Neighborhood socioeconomic disadvantage, inequalities, and cognitive ageing

Prof. Dr. Anja Leist, 3 March 2022

w/Dr. Fabiana Ribeiro, Dr. Jason Settels, Matthias Klee, MSc, Dr. Ariane Bertogg, Jung Hyun Kim, MSc, and others

Cognitive Neuroscience Seminar, Taub Institute for Research on Alzheimer's Disease and the Aging Brain at Columbia University

UNIVERSITÉ DU LUXEMBOURG

European Research Council
Established by the European Commission

Conflict of interest

Dr Leist received remuneration from Roche for advisory activities related to expanding health equity in AD.

CRISP Cognitive Aging: From Educational Opportunities to Individual Risk Profiles

- Investigate the social and behavioral determinants of cognitive ageing and dementia
- Test contextual-level inequalities related to education, sex/gender, and socioeconomic conditions
- Use new methods for risk prediction and causal inference in observational data

Funded by the European Research Council (grant agreement no. 803239), 01/2019-07/2024

Why social and behavioral determinants of cognitive ageing and dementia?

Cognitive impairment and dementia are among the great societal challenges of ageing societies

No medical cure for dementia yet

Modifiable social and behavioral risk factors explain up to 40% of all dementia cases (Livingston et al., 2020)

Important to understand (1) dementia risk of vulnerable individuals and (2) potential for dementia prevention

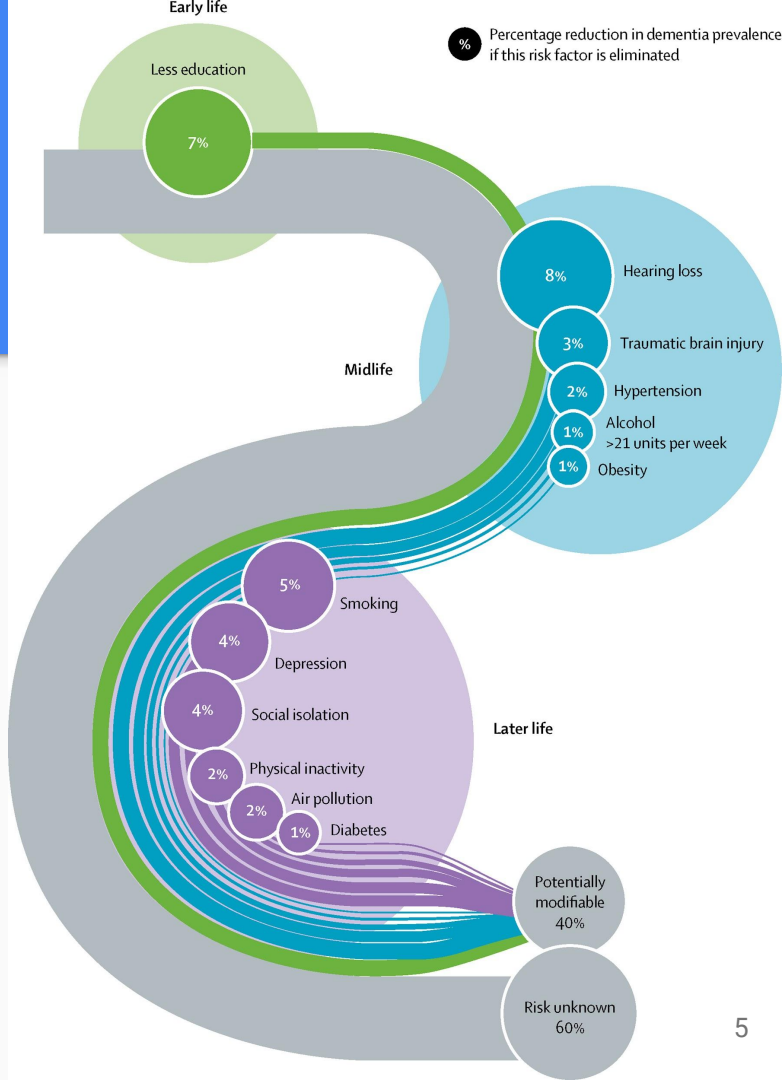
Livingston, G., Huntley, J., Sommerlad, A., Ames, D., Ballard, C., Banerjee, S., ... & Mukadam, N. (2020). Dementia prevention, intervention, and care: 2020 report of the Lancet Commission. *The Lancet*, 396(10248), 413-446.

Modifiable dementia risk

Dementia: Range of conditions characterized by memory impairment. Irreversible, not possible to cure or delay decline.

Potentially modifiable risk factors account for up to 40% to all dementia diagnoses.

In comparison, genetic risk for dementia contributes to approximately 7% of all dementia diagnoses.



Livingston, G., Huntley, J., Sommerlad, A., Ames, D., Ballard, C., Banerjee, S., ... & Mukadam, N. (2020). Dementia prevention, intervention, and care: 2020 report of the Lancet Commission. *The Lancet*, 396(10248), 413-446.

Why contextual-level inequalities in cognitive ageing and dementia?

Little focus on some particularities of cognitive ageing and dementia, e.g.

- Substantial **country-level variation** in population-based studies → impact of human development (education, health, socioeconomics)?
- **Sex/gender differences** in prevalence of dementia → impact of gender inequalities, e.g. gender-role attitudes?
- Cognitive development highly influenced by **schooling** → impact of schooling systems, educational opportunities?

CRISP output (selection)

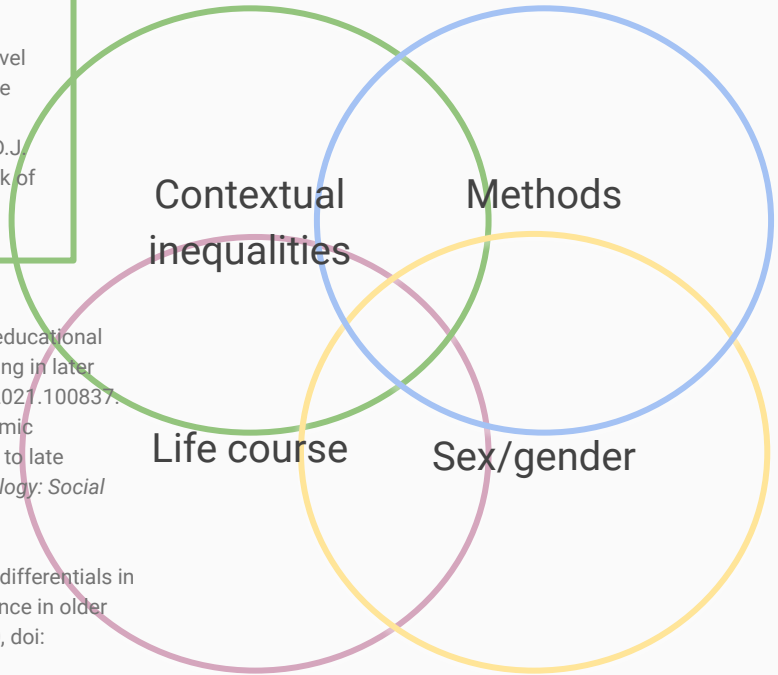
Neighborhood socioeconomic disadvantage
Settels, J., & Leist, A. K. (2021). Changes in neighborhood-level socioeconomic disadvantage and older Americans' cognitive functioning. *Health & Place*, 68, 102510.
Klee, M., Leist, A.K., Veldsman, M., Ranson, J.M., Llewellyn, D.J. (under review). Socioeconomic deprivation, genetics and risk of dementia.

Schooling and childhood socioeconomic conditions
Leist, A. K., Bar-Haim, E., & Chauvel, L. (2021). Inequality of educational opportunity at time of schooling predicts cognitive functioning in later adulthood. SSM - Population Health, doi: 10.1016/j.ssmph.2021.100837.
Ford, K.J., Kobayashi, L., & Leist, A.K. Childhood socioeconomic disadvantage and pathways to memory performance in mid to late Adulthood: What matters most? Revise, *Journals of Gerontology: Social Sciences*.

Psychosocial work characteristics
Ford, K., Batty, G. D., & Leist, A. K. (2021). Examining gender differentials in the association of low control work with cognitive performance in older workers. European Journal of Public Health, 31(1), 174–180, doi: 10.1093/eurpub/ckaa173

Employment transitions
Kim, J.H., Muniz-Terrera, G., & Leist, A. K. Does (re-)entering the labor market at advanced ages protect against cognitive decline? In preparation

Partnership
Bertogg, A., & Leist, A. K. (2021). Partnership and cognitive aging in Europe: Mediating factors and social stratification. Journals of Gerontology: Social Sciences, https://doi.org/10.1093/geronb/gbab020.



Klee, M., Langa, K.M., Leist, A.K. Algorithms for probable dementia classification in the Survey of Health, Ageing and Retirement in Europe. In preparation.

Leist, A. K., Klee, M., Kim, J. H., Rehkopf, D. H., Bordas, S. P. A., Muniz-Terrera, G., & Wade, S. (2021, June). Machine learning in the social and health sciences. arXiv. https://arxiv.org/abs/2106.10716 Revise, *Science Advances*

… Cognitive trajectories with unsupervised ML (lead: M. Klee), causal inference in observational data (lead: Zhalama)

Ribeiro, F., Teixeira-Santos, A. C., & Leist, A. K. (2021). The prevalence of mild cognitive impairment in Latin America and the Caribbean: a systematic review and meta-analysis. *Aging & Mental Health*, https://doi.org/10.1080/13607863.2021.2003297

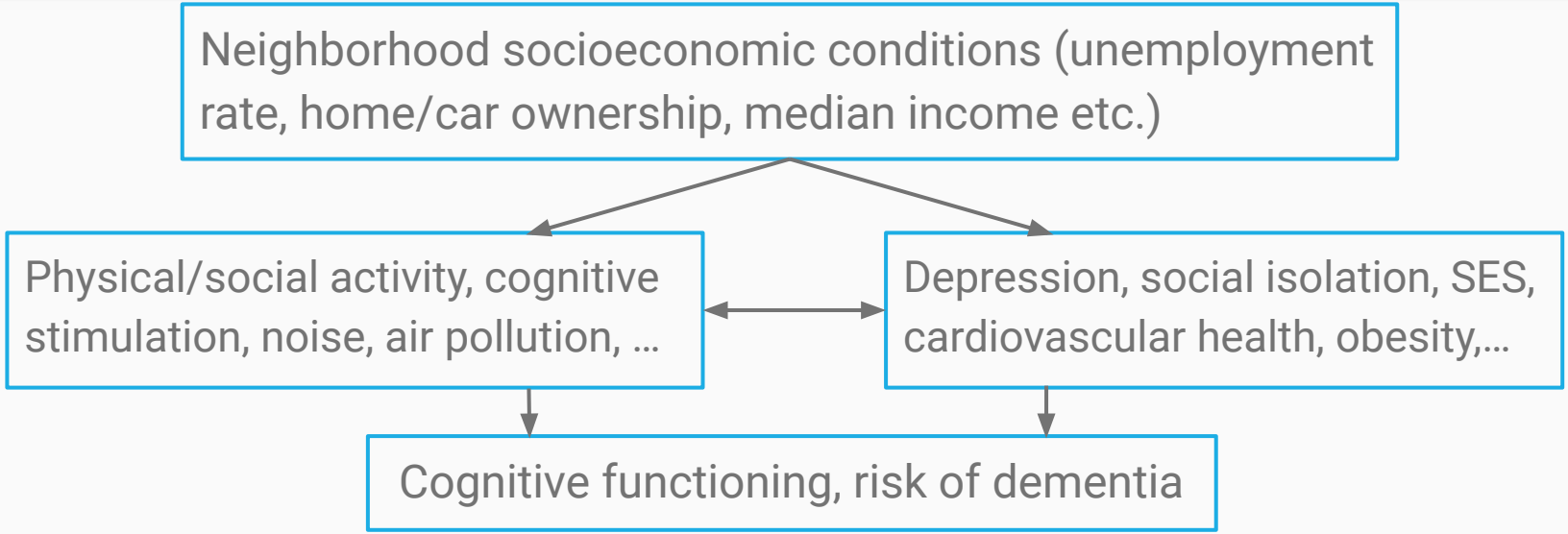
Ford, K. J., & Leist, A. K. (2021). Returns to educational and occupational attainment in cognitive performance for middle-aged South Korean men and women. Gerontology and Geriatric Medicine (SAGE), 7, https://doi.org/10.1177/23337214211004366.

Bertogg., A., & Leist, A.K. (under review). Gendered life courses and cognitive functioning in later life: The role of gender norms and employment biographies.

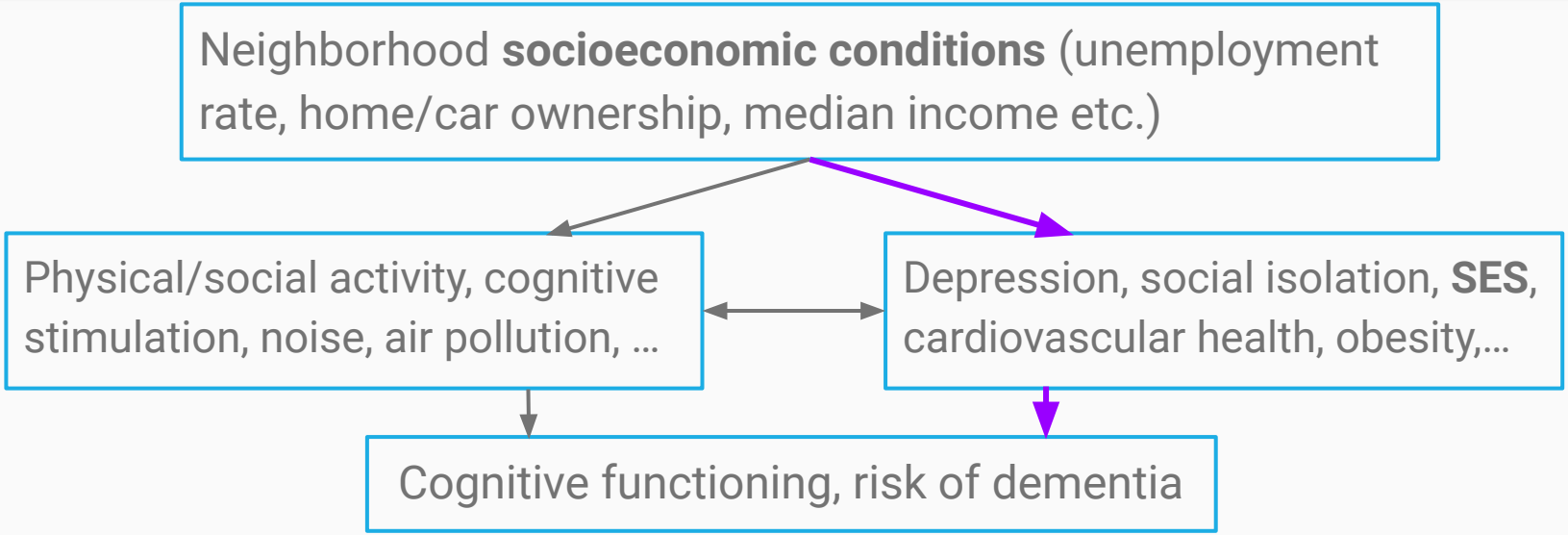
… Gender inequalities in Latin American countries (lead: F. Ribeiro)

https://cognitiveageing.uni.lu

Why neighborhood socioeconomic disadvantage?



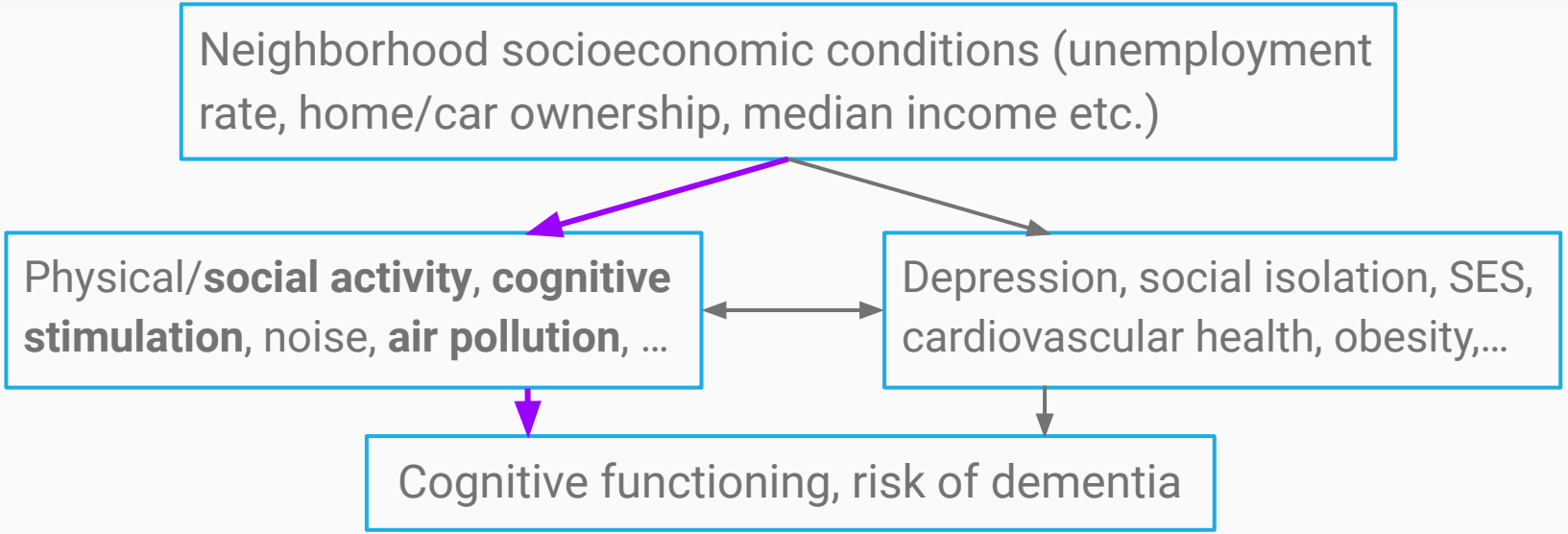
Why neighborhood socioeconomic disadvantage?



Clarke, P. J., Ailshire, J. A., House, J. S., Morenoff, J. D., King, K., Melendez, R., & Langa, K. M. (2012). Cognitive function in the community setting: the neighbourhood as a source of 'cognitive reserve'?. J Epidemiol Community Health, 66(8), 730-736.

Cadar, D., Lassale, C., Davies, H., Llewellyn, D. J., Batty, G. D., & Steptoe, A. (2018). Individual and area-based socioeconomic factors associated with dementia incidence in England: evidence from a 12-year follow-up in the English longitudinal study of ageing. JAMA psychiatry, 75(7), 723-732.

Why neighborhood socioeconomic disadvantage?



Ailshire, J. A., & Clarke, P. (2015). Fine particulate matter air pollution and cognitive function among US older adults. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 70(2), 322-328.

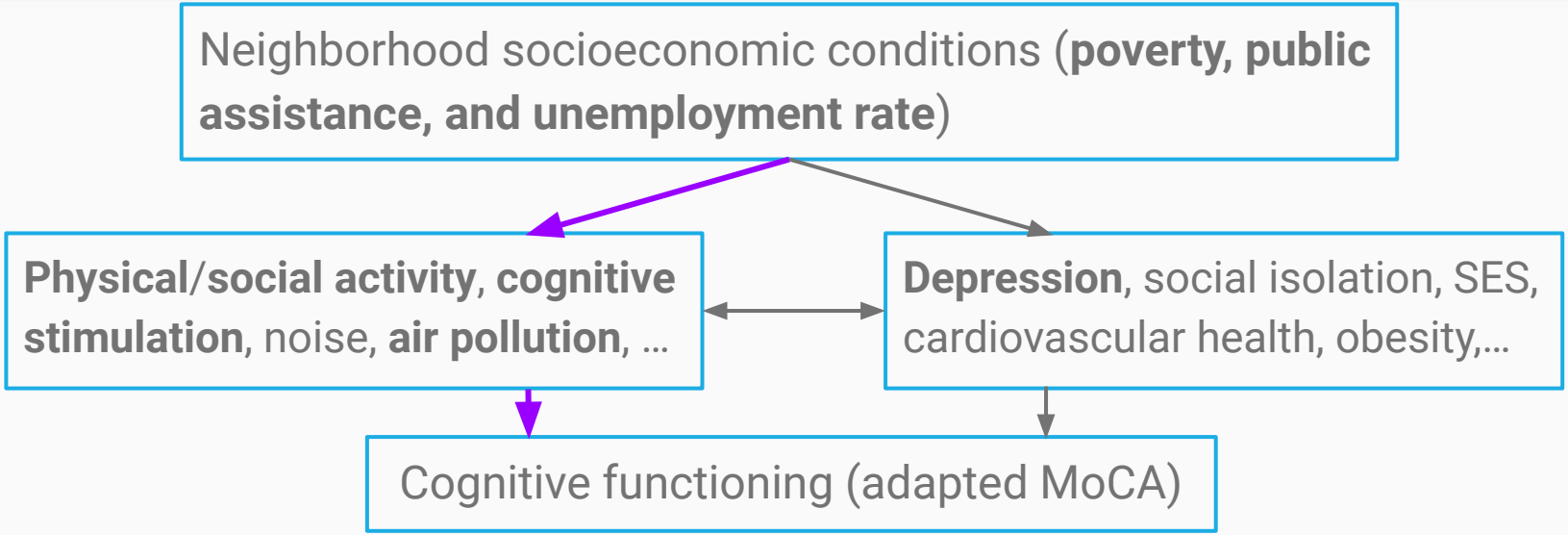
Ailshire, J., Karraker, A., & Clarke, P. (2017). Neighborhood social stressors, fine particulate matter air pollution, and cognitive function among older US adults. *Social Science & Medicine*, 172, 56-63.

Clarke, P. J., Weuve, J., Barnes, L., Evans, D. A., & de Leon, C. F. M. (2015). Cognitive decline and the neighborhood environment. *Annals of Epidemiology*, 25(11), 849-854.

Do changes in neighborhood conditions go along with changes in cognitive functioning?

Jason Settels, PhD, IRSEI, UL

Changes in neighborhood SES associated with changes in cognitive functioning?



Changes in neighborhood socioeconomic disadvantage?

- National Social Life, Health and Aging Project (NSAP) (*n* = 1837)
- Longitudinal design: wave 2 (2010-11), wave 3 (2015-16)

- Outcome: Montreal Cognitive Assessment adaptation (CCFM), executive function, visuo-construction skills, naming, memory, attention, language, abstract thinking, and orientation

Settels, J., & Leist, A. K. (2021). Changes in neighborhood-level socioeconomic disadvantage and older Americans' cognitive functioning. *Health & Place*, 68, 102510.

Changes in neighborhood socioeconomic disadvantage?

Neighborhood socioeconomic disadvantage:

- Poverty, public assistance, and unemployment rate
- Rates standardized and averaged; scores at wave 2 subtracted from scores at wave 3
- Census-tract level: 1,200-8,000 individuals, optimum size 4,000 individuals
- 598 census tracts, with 1 to 25 respondents per census tract

→ OLS regressions and mediation analyses

Settels, J., & Leist, A. K. (2021). Changes in neighborhood-level socioeconomic disadvantage and older Americans' cognitive functioning. *Health & Place*, 68, 102510.

Table 1. Mediating pathways.

Larger Variable	Component Variables
Community involvement	Volunteer work in the past year
	Attendance at meetings of organized groups in the past year
	Attendance at religious services
Size of close social network	–
Social support	Social support from family
	Social support from friends
Community social capital	–
Total household assets	–
Physical activity	–
Substance consumption	Alcoholic drinks per week
	Cigarettes per day
Depressive symptoms	–

Mediators between changes in neighborhood socioeconomic disadvantage and changes in cognitive functioning

Settels, J., & Leist, A. K. (2021). Changes in neighborhood-level socioeconomic disadvantage and older Americans' cognitive functioning. *Health & Place*, 68, 102510.

Table 2
Descriptive statistics for time-changing variables (N = 1837).

Variables	Wave 2		Wave 3		Change over Waves 2 and 3	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean/ %	Standard Deviation
Dependent Variable						
Cognitive Functioning (0–20)	15.26	3.15	14.58	3.54	−0.68	2.67
Independent Variable						
Neighborhood-Level Socioeconomic Disadvantage	−0.07	0.78	−0.09	0.77	−0.01	0.55
Mediating Variables						
Depressive Symptoms (1–4)	1.40	0.42	1.47	0.44	0.07	0.43
Close Social Ties (0–7)	4.60	1.50	4.19	1.31	−0.42	1.66
Physical Activity (0–5)	2.90	1.78	2.66	1.86	−0.24	1.94
Number of Alcoholic Drinks per Week	2.78	5.98	2.33	5.09	−0.45	4.23
Number of Cigarettes per Day	1.39	4.84	0.97	4.04	−0.41	3.02
Social Support from Family (0–3)	2.42	0.68	2.40	0.68	−0.01	0.76
Social Support from Friends (0–3)	2.03	0.83	1.98	0.78	−0.07	0.80
Logged Total Household Assets[1]	12.02	3.03	11.85	3.22	−0.13	2.81
Neighborhood Social Capital	0.04	0.56	0.05	0.56	0.01	0.51
Frequency of Volunteer Work in Past Year (0–6)	2.36	2.12	2.25	2.17	−0.12	1.78
Frequency of Attendance at Meetings of Organized Groups in Past Year (0–6)	2.89	2.12	2.77	2.20	−0.16	2.01
Frequency of Attendance at Religious Services (0–5)	2.67	1.77	2.57	1.77	−0.09	1.16
Control Variable						
Change in Census Tract						
Did not Change Census Tracts between Waves 2 and 3	–	–	–	–	82.47%	–
Changed Census Tracts between Waves 2 and 3	–	–	–	–	17.53%	–

[1] To adjust for inflation, amounts from wave 2 were multiplied by 1.086449 before being log transformed.

Settels, J., & Leist, A. K. (2021). Changes in neighborhood-level socioeconomic disadvantage and older Americans' cognitive functioning. *Health & Place*, 68, 102510.

Table 4
OLS regressions of change in cognitive functioning.

VARIABLES	Wave(s) of Assessment	Model 1	Model 2
Change in Census Tact-Level Socioeconomic Disadvantage	Change W2 to W3	−0.414* (0.172)	−0.337* (0.159)
Female (ref. male)	W2	−0.283 (0.150)	−0.191 (0.149)
Black (ref. White)	W2	0.236 (0.270)	0.336 (0.274)
Hispanic, Non-Black		0.953* (0.407)	0.812* (0.395)
Other		0.387 (0.341)	0.397 (0.336)
Census Tract Logged Population Density (Persons per Square Mile)	W2		−0.031 (0.050)
Census Tract Located in MSA (ref. Not Located in MSA)	W2		−0.021 (0.229)
Age	W2		−0.065*** (0.013)
Separated or Divorced (ref. Married or Living with a Partner)	W2		−0.329 (0.299)
Widowed			−0.123 (0.237)
Never Married			0.011 (0.476)
No Children (ref. Three or More Children)	W2		0.168 (0.297)
One or Two Children			−0.137 (0.166)
High School Diploma (ref. University Degree)	W2		−0.343* (0.172)
Less than High School Diploma			−0.120 (0.267)

Main analyses

Increase in neighborhood socioeconomic disadvantage was associated with stronger declines in cognitive functioning

+ controlling for self-rated physical health, health problems, working for pay, length of residence in local area, changed census tract, participation in wave 1, census-tract level population density.

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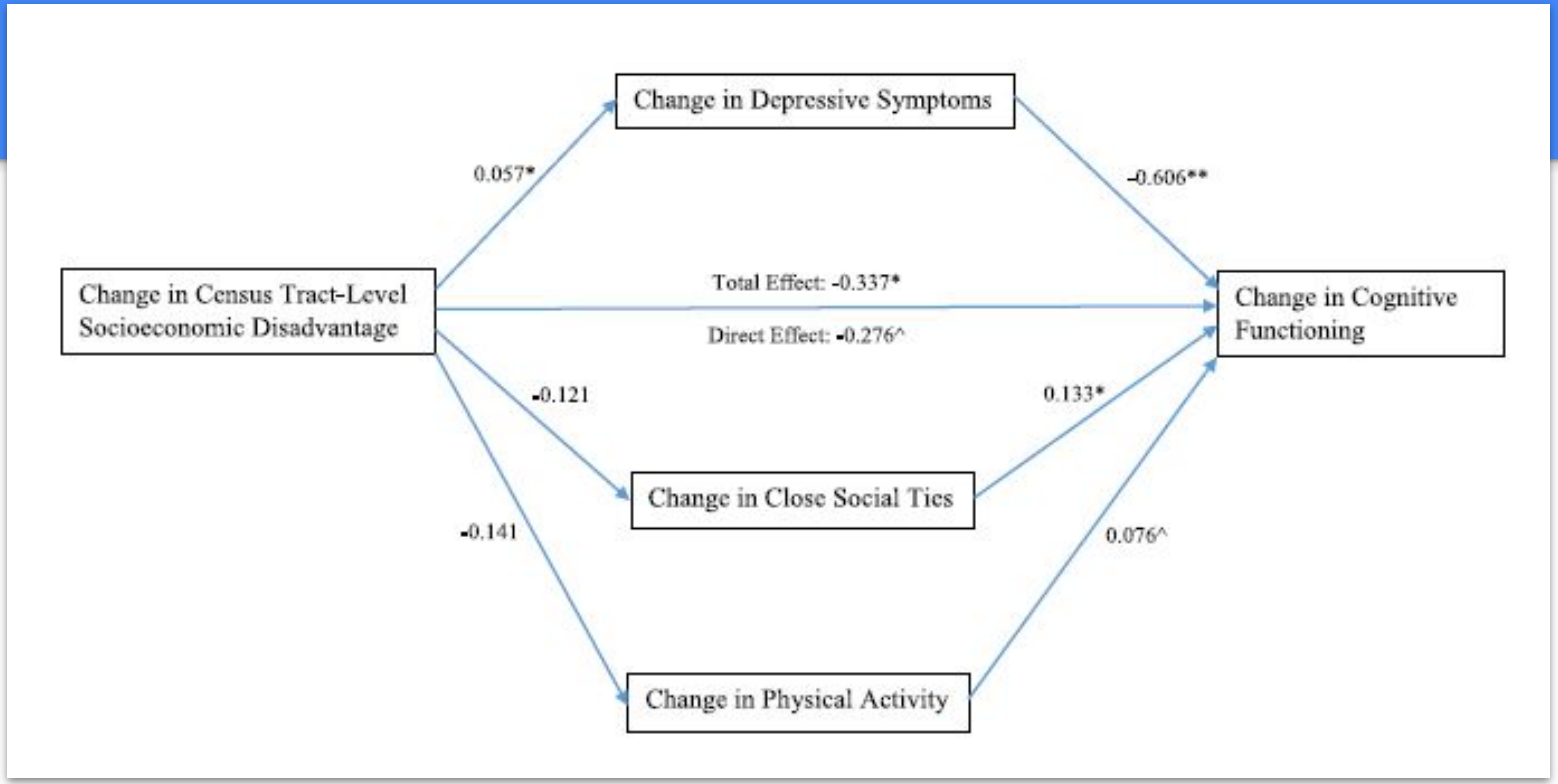
Mediation analyses



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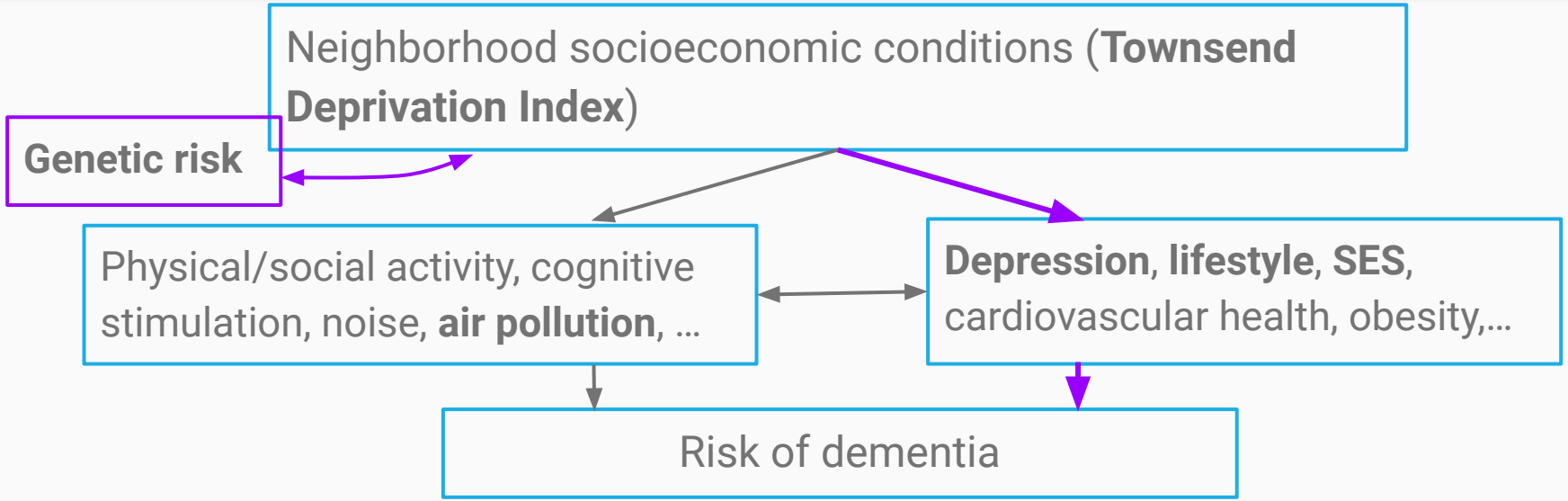
Do neighborhood socioeconomic conditions interact with genetic risk of dementia?

Matthias Klee, PhD candidate,
IRSEI, UL

Neighborhood deprivation x genetic dementia risk?



Neigborhood deprivation x genetic risk

- UK Biobank: 196,368 participants 60+, European ancestry
- Time-to-event design: 2006-10 initial assessment, follow-up until 2016-17
- Dementia ascertained through hospital or death records
- Polygenic risk score for developing dementia: Quintiles 1 (low), 2-4 (moderate), 5 (high genetic risk)

Klee, M., Leist, A.K., Veldsman, M., Ranson, J.M., Llewellyn, D.J. (under review). Socioeconomic deprivation, genetics and risk of dementia.

Neigborhood deprivation x genetic risk

Townsend Deprivation Index:

- Unemployment, home ownership, car ownership and household overcrowding rate
- From baseline assessment and national census output areas (40 to 125+ households)
- Quintiles 1-4 (low) compared against quintile 5 (high deprivation)

Individual-level socioeconomic deprivation: home, car ownership, housing type, annual household income

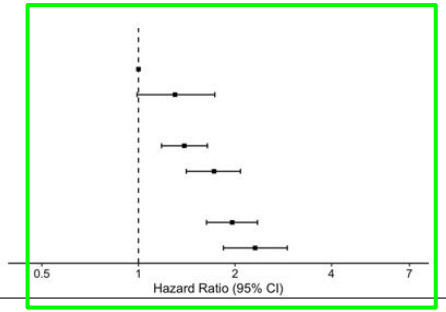
Klee, M., Leist, A.K., Veldsman, M., Ranson, J.M., Llewellyn, D.J. (under review). Socioeconomic deprivation, genetics and risk of dementia.
ONS. https://www.ons.gov.uk/methodology/geography/ukgeographies/censusgeography

Neigborhood deprivation x genetic risk

Figure 1. Risk of Incident Dementia for A Area-level and B Individual-level Socioeconomic Deprivation with Genetic Risk

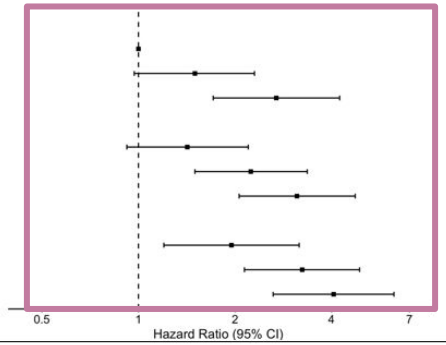
A Area-level Socioeconomic Deprivation

Subgroup	Total No.[a]	No. Dementia Cases / Person-Years[a]	HR (95% CI)	P Value
Low Genetic Risk				
Low-to-Moderate Deprivation	31,648	177 / 249,647	1 [Reference]	
High Deprivation	7,626	70 / 59,124	1.30 (0.99-1.73)	.06
Intermediate Genetic Risk				
Low-to-Moderate Deprivation	94,316	744 / 744,724	1.39 (1.18-1.64)	<.001
High Deprivation	23,505	294 / 182,389	1.72 (1.41-2.08)	<.001
High Genetic Risk				
Low-to-Moderate Deprivation	31,131	345 / 246,144	1.96 (1.63-2.35)	<.001
High Deprivation	8,142	139 / 63,285	2.31 (1.84-2.91)	<.001



B Individual-level Socioeconomic Deprivation

Subgroup	Total No.[a]	No. Dementia Cases / Person-Years[a]	HR (95% CI)	P Value
Low Genetic Risk				
Low Deprivation	8,110	25 / 63,790	1 [Reference]	
Intermediate Deprivation	23,624	134 / 186,093	1.50 (0.97-2.30)	.07
High Deprivation	7,540	88 / 58,887	2.69 (1.71-4.24)	<.001
Intermediate Genetic Risk				
Low Deprivation	23,417	103 / 184,307	1.42 (0.92-2.20)	.12
Intermediate Deprivation	70,774	614 / 558,529	2.24 (1.50-3.36)	<.001
High Deprivation	23,630	321 / 184,276	3.12 (2.06-4.74)	<.001
High Genetic Risk				
Low Deprivation	7,747	46 / 61,124	1.95 (1.20-3.17)	.01
Intermediate Deprivation	23,423	294 / 184,928	3.24 (2.14-4.89)	<.001
High Deprivation	8,103	144 / 63,377	4.06 (2.63-6.26)	<.001



All Cox proportional-hazards regressions were adjusted for covariates relevant in polygenic risk analyses, age, sex, education, marital status, healthy lifestyle and depressive symptoms in last two weeks. Additionally, adjustments for individual-level (A) and area-level socioeconomic deprivation (B) were included.

Klee, M., Leist, A.K., Veldsman, M., Ranson, J.M., Llewellyn, D.J. (under review). Socioeconomic deprivation, genetics and risk of dementia.

Dementia prevalence and prevention potential in different parts of the world

Background

- Compare dementia prevalence in lower-resource settings against prevalence in higher-resource settings
- Compare secular trends in dementia incidence/prevalence in lower-resource settings against declining incidence of dementia in many high-income countries over the last two decades
- Investigate interplay between rising life expectancy, rising educational attainment, increases in cardiovascular risk and dementia prevalence in lower-resource settings

What is the dementia prevalence in Latin America and the Caribbean, and what are the secular trends?

Fabiana Ribeiro, PhD, IRSEI, UL

Prevalence of mild cognitive impairment and dementia in LAC

Lead: Dr Fabiana Ribeiro

- Prevalence of mild cognitive impairment in Latin America and the Caribbean, published in *Aging & Mental Health* 2021, DOI: 10.1080/13607863.2021.2003297
- Prevalence of dementia and mild cognitive impairment in Latin America and the Caribbean, *under review*

Cognitive impairment in Sao Paulo, Brazil, 2000-2015

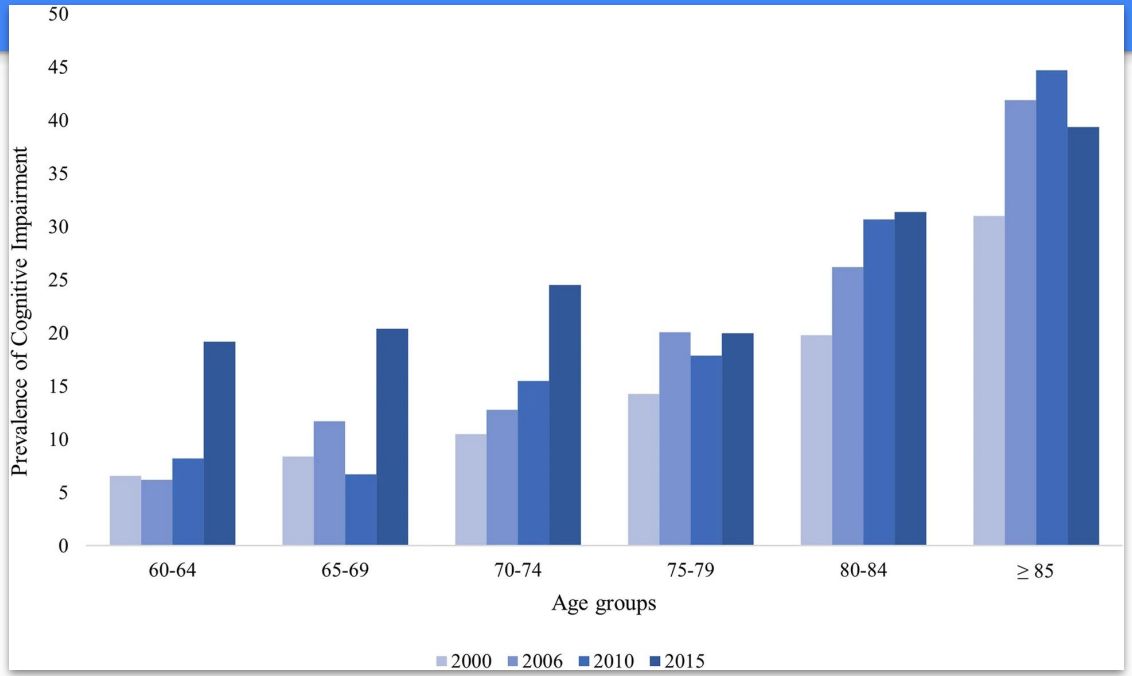
Health, Welfare and Aging survey, repeated cross-section with panel respondents, 2000, 2006, 2010, 2015

Outcome: abbreviated Mini-Mental State Exam, education-adjusted

Associated protective and risk factors: education, cardiovascular risk factors

Ribeiro, F. S., de Oliveira Duarte, Y. A., Santos, J. L. F., & Leist, A. K. (2021). Changes in prevalence of cognitive impairment and associated risk factors 2000–2015 in São Paulo, Brazil. BMC geriatrics, 21(1), 1-10.

Prevalence of cognitive impairment by age group 2000-2015

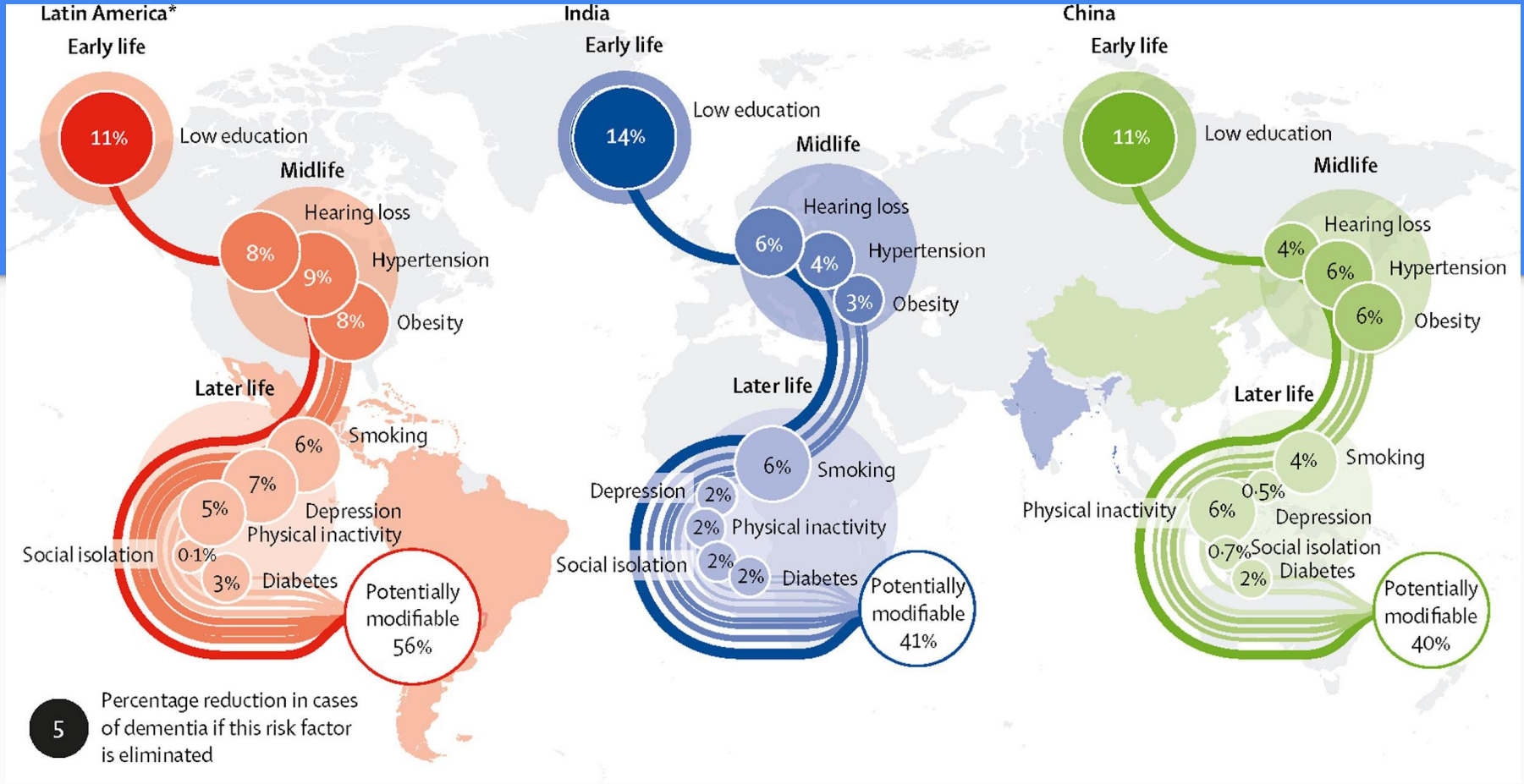


Increases in prevalence of cognitive impairment, specifically 60-79 years, 2000-2015

Increases in formal education and income, 2000-2015

Increases in prevalence of diabetes, hypertension, overweight/obesity, 2000-2015

Ribeiro, F. S., de Oliveira Duarte, Y. A., Santos, J. L. F., & Leist, A. K. (2021). Changes in prevalence of cognitive impairment and associated risk factors 2000–2015 in São Paulo, Brazil. BMC geriatrics, 21(1), 1-10.



Mukadam, N., Sommerlad, A., Huntley, J., & Livingston, G. (2019). Population attributable fractions for risk factors for dementia in low-income and middle-income countries: an analysis using cross-sectional survey data. The Lancet Global Health, 7(5), e596-e603.

Ongoing research on dementia in LAC

Lead: Dr Fabiana Ribeiro

- Understand better dementia prevention potential in Latin America and the Caribbean through identifying hidden modifiable risk factors:
  - Gender-role norms around care responsibilities, education and careers
  - Undernutrition, food insecurity
  - …

Ongoing research on contextual-level inequalities and norms

Lead: Ariane Bertogg, PhD, University of Konstanz

Test the contribution of gender-role norms and their interaction with employment biographies to cognitive ageing in men and women in Europe with SHARE data, *under review*

Thank you!

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https://cognitiveageing.uni.lu

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