How biomarkers of aging and self-reported health respond to guaranteed income: insights from the CLSA

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Overview and signposting

- This presentation is an amalgamation of three projects:
  - Two projects from Luke's MSc thesis & related work
  - One additional project related to the same grant
  - All three projects were supported by a CLSA Catalyst Grant from CIHR
- Project 1: Measuring stress as a biomarker, "allostatic load"
- Project 2: Cross-sectional evidence of allostatic load's association with public pension (guaranteed annual income)
- Project 3: Longitudinal evidence of changes in self-reported health with public pension

Basic principles to set up projects

Universally, health is better among the wealthy and worse among the poor

High-income Canadians live longer than low-income Canadians

Low-income Canadians have twice the rates of morbidity as high-income Canadians

Low-income Canadians are significantly more likely to become a high-cost healthcare user

References:
Bushnik et al., 2020, Shahidi et al., 2020, Gundersen et al., 2018, CIHI, 2015, Mondor et al., 2020, Mudryj et al., 2019

Why older adults?

- Older adults make up a growing proportion of Canadian population, important policy target for government, all people on this call probably know this.
- Importantly: SDoH influence our environment, and by the time someone reaches older adulthood they've lived most of their life in some environment.
- If it is a low income environment AND income manages to influence their health AFTER that experience (e.g., at age 65), then perhaps earlier intervention is defensible from health perspective.

Project 1 Intro: Measuring Health

- Diverse range of tools, rubrics and measurements are used to inform policy and clinical decisions
- All measures walk the line between comprehensiveness and practicality:
  - Comprehensive measures may be more detailed, but harder to obtain
  - More concise measures may be easier to compute and apply

Frailty and Frailty Index:

- “A state of vulnerability to adverse health outcomes due to age-related decline across physiological systems”
- Frailty Index in CLSA:
  - 52 self-reported, clinical, laboratory-based variables
  - Associated with increased hospitalization, stroke, all-cause mortality

References:
Perez-Zepeda et al., 2021, Theou & Rockwood, 2015, Burton et al., 2022, Ida et al., 2019, Kaskirbayeva et al., 2023, Kojima et al., 2018)

Allostatic Load (Stats Can)

- *"Physiologic dysregulation, or cumulative wear-and-tear, on the body as the result of ongoing environmental stressors and demands."*
- 9, easily accessible variables:
  - Total Cholesterol, High-Density Lipoprotein, Glycated Hemoglobin, Waist-to-Hip ratio, average Systolic BP, average Diastolic BP, resting heart rate, C-Reactive protein, Albumin
- Associated with cognitive decline, worsening CVD, increased all-cause mortality

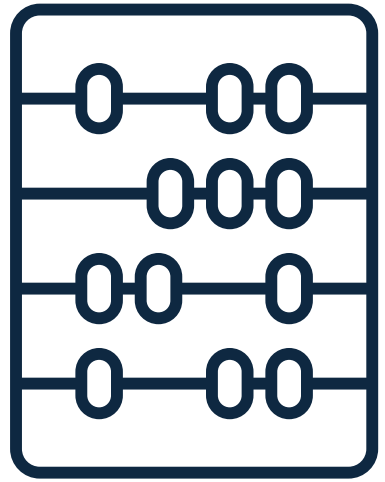
References:
Juster et al., 2010, Thomson et al., 2019, Guidi et al., 2021, Borrell et al., 2010, Karlamangla et al., 2006

This study…

- Unaware of any Canadian or other research examining the relationship of the Frailty Index and Allostatic Load
- If they are seen to move together, Allostatic Load may contain “key” biomarkers of frailty

Methods

- Frailty Index developed as per existing protocols
- Allostatic load developed as per Stats Can guidelines
  - **Clinically** high-risk value = 1
  - AL Score = sum of all high risk values
- Condensed to AL Score = 0-5+



References:
Searle et al., 2008; Pérez-Zepeda et al., 2021, Thomson et al., 2019

Results:

Average AL and FI:

Both FI and AL indicated fairly good health, got better with higher income

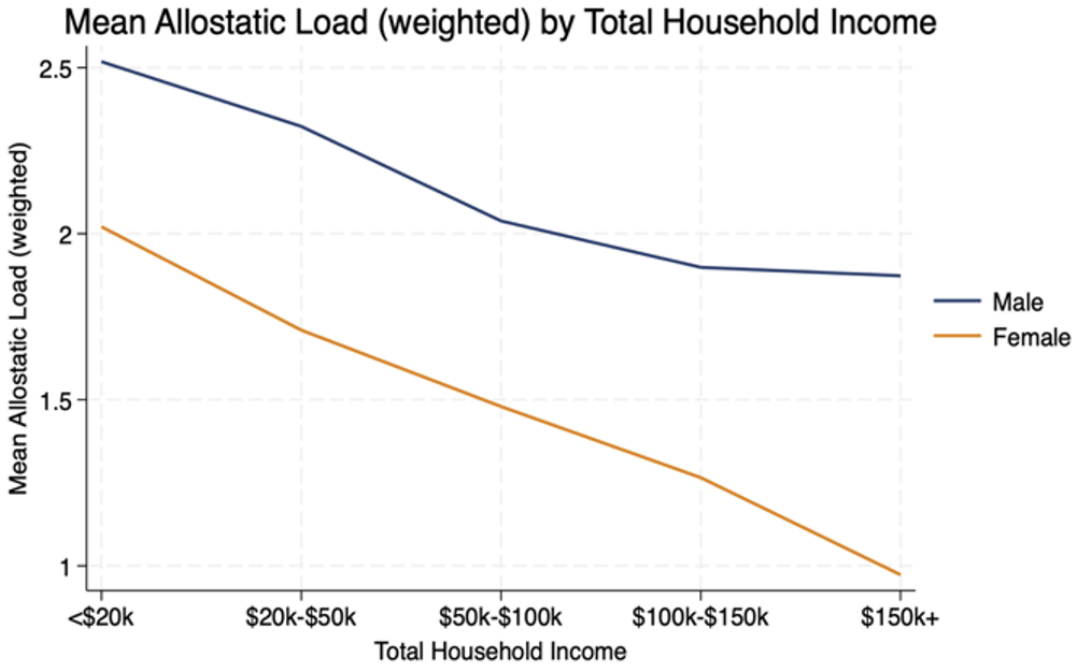


Figure 1. Mean allostatic load (weighted) by age and total household income

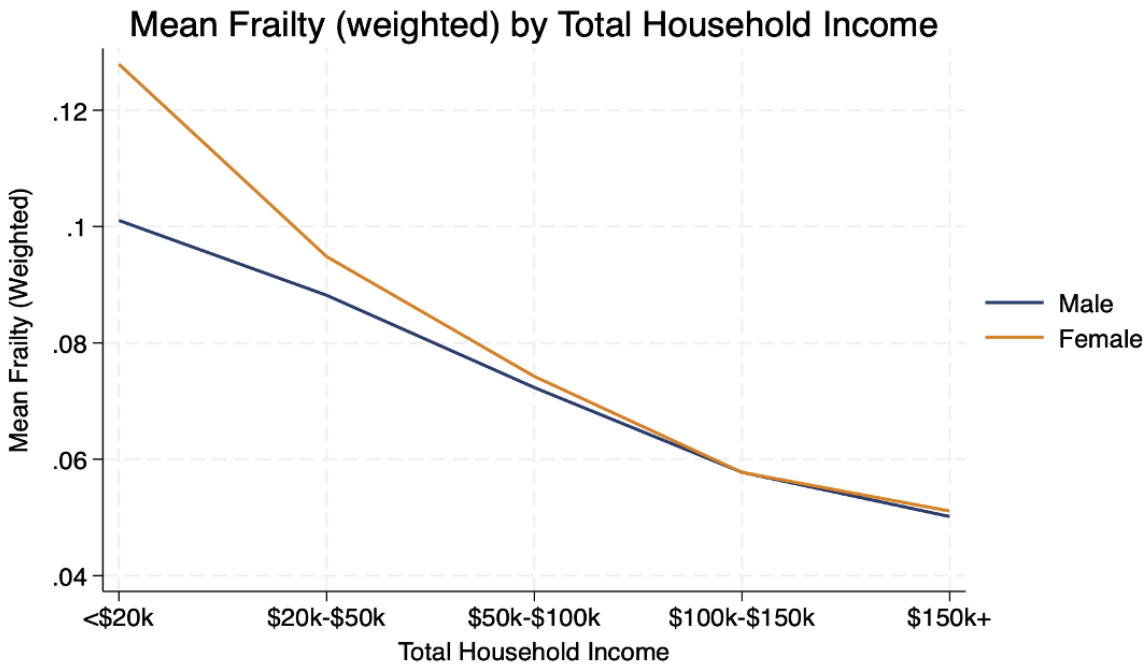


Figure 2. Mean frailty index score (weighted) by age and total household

The distribution of frailty by AL

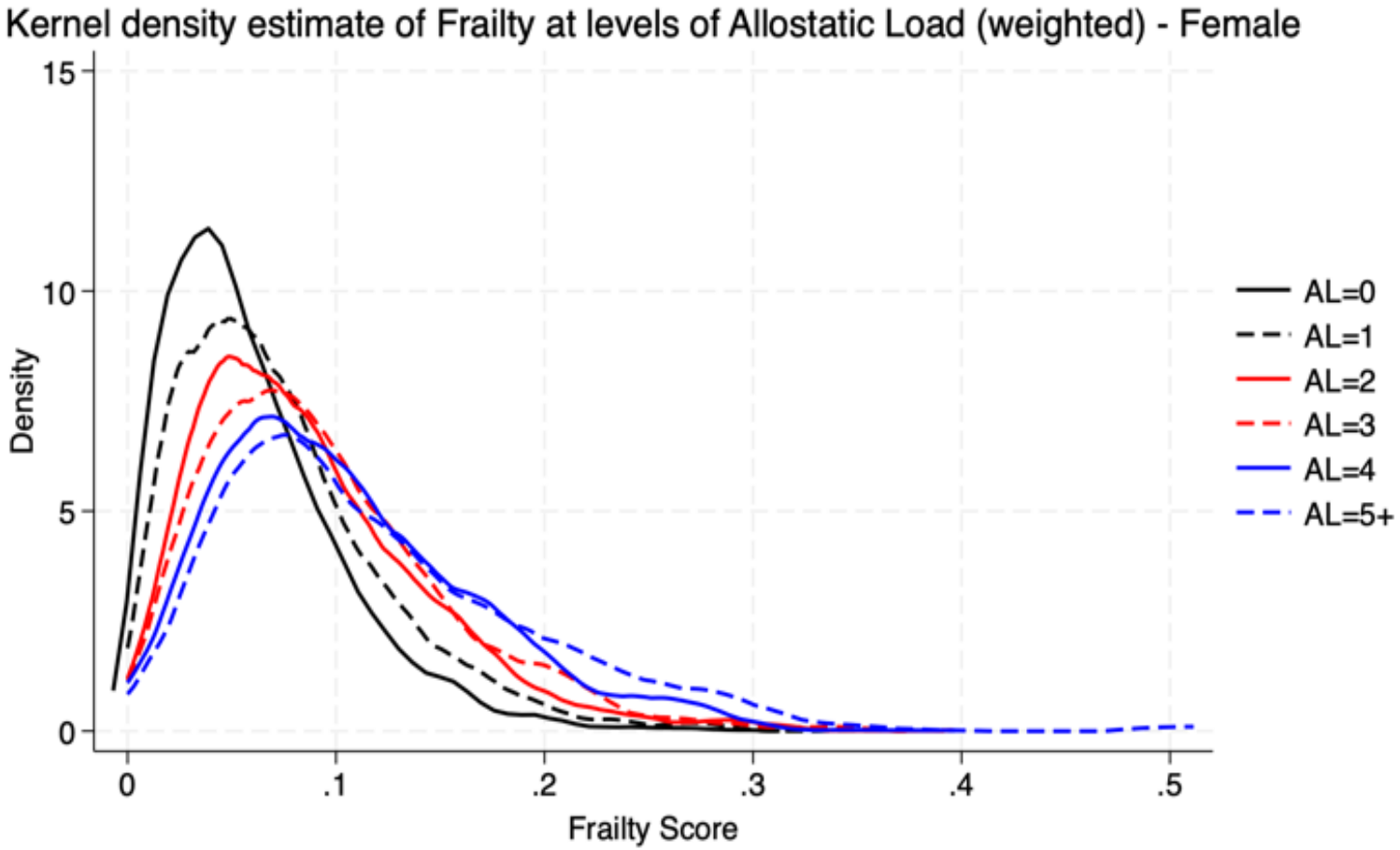


Figure 3. Density estimates of frailty at all levels of allostatic load for males and females (weighted)

Results, increased AL means increased FI:

Table 2. Linear regression estimates for the association between allostatic load and standardized frailty index score

		Female	Male
		Coefficient (95% CI):	Coefficient (95% CI):
Allostatic Load			
	0	Ref	Ref
	1	0.099* (0.054 – 0.145)	0.147* (0.088 – 0.207)
	2	0.243* (0.187 – 0.299)	0.276* (0.213 – 0.339)
	3	0.330* (0.258 – 0.403)	0.401* (0.329 – 0.473)
	4	0.500* (0.391 – 0.609)	0.504* (0.409 – 0.599)
	5+	0.751* (0.557 – 0.946)	0.625* (0.492 – 0.758)

Table 3. Logistic regression estimates for the association between allostatic load, standardized 52-item frailty, standardized 51-item frailty (sensitivity analysis) and Self-Rated Health

	<65		65-74		75+	
	Female OR (95% CI)	**Male** OR (95% CI)	**Female** OR (95% CI)	**Male** OR (95% CI)	**Female** OR (95% CI)	**Male** OR (95% CI)
Model One:						
Allostatic Load Score	0.697* (0.647 – 0.752)	0.674* (0.624 – 0.729)	0.780* (0.722 – 0.843)	0.708* (0.656 – 0.765)	0.746* (0.667 – 0.834)	0.769* (0.683 – 0.867)

Key Takeaways:

- Allostatic load and frailty are both similarly patterned by socioeconomic and sociodemographic factors.
- Higher levels of allostatic load were associated with increased frailty index scores consistently across both males and females.
- Higher allostatic load and frailty scores were both associated with increased odds of reporting poor or fair health.

Conclusions:

Allostatic load may represent a practical and efficient measure of health and health risk with a tolerable loss of comprehensiveness.

So what happens when we use it…
(Project 2)

Duignan & Dutton (2024) The association between allostatic load and guaranteed annual income using the Canadian Longitudinal Study on Aging: A cross-sectional analysis of the benefits of guaranteed public pensions. *Health Policy*. https://pubmed.ncbi.nlm.nih.gov/38522246/

Guaranteed Annual Income

- *“Reoccurring payment provided by the government to all citizens”*
- Previous Canadian Evidence includes:
  - MINCOME
  - Ontario Basic Income Pilot
- Old Age Security (OAS) and the Guaranteed Income Supplement
  - $21,774.60 per year

References:
Parijs, 2004, Chetty et al., 2016, Forget, 2013, Hamilton and Mulvale, 2019

Study Objectives:

Use Allostatic Load and model its association with OAS receipt in financially insecure Canadians.

Methods:

- Allostatic Load index, CLSA baseline data

- Financial Insecurity variable (required all three)
  - Total Household Income <$50,000
  - Total Savings <$100,000
  - Not owning a home or owning it with a mortgage

- OAS as Highest Personal Income Source

Results

Table 2. Mean allostatic load scores by age and sex (weighted)

		Female		Male	
		<65	>65	<65	>65
All		1.38	1.56	1.97	2.00
Financial Security					
	Financially Insecure	1.85	1.93	2.39	2.42
	Financially Secure	1.31	1.48	1.93	1.95

Table 3. Ordered logistic regresions estimate results for the association between financial insecurity, old age security and allostatic load

	Female	Male
	Odds Ratio (95% CI):	**Odds Ratio (95% CI):**
Financial security		
Financially Insecure	1.544* (1.335 - 1.785)	1.569* (1.316 - 1.871)
Financially Secure	Ref	Ref
Highest Personal Income Source		
OAS	1.175 (0.943 - 1.464)	2.120* (1.476 - 3.045)
Non-OAS (Other)	Ref	Ref
Interaction		
Financially Insecure*OAS	0.677* (0.483 - 0.949)	0.398* (0.227 - 0.696)

Discussion

- There may be an objective health benefit to receiving GAI
- Despite using a conservative definition of financial insecurity, results were seen: perhaps income alone may not truly capture those in need, especially around the age of retirement
- Future considerations for the Old Age Security program: quantifying its benefit can justify its expense

What if we watch people transition onto pensions… (Project 3)

Jiménez & Dutton (2024) Transitioning to a guaranteed annual income and the impact on activities of daily living in older adults: Evidence from public pensions in Canada using the CLSA. *Canadian Journal of Public Health*. https://pubmed.ncbi.nlm.nih.gov/38647638/

People transition onto pensions at age 65, usually

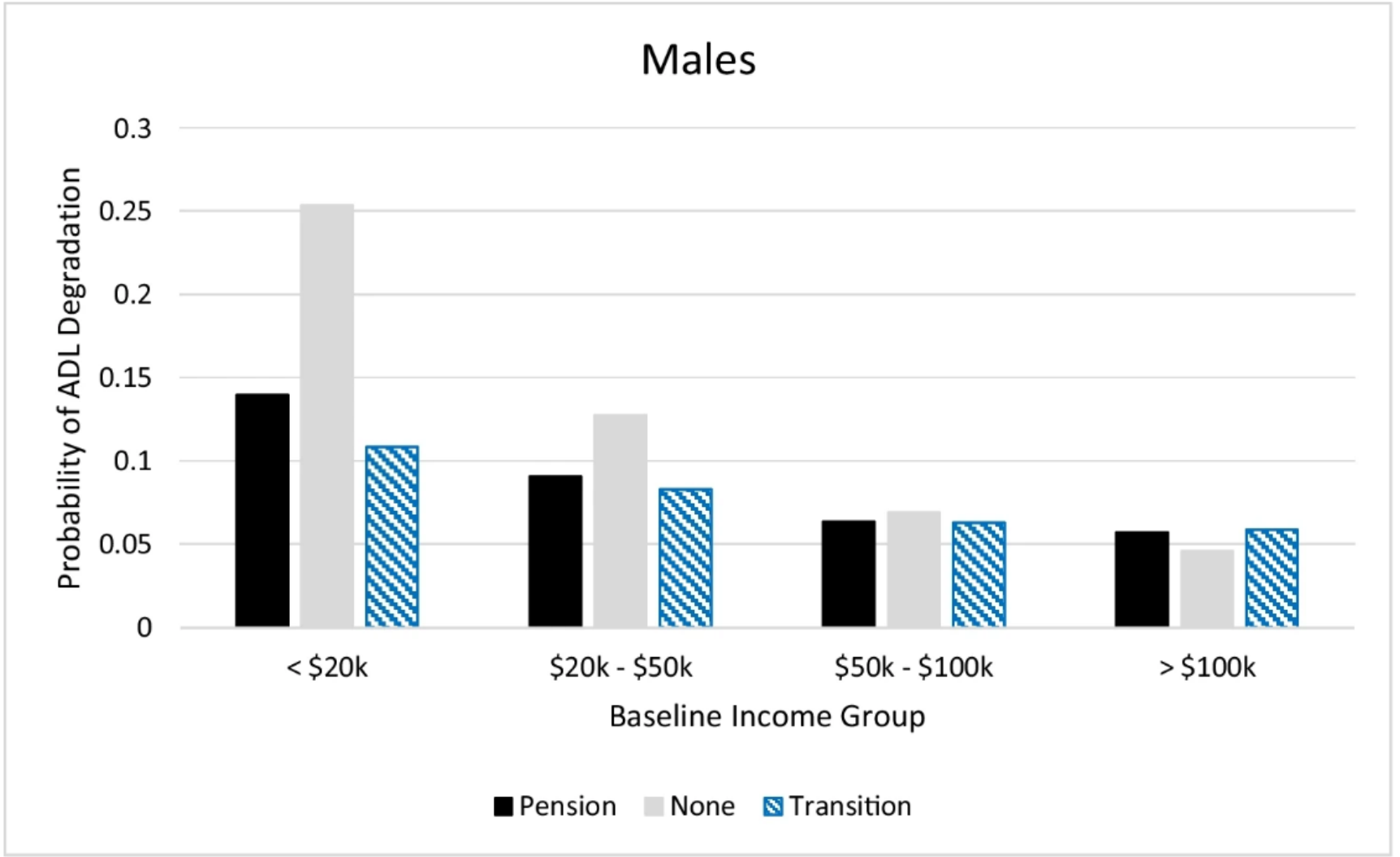
- Using CLSA baseline and FU1 we canobserve changes in various health variables
- We decided to go with function: “activities of daily living”
  - Important, possible to observe change, relevant to older adults
- Methods: Logistic regression to model likelihood of changing ADL with transition onto pension in males and females (two models each sex: improved versus not; degraded versus not).
  - Including confounders and allowing impact of transition onto pension to be modified by baseline income. All weights.
    - Report marginal effects so humans can understand it.

Some summary statistics

- Going to show only male results, brevity, n=12,639, age 55+. ADLs measured with OARS Multidimensional Functional Assessment Q.
- Approximately 94% of sample had no functional impairment at baseline. 7.5% degrade, 3% improve.
- Only 3% in the poorest group, 90% owned their house
- Pensions status: Received at baseline and follow-up (yes), received no pension (no), or received a pension at follow-up but not baseline (transitioned). OAS or OAS+GIS counts as pension.
- 55% yes, 23% transition, 22% no.

Results, Probability of ADL Improvement (smaller sample, many at max):

Results, Probability of ADL Degradation



Overall conclusions

- Public pensions were not designed as a health intervention, but they seem to be an important one in terms of omnibus health quality measures studied here.
- Questions naturally arise:
  - Why make someone wait until they are 65? What is magical about that age such that surviving until then makes one qualified for an improvement in ADLs or AL?
  - Retirement: more free time, possible increased quality of life. Consistent with low-income group?

Thank you!

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