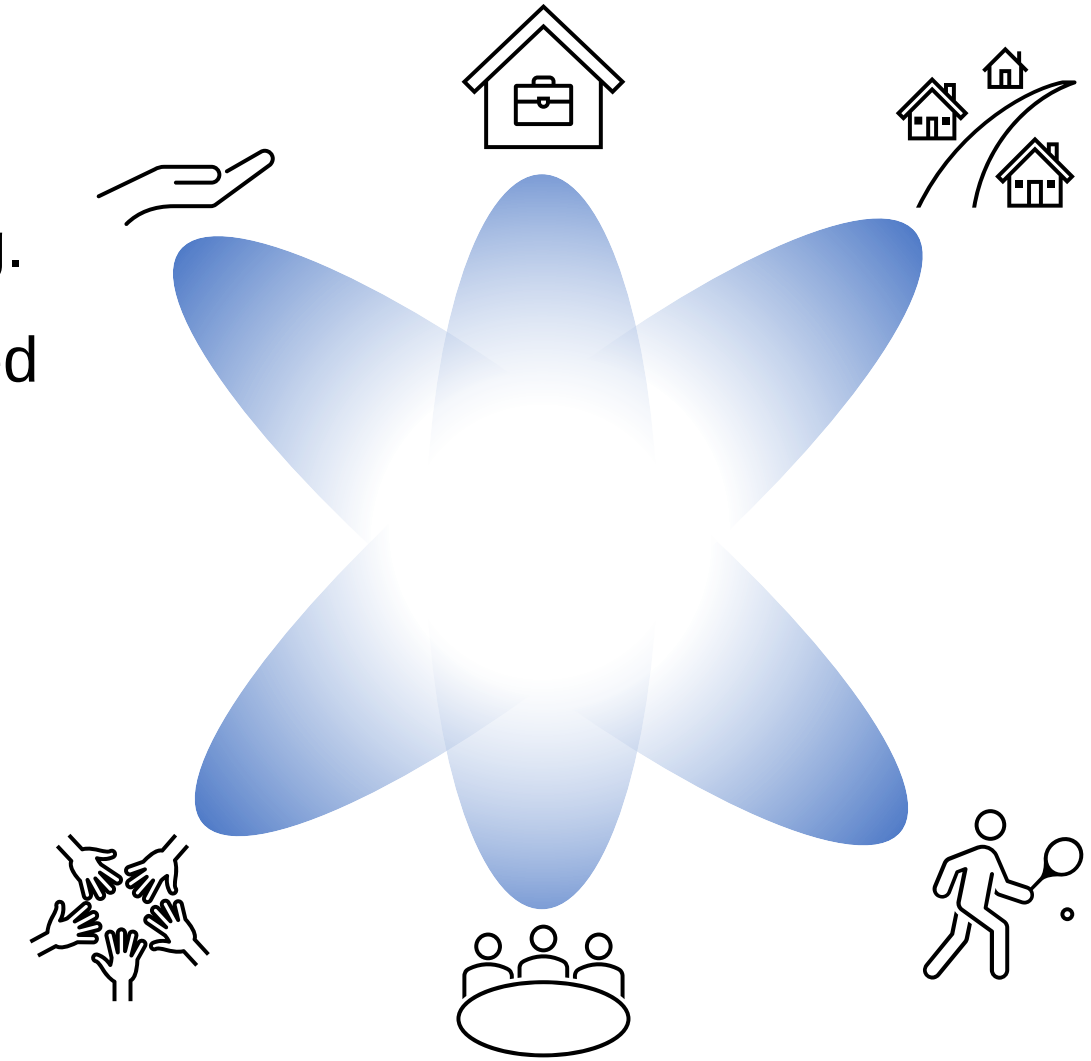
Social Factors and Nutrition Outcomes

- Social factors previously associated with increased nutritional risk (Locher et al., 2005; Ramage-Morin & Garriguet, 2013; Mills et al., 2024):
  - Low social support, Poor social cohesion, Social isolation, Limited social networks
  - Infrequent social participation (longitudinal evidence)
  - Having a partner reported to be protective against nutritional risk

- Social factors previously associated with dietary outcomes (Bloom et al,. 2017; Pieroth et al., 2017; Mehranfar et al., 2024):
  - Having a stable partner linked with increased F&V intake (longitudinal evidence)
  - Greater social support and social participation linked with better diet quality

Conceptualizing a Social Environment

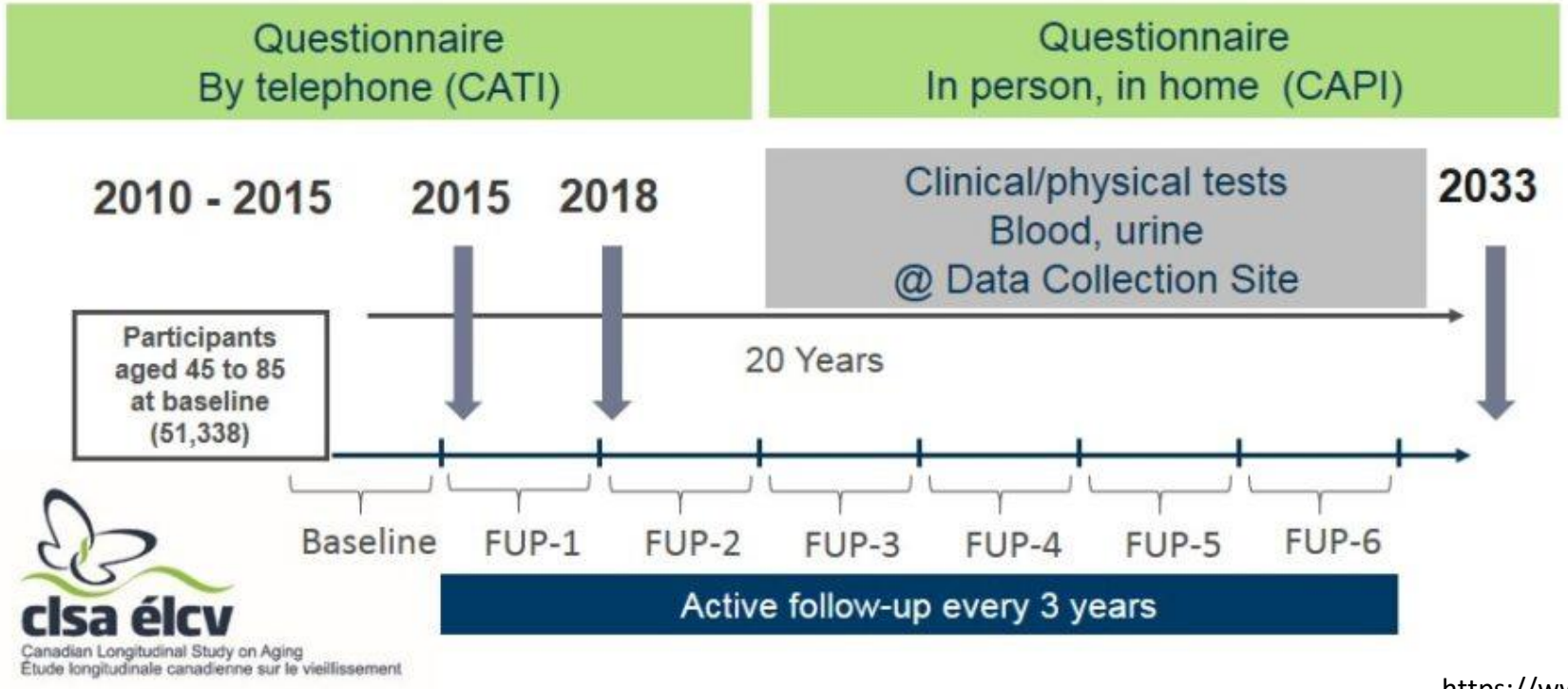
- Several studies have reported links between social factors and outcomes relevant to aging.
  - However, research has largely investigated multiple social factors individually.
- Aggregating social factors to reflect one's social environment may provide novel insight into links between social factors and aging.



CLSA Research Platform

50,000 participants aged 45 - 85 at baseline

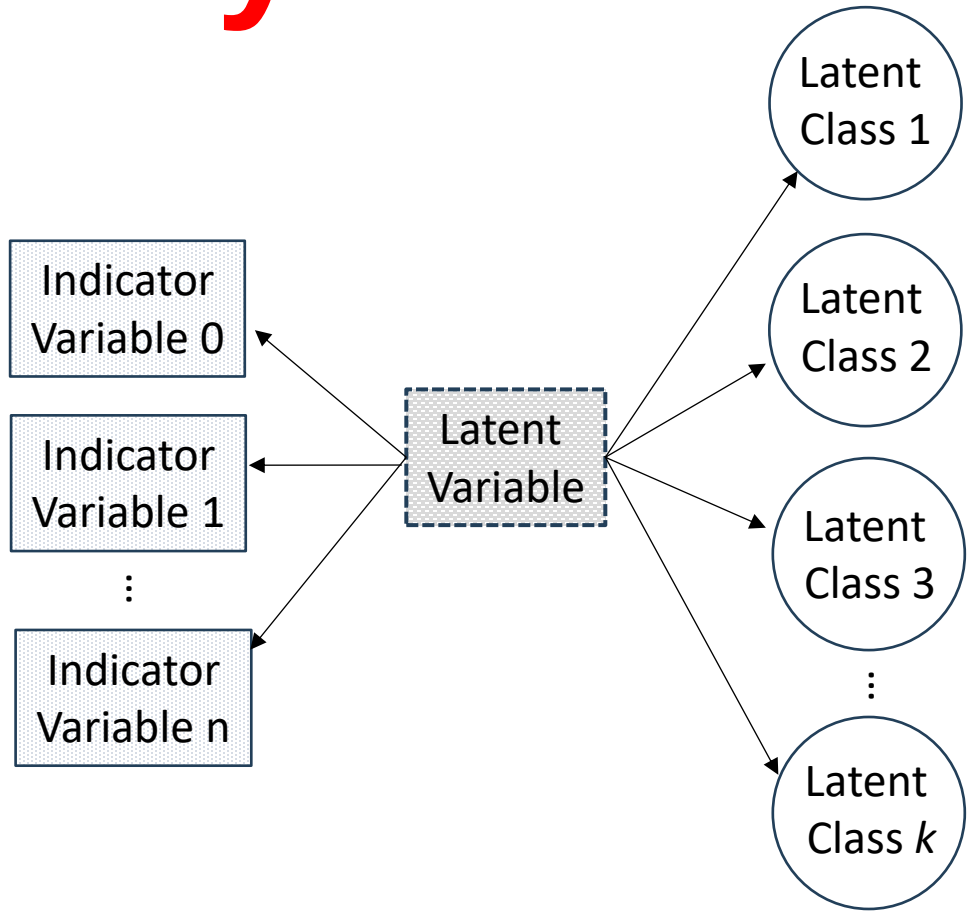
Tracking Cohort	Comprehensive Cohort
Target: 20,000 Actual: 21,241 Randomly selected within provinces	Target: 30,000 Actual: 30,097 Randomly selected within 25-50 km of 11 sites



https://www.clsa-elcv.ca/data-availability/

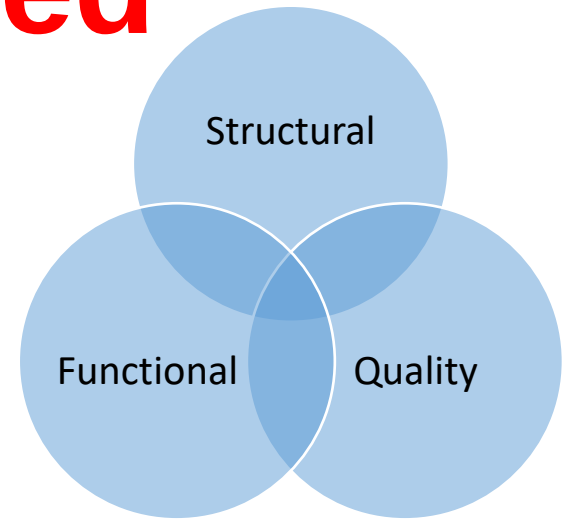
Latent Structure Analysis

- Person-centered analytical approach focusing on patterns of responses from individual participant data.
  - A set of correlated indicator predictor variables are used for the modelling.
- Identifies underlying subgroups that are considered to be latent.
  - Can be measured indirectly through the indicator variables.
- Latent class analysis (LCA): Indicator variables are categorical in nature.



Adapted from Aflaki et al. J Clin Epi 2022

LCA Indicator Variables created from CLSA Social Variables



7 indicator variables from 24(+) individual survey items reflecting:

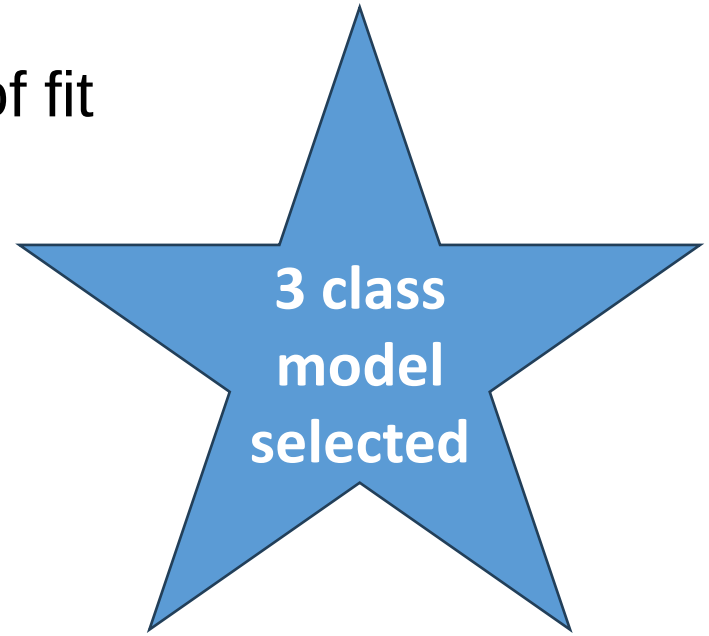
- **Network size:** Number of individuals occupying preidentified roles (close friends and family members) (Berkman & Kawachi, 2000).
- **Structural social isolation index:** Objective measures related to social network linkages (Menec et al., 2019).
- **Social cohesion:** Reciprocity, altruism and values/norms shared within a community (Bertossi Urzua et al., 2019).
- **Social Support:** Perceptions of emotional and tangible supports, affection, and positive social interactions (4 MOS Social Support Subscales) (Robitaille et al., 2011).

Latent class number selection

Conducted with R “poLCA” package.

Optimal number of latent classes was determined based on criteria from Jung & Wickrama, 2008:

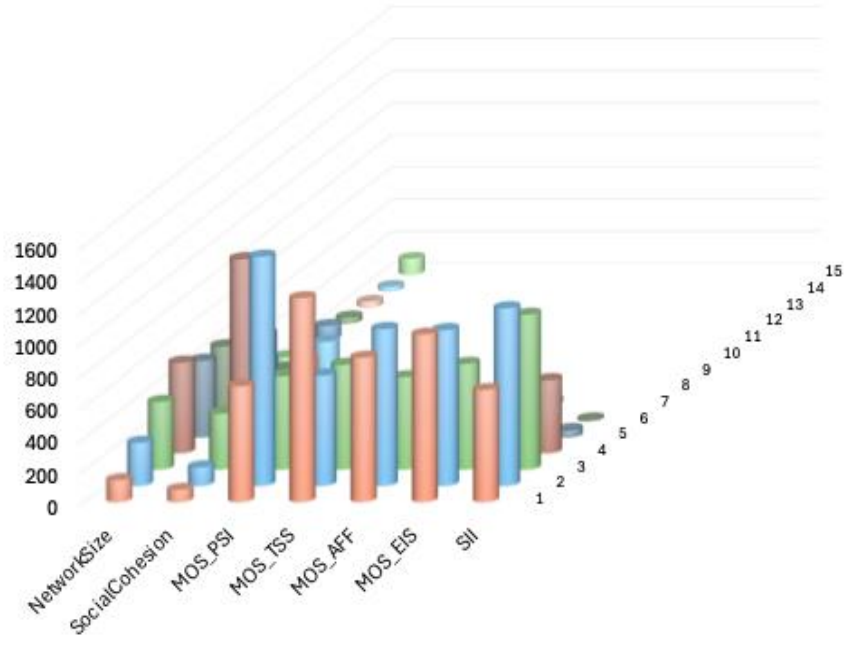
- Lower values of AIC, BIC and Chi-square goodness of fit
- High entropy values
- High posterior probabilities (class membership)
- No classes possessing <1% of the sample



AIC: Akaike information criteria; BIC: Bayesian information criteria

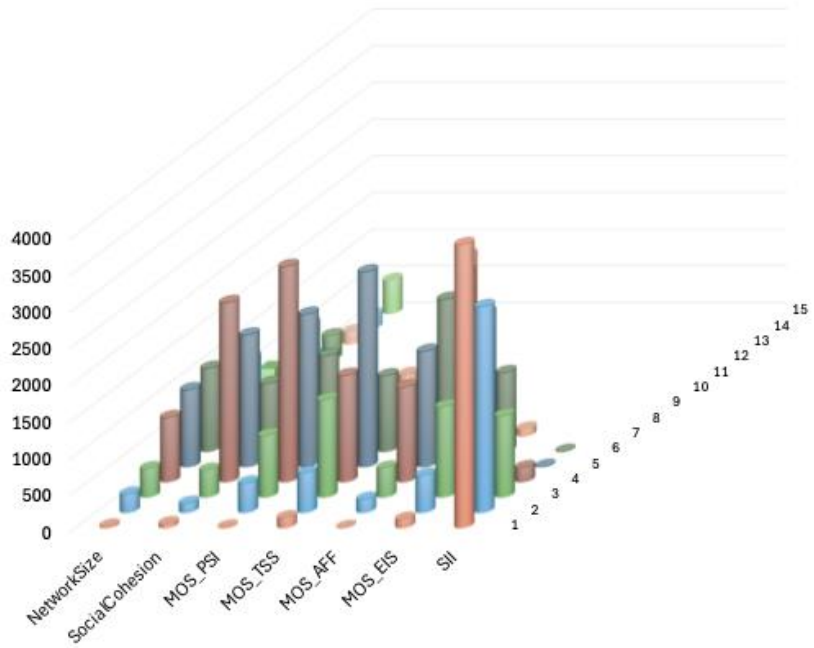
Social Environment Profiles

Weaker



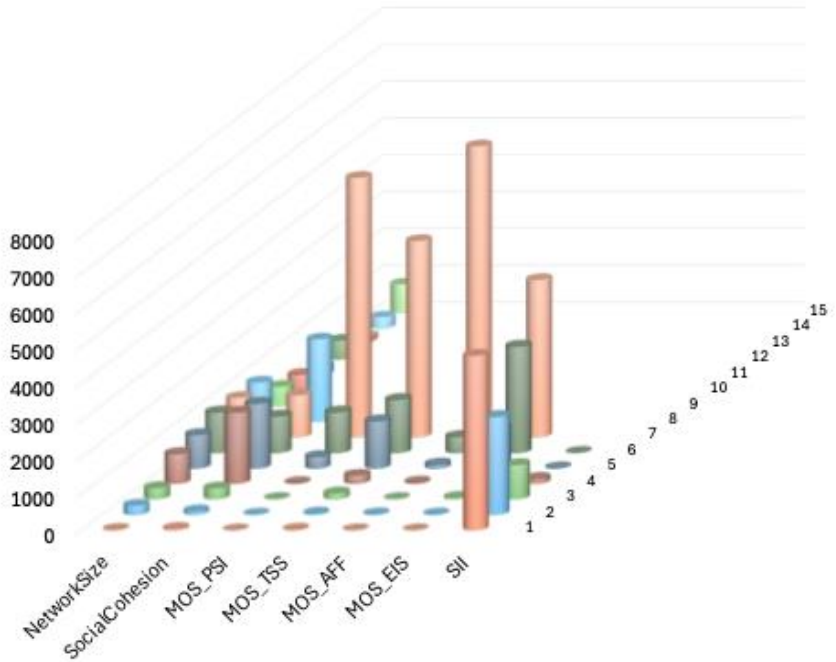
17% CLSA Sample

Intermediate



40% CLSA Sample

Stronger



43% CLSA Sample

Knowledge Gaps: Social environment and nutrition outcomes

- How may multiple social factors in combination, reflecting a social environment, be related to nutritional risk?
- If there is an association, what dietary factors may be relevant?

Objectives and hypothesis

- Primary objective: Determine whether the social environment, reflecting social connection, is associated with nutritional risk.
- Secondary objective: Determine whether dietary intake of healthful food groups differs according to social environment profiles.

- Hypothesis: A stronger social environment will be significantly associated with lower nutritional risk status and higher consumption of healthful food groups.

Methods: Nutritional risk assessment

- SCREEN-II-AB (rebranded as SCREEN 8): 8 main questions, with 3 follow-up questions, pertaining to weight changes, skipping meals, appetite, ability to chew/swallow, consumption of fruits and vegetables, fluid consumption, time spent eating alone, and meal preparation patterns.
  - Sums to a score with maximum possible value 48.
  - A score <38 indicates high nutritional risk status.

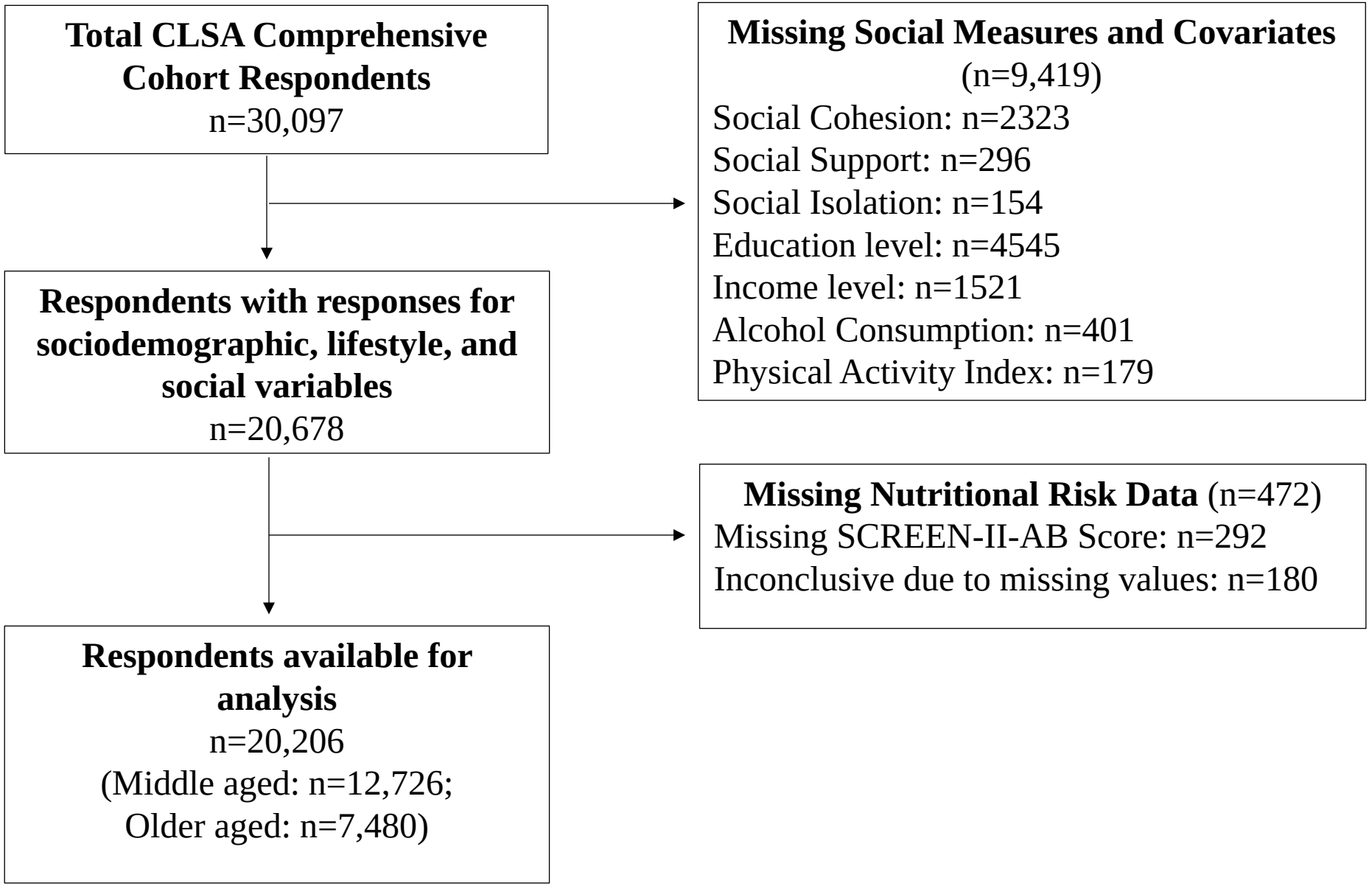
Keller, https://olderadultnutritionscreening.com/

Methods: Food Group Assessment

- CLSA Short Dietary Questionnaire (SDQ): 36 food and beverage items.
  - Raw responses transformed into number of times eaten/day measure.
  - Four healthful food groups created from 27 SDQ items: Whole grains, protein foods, dairy foods, fruits and vegetables (evaluated with and without juices).

Statistical Analysis

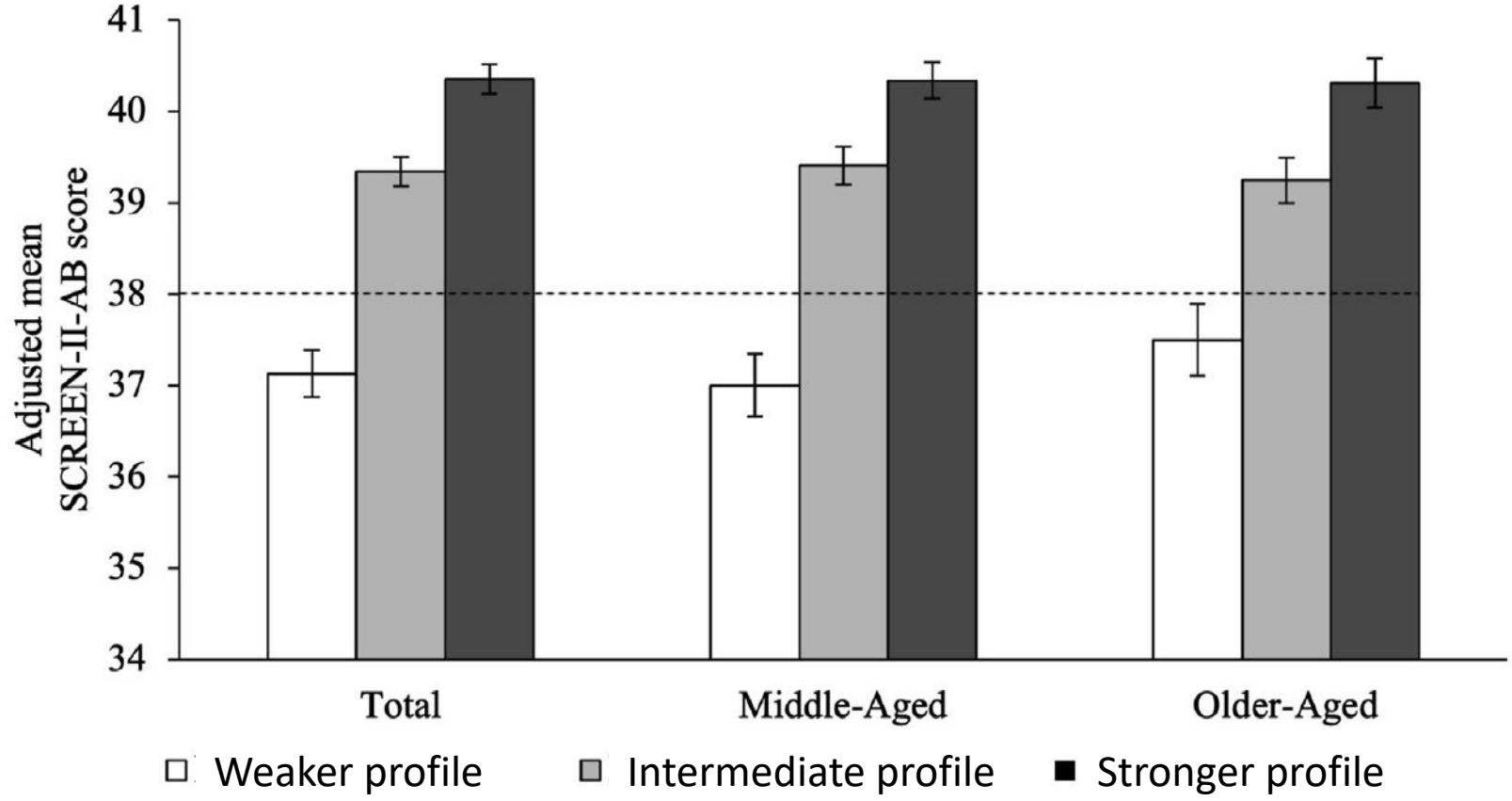
- Analysis of Covariance adjusted for an increasing set of pre-selected covariates
  - Model 1: Adjusted for age, sex, and province of recruitment
  - Model 2 (additional sociodemographic factors): Model 1 + income, education, marital status, self-reported ethnicity, immigration, and urban/rural residence
  - Model 3 (additional lifestyle factors): Model 2 + smoking status, alcohol consumption, and physical activity level.
- Models conducted among the entire CLSA sample available for analyses, as well as stratified by age group (middle-aged 45-64 years and older aged: ≥65 years).


Total CLSA Comprehensive Cohort Respondents
n=30,097
Missing Social Measures and Covariates
(n=9,419)
Social Cohesion: n=2323
Social Support: n=296
Social Isolation: n=154
Education level: n=4545
Income level: n=1521
Alcohol Consumption: n=401
Physical Activity Index: n=179
Respondents with responses for sociodemographic, lifestyle, and social variables
n=20,678
Missing Nutritional Risk Data (n=472)
Missing SCREEN-II-AB Score: n=292
Inconclusive due to missing values: n=180
Respondents available for analysis
n=20,206
(Middle aged: n=12,726;
Older aged: n=7,480)

Participant Characteristics

Characteristic	Total (n=20,206)	Middle-Aged (n=12,726)	Older-Aged (n=7,480)	p-value
Age, y	61.7 ± 9.9	55.4 ± 5.4	72.4 ± 5.6	<0.0001
Biological Sex				<0.0001
Male	10337 (51.0%)	6290 (49.4%)	4047 (54.1%)	
Female	9869 (49.0%	6436 (50.6%)	3433 (45.9%)	
Marital Status				<0.0001
Married	14691 (72.7%)	9684 (76.1%)	5007 (66.9%)	
Single/Never married	1640 (8.1%)	1230 (9.7%)	410 (5.5%)	
Divorced/Separated/Widowed	3870 (19.2%)	1807 (14.2%)	2063 (27.6%)	
High Nutritional Risk	6566 (32.5%)	4119 (32.4%)	2447 (32.7%)	0.611
Not High Nutritional Risk	13640 (67.5%)	8607 (67.6%)	5033 (67.3%)	
SCREEN-II-AB Score	39.4 ± 5.9	39.4 ± 6.0	39.3 ± 5.8	0.189
Social environment profile				<0.0001
Weaker	3522 (17.4%)	2080 (16.3%)	1442 (19.3%)	
Intermediate	8127 (40.2%)	4968 (39.0%)	3159 (42.2%)	
Stronger	8557 (42.3%)	5678 (44.6%)	2879 (38.5%)	

Results: Nutritional risk score



Results from fully adjusted model (model 3)

Ingham et al. J Nutr 2023

Results: SCREEN-II-AB responses

- Significant differences across social environment profiles for all 8 main SCREEN-II-AB questions. Compared to the weaker profile, intermediate and stronger social environment profiles had higher frequencies of reporting:

Stable body weight in past 6 months	Daily fruit and vegetable consumption
Not skipping meals	≥8 cups of fluid per day
Very good appetite	Almost always consuming meals with someone at least once a day
Never coughing/choking/pain when swallowing food	Not cooking their own meals

Results: Food group consumption

- Varied observations by social environment profile depending on age subgroup:

Fruits and Vegetables	**Significantly increased as social environment strengthened within all samples (dose-response pattern).**
Proteins	Significantly lower in weaker vs. stronger profile among total participants sample only. No other differences.
Dairy	Significantly lower in weaker vs. intermediate profile among middle-aged and total participants samples. No significant differences among older-aged sample.
Whole Grains	No significant differences.

Summary

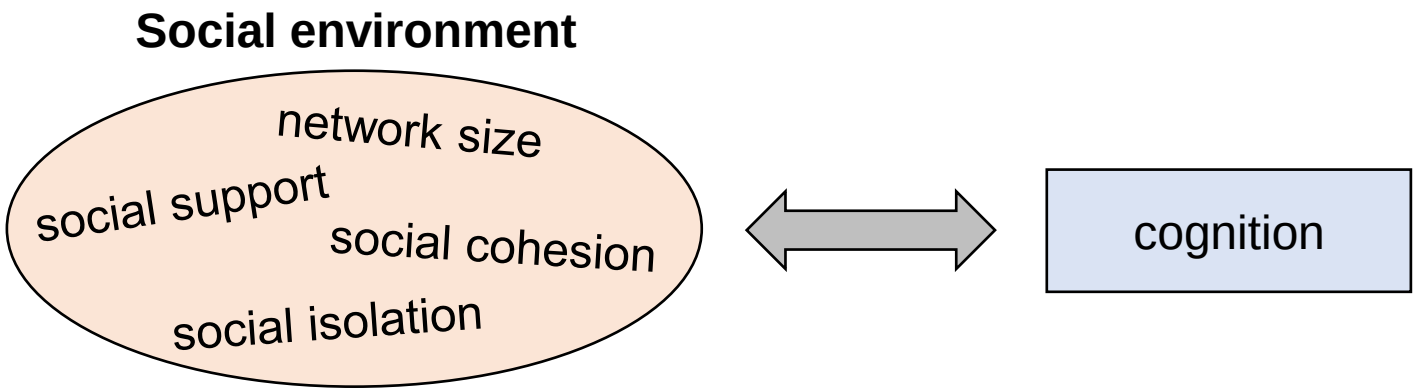
- The conceptualized social environment profiles were significantly associated with nutritional risk.
- The association followed a dose-response pattern, with nutritional risk scores increasing in relation to the strength of the social environment.
- Consumption frequency of fruits and vegetables consistently showed a dose-response pattern by social environment profile.

Social factors and cognition

- Aging is accompanied by normal cognitive alterations (e.g. decreased processing speed, poorer divided attention) (Harada et al., 2013).
- Social ties can help mitigate these effects (Kuiper et al., 2016).
- Research examining the relationship between cognitive function and combined social factors (reflecting a social environment) is scarce.

Objective and hypothesis

Objective: Evaluate relationships between social environment profiles of various strengths and cognitive performance



Hypothesis: A stronger social environment profile is associated with better cognitive performance in three domains: executive function, prospective memory, and episodic memory.

Three cognitive domains

Executive function

The ability to regulate thoughts and behavior

Prospective memory

The ability to remember to perform an intended action in the future

Episodic memory

The ability to recall specific events or experiences from the past

Executive function

Mental Alternation Test (MAT; Teng, 1995)
- Alternate between numbers and letters as many times as possible for 30 s

1, a, 2, b, 3, c…

Stroop Neurological Screening Test – Victoria Version (Bayard et al., 2009; Regard et al., 1981)
- Name the color of the ink of color words printed on a card

BLUE RED YELLOW

red, green, blue…

Animal-Fluency test (AFT; Survey of Health, Ageing and Retirement in Europe, 2005)
- Name as many animals as possible in 60 s

cat, dog, horse…

Controlled-oral-word-association test (COWAT; Spreen & Benton, 1977)
- Name as many words that begin with a given letter (F, A, or S) as possible in 60 s

apple, all, animal…

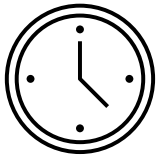
Prospective memory

Miami Prospective Memory Test (MPMT; Loewenstein & Acevedo, 2004)

Event-based: Remember to perform specific actions **when an alarm goes off**

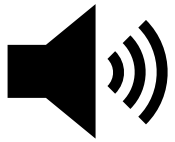
- Experimenter: “When this timer goes off, I want you give me a five dollar bill and to give yourself a ten dollar bill…”

Time-based: Remember to perform specific actions **exactly 15 minutes** after being instructed to do so



- Experimenter: “When this clock reaches 8:15, I want you to open this envelope and give me the card with the number 17…”

Episodic memory

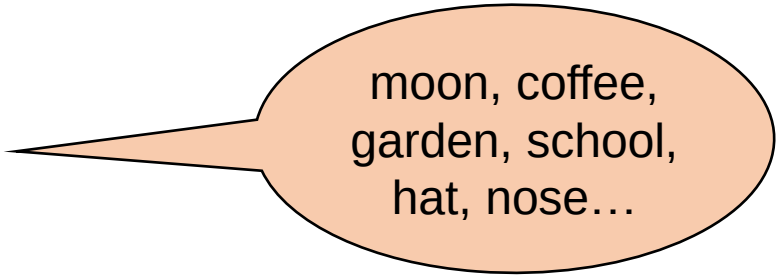


coffee, school, moon…

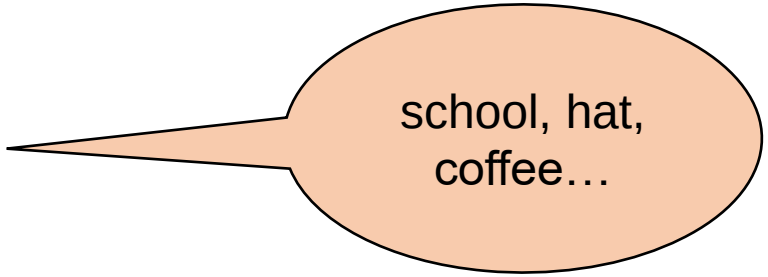
Rey Auditory Verbal Learning Test (RAVLT; Rey, 1964)

- Recall as many words as possible from a list of 15 common words

Immediate recall



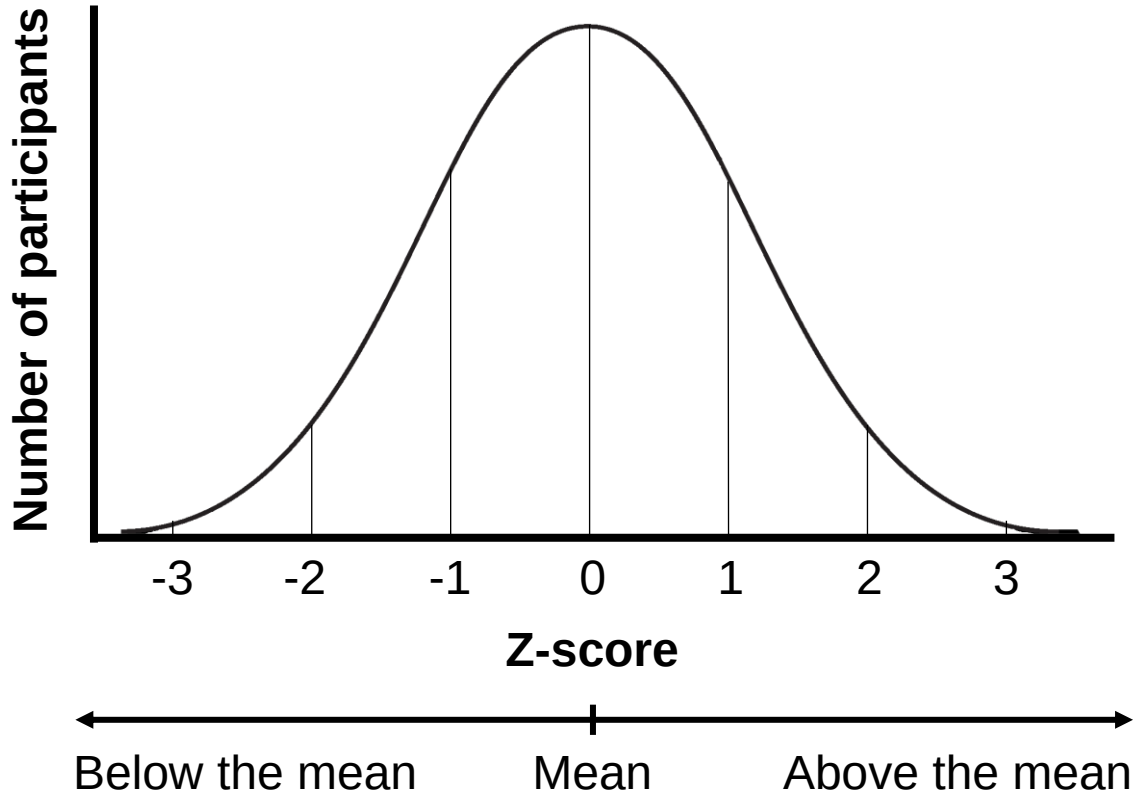
Delayed recall (5 minutes later)



Data processing

- A Z-score was calculated for each test score of each participant
- For English and French separately
- Z-scores were combined to form an **average score for each cognitive domain**:
  - Executive function
  - Prospective memory
  - Episodic memory

⇧ Z-score = ⇧ cognitive performance

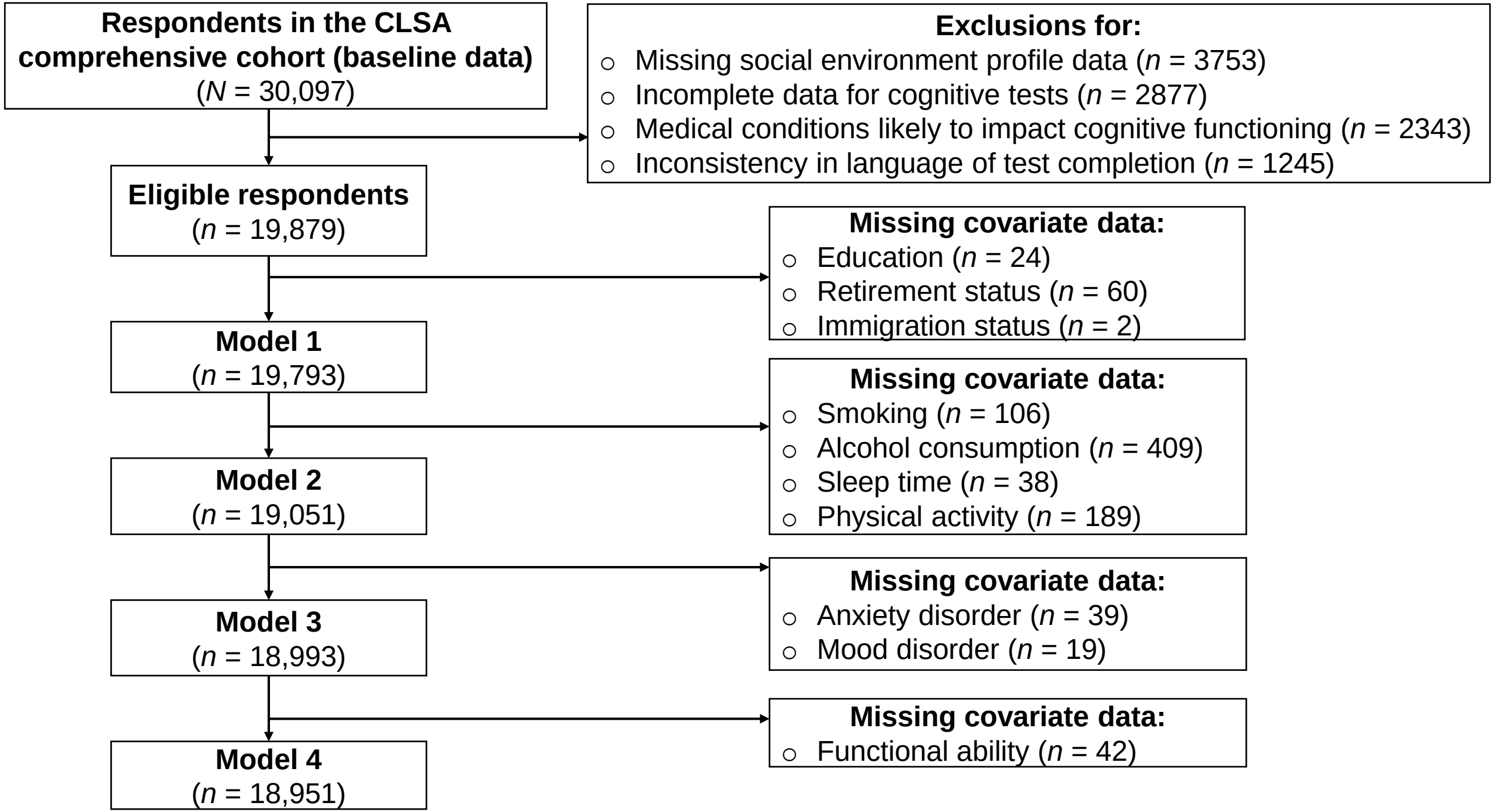


Statistical analysis

- Comparison of the **Z-scores** obtained in each cognitive domain across **three social environment profiles**

  Weaker / intermediate / stronger

- Analysis of covariance
  - Model 1 (adjusted for **sociodemographic factors**): age, sex, education, retirement status, immigration status, ethnicity, urban vs. rural residence, and province of recruitment
  - Model 2 (additional **lifestyle factors**): Model 1 + alcohol consumption, smoking status, sleep time, and physical activity level
  - Model 3 (additional **mental health factors**): Model 2 + history of anxiety disorder and history of mood disorder
  - Model 4 (additional **general health factors**): Model 3 + functional ability level and historical number of chronic conditions/comorbidities (other than those likely to impact cognitive functioning)


Respondents in the CLSA comprehensive cohort (baseline data)
(N = 30,097)
Exclusions for:
Missing social environment profile data (n = 3753)
Incomplete data for cognitive tests (n = 2877)
Medical conditions likely to impact cognitive functioning (n = 2343)
Inconsistency in language of test completion (n = 1245)
Eligible respondents
(n = 19,879)
Missing covariate data:
Education (n = 24)
Retirement status (n = 60)
Immigration status (n = 2)
Model 1
(n = 19,793)
Missing covariate data:
Smoking (n = 106)
Alcohol consumption (n = 409)
Sleep time (n = 38)
Physical activity (n = 189)
Model 2
(n = 19,051)
Missing covariate data:
Anxiety disorder (n = 39)
Mood disorder (n = 19)
Model 3
(n = 18,993)
Missing covariate data:
Functional ability (n = 42)
Model 4
(n = 18,951)

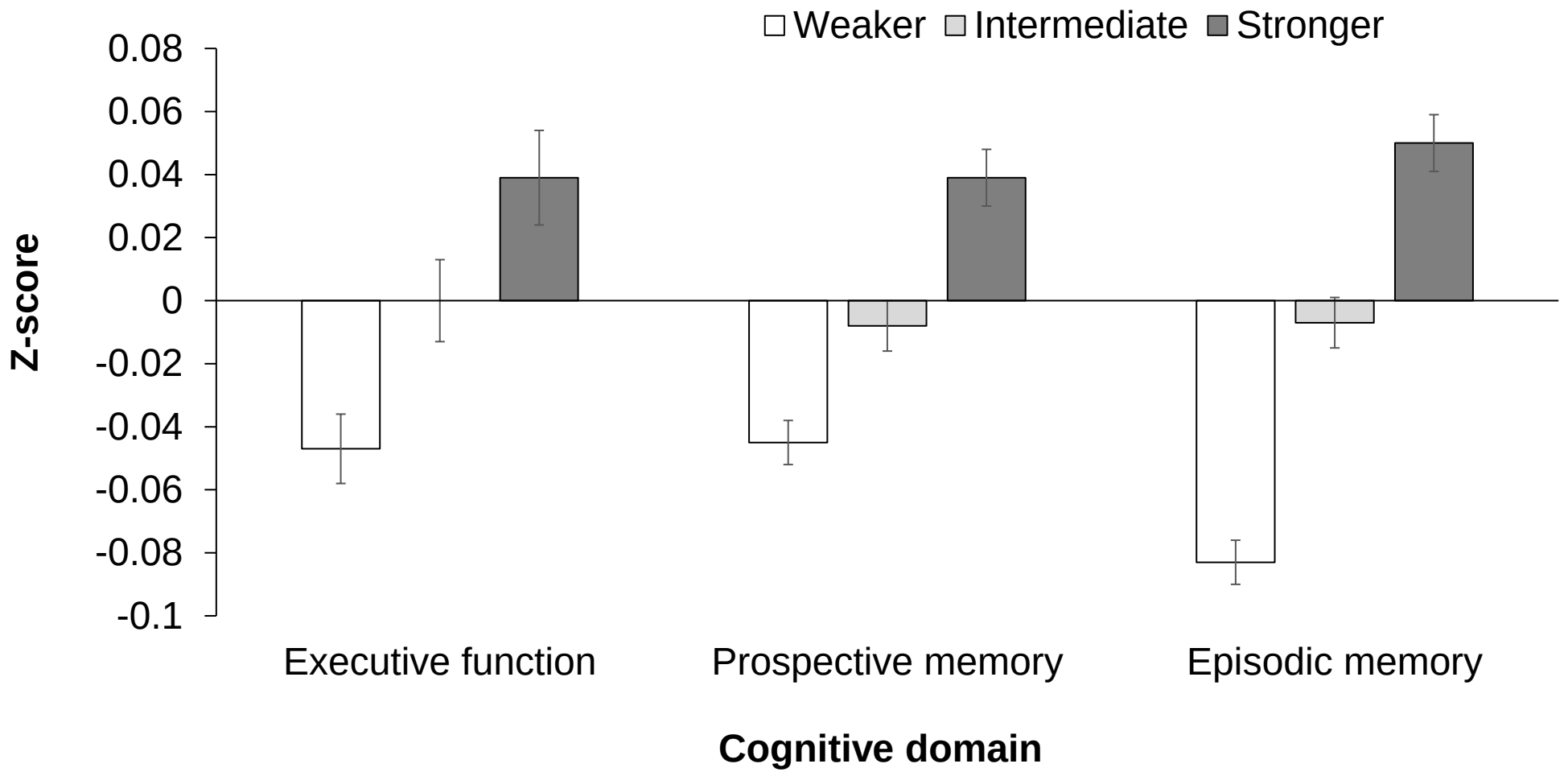
Sociodemographic characteristics (1)

Characteristic	Weaker (*n* = 3293)	Intermediate (*n* = 8001)	Stronger (*n* = 8499)	*p*
Age (*M* ± *SD* years)	63.5 ± 10.3	62.2 ± 10.1	61.3 ± 9.6	< .001
Sex				
Female	1691 (51.4%)	4224 (52.8%)	4165 (49.0%)	< .001
Male	1602 (48.6%)	3777 (47.2%)	4334 (51.0%)	
Highest education level				
Less than secondary school	208 (6.3%)	366 (4.6%)	329 (3.9%)	< .001
Secondary school	315 (9.6%)	746 (9.3%)	715 (8.4%)	
Some post-secondary education	289 (8.8%)	613 (7.7%)	521 (6.1%)	
Post-secondary degree/diploma	2481 (75.3%)	6276 (78.4%)	6934 (81.6%)	
Retirement status				
Completely retired	1507 (45.8%)	3332 (41.6%)	3410 (40.1%)	< .001
Partly retired	330 (10.0%)	915 (11.4%)	973 (11.4%)	
Not retired	1456 (44.2%)	3754 (46.9%)	4116 (48.4%)	
Immigration status				
Immigrant	623 (18.9%)	1379 (17.2%)	1343 (15.8%)	< .001
Non-immigrant	2670 (81.1%)	6622 (82.8%)	7156 (84.2%)	

Sociodemographic characteristics (2)

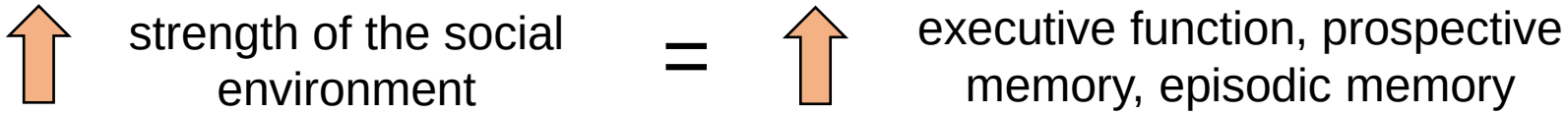
Characteristic	Weaker (*n* = 3293)	Intermediate (*n* = 8001)	Stronger (*n* = 8499)	*p*
Ethnicity				
Caucasian	3112 (94.0%)	7708 (95.8%)	8297 (97.3%)	< .001
Non-Caucasian	199 (6.0%)	336 (4.2%)	227 (2.7%)	
Urban vs. rural residence				
Urban	3149 (95.1%)	7402 (92.0%)	7709 (90.4%)	< .001
Rural	162 (4.9%)	642 (8.0%)	815 (9.6%)	
Province/region at recruitment				
Ontario	672 (20.4%)	1653 (20.7%)	1901 (22.4%)	< .001
Quebec	718 (21.8%)	1489 (18.6%)	1465 (17.2%)	
British Columbia	745 (22.6%)	1718 (21.5%)	1862 (21.9%)	
Prairie region	718 (21.8%)	1698 (21.2%)	1523 (17.9%)	
Atlantic region	440 (13.4%)	1443 (18.0%)	1748 (20.6%)	

Results


Weaker
Intermediate
Stronger
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
-0.1
Z-score
Executive function
Prospective memory
Episodic memory
Cognitive domain

Summary and further considerations

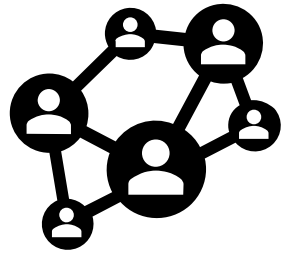
- The social environment profiles were significantly associated with cognitive function.



- Effects were small, but tended to be **larger for older individuals**.
- Results were similar for weighted and unweighted analyses.

Strengths and limitations

- Characterization of the social environment
  - Comprehensive assessment (focus = **connection** with other individuals)



- Potential response bias (**self-reported data**)

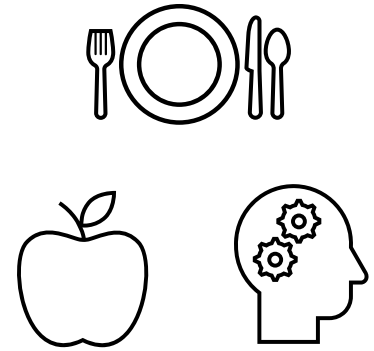
- Nutrition analyses
  - Food group consumption: **Portion size** was not assessed

- Cognition analyses
  - Exclusion of respondents with known **cognitive impairment**

- The **directionality** of the relationships cannot be established.

Conclusion

- Stronger social environment:
  - Less nutritional risk
  - More frequent consumption of certain healthy food groups
  - Better cognitive functioning



- Contribution to the literature
  - The relationships between social factors, nutritional risk, and cognition also hold when considering **multiple social factors in combination**.

Acknowledgements

Research Team
Mike Cisneros-Franco, PhD
Laurette Dubé, PhD
Nicole Ingham, MSc
Katherine Labonté, PhD
Daiva Nielsen, PhD
Catherine Paquet, PhD

Special thanks to the CLSA participants and CLSA research team!

Funding

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

School of Human Nutrition
Environment • Nutrients • Health • Society

UNIVERSITÉ LAVAL

McGill

DESAUTELS

Réseau Québécois de Recherche sur le Vieillissement

References

- Aflaki K, Vigod S, Ray JG. Part I: A friendly introduction to latent class analysis. J Clin Epidemiol. 2022;147:168-170.
- Bayard, S., Erkes, J., Moroni, C., & les members du Collège des Psychologues Cliniciens spécialisés en Neuropsychologie du Languedoc Roussillon (CPCN-LR). (2009). *Test du Stroop Victoria - Adaptation francophone. Matériel, consignes, procédure de cotation et données normatives*.
- Berkman, Lisa F., Ichirō Kawachi, and M. Maria Glymour, eds. Social epidemiology. Oxford University Press, 2014.
- Bertossi Urzua C, Ruiz MA, Pajak A, Kozela M, Kubinova R, Malyutina S, Peasey A, Pikhart H, Marmot M, Bobak M. The prospective relationship between social cohesion and depressive symptoms among older adults from Central and Eastern Europe. J Epidemiol Community Health. 2019;73(2):117-122.
- Bloom I, Edwards M, Jameson KA, Syddall HE, Dennison E, Gale CR, Baird J, Cooper C, Aihie Sayer A, Robinson S. Influences on diet quality in older age: the importance of social factors. Age Ageing. 2017;46(2):277-283.
- Harada, C. N., Love, M. C. N., & Triebel, K. (2013). Normal cognitive aging. *Clinics in Geriatric Medicine*, *29*(4), 737-752.
- Holt-Lunstad J. Social Connection as a Public Health Issue: The Evidence and a Systemic Framework for Prioritizing the "Social" in Social Determinants of Health. Annu Rev Public Health. 2022;43:193-213.
- Ingham N, Labonté K, Dube L, Paquet C, Nielsen DE. A More Supportive Social Environment May Protect Against Nutritional Risk: A Cross-Sectional Analysis Using Data From the Canadian Longitudinal Study on Aging. J Nutr. 2023;153(6):1793-1802.
- Jung, T., & Wickrama, K. A. S. (2008). An introduction to latent class growth analysis and growth mixture modeling. Social and Personality Psychology Compass, 2(1), 302–317.
- Keller HH. Using and scoring SCREEN. Older Adult Nutrition Screening. URL: https://olderadultnutritionscreening.com/faq/ [accessed 2024-11-15]
- Kuiper, J. S., Zuidersma, M., Zuidema, S. U., Burgerhof, J. G. M., Stolk, R. P., Oude Voshaar, R. C., & Smidt, N. (2016). Social relationships and cognitive decline: a systematic review and meta-analysis of longitudinal cohort studies. *International Journal of Epidemiology*, *45*(4), 1169-1206.

References

- Locher JL, Ritchie CS, Roth DL, Baker PS, Bodner EV, Allman RM. Social isolation, support, and capital and nutritional risk in an older sample: ethnic and gender differences. Soc Sci Med. 2005;60(4):747-61.
- Loewenstein, D., & Acevedo, A. (2004). *The prospective memory test: Administration and scoring manual* (Unpublished Manuscript). University of Miami School of Medicine.
- Marie Mills C., Keller H., DePaul V.G., Donnelly C. Social factors associated with changes in nutrition risk scores measured using SCREEN-8: data from the Canadian Longitudinal Study on Aging. Can J Diet Pract Res. 2024;85(2):83-90.
- Mehranfar S, Madani Civi R, Plunkett R, Murphy RA, Cohen TR, Conklin AI. The Longitudinal Evidence on Social Ties and Fruit and Vegetable Intake among Aging Adults: A Systematic Review. Nutr Rev. 2024:nuae134.
- Menec VH, Newall N, Mackenzie C, Shooshtari S, Nowicki S. Examining individual and geographic factors associated with social isolation and loneliness using Canadian Longitudinal Study on Aging (CLSA) data. PLoS One, 2019; 14(2): e0211143
- Pieroth R, Rigassio Radler D, Guenther PM, Brewster PJ, Marcus A. The Relationship between Social Support and Diet Quality in Middle-Aged and Older Adults in the United States. J Acad Nutr Diet. 2017;117(8):1272-1278.
- Ramage-Morin PL, Garriguet D. Nutritional risk among older Canadians. Health Rep. 2013;24(3):3-13.
- Regard, M. (1981). *Stroop test: Victoria version. Manual of instructions and norms*. University of Victoria, Department of Psychology.
- Rey, A. (1964). *L'examen clinique en psychologie*. Paris: Presses universitaire de France.
- Robitaille A, Orpana H, McIntosh CN. Psychometric properties, factorial structure, and measurement invariance of the English and French versions of the Medical Outcomes Study social support scale. Health Rep. 2011 Jun;22(2):33-40.
- Spreen, O., & Benton, A. L. (1977). *Neurosensory center comprehensive examination for aphasia: Manual of directions* (Rev. ed.). Neuropsychology Laboratory, University of Victoria.
- Survey of Health, Ageing and Retirement in Europe (SHARE). (2005). Cognition Module Document: 2004 Questionnaire version 10 (manually edited April 2005).
- Teng, E. L. (1995). The mental alternations test (MAT). *The Clinical Neuropsychologist*, *9*, 287.