

Socioepigenomics of Cellular Immunosenescence in Adulthood: The Add Health Study

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Presented by Jennifer Momkus

Immunosenescence

Age-related decline of immune function

- Increased inflammation
- Cellular changes
 - > naïve vs. memory T cells

Biological aging specific to the immune system

- Mechanisms by which socio-environmental factors “get under the skin”

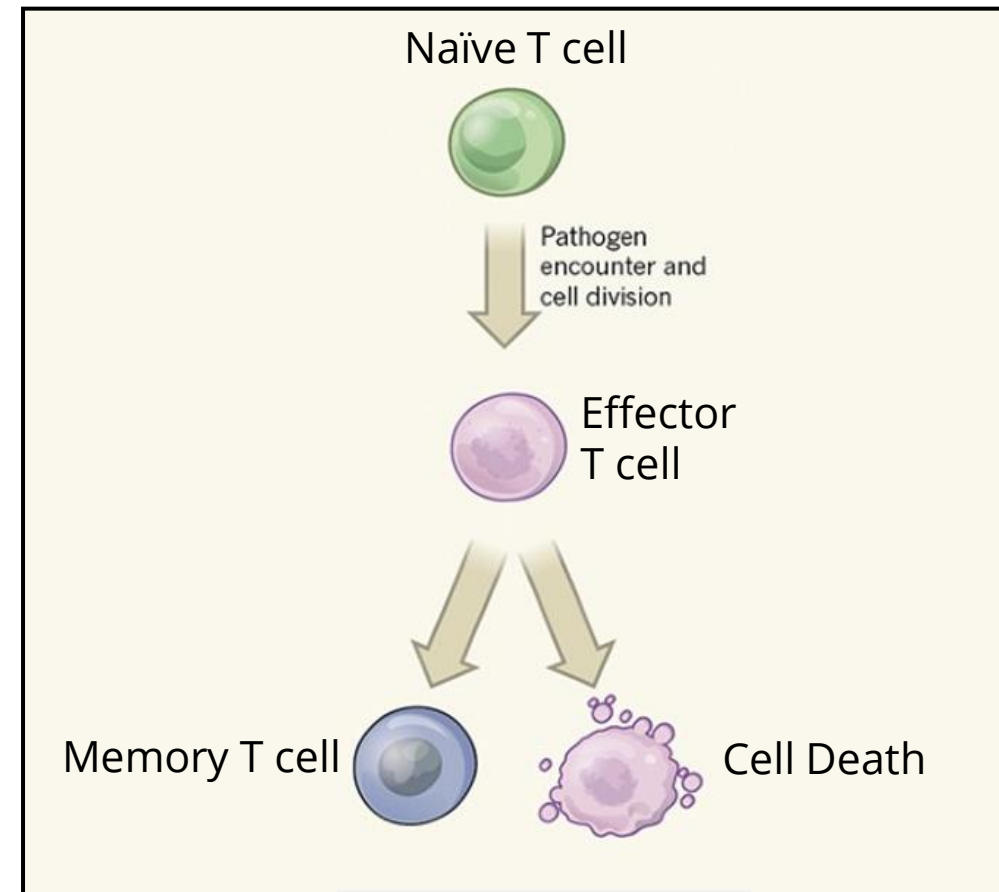
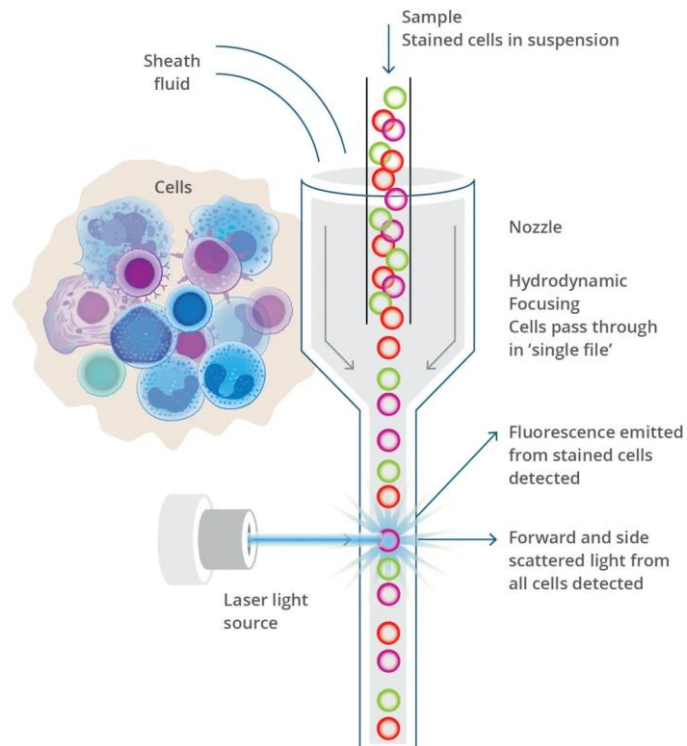


Figure adapted from Omilusik, K.D. and Goldrath, A.W., 2017. The origins of memory T cells.

Measuring Immune Phenotypes

- **Flow Cytometry:**

- Requires intact cells



<https://www.streck.com/blog/principles-of-flow-cytometry/>

- **DNA Methylation:**

- Only requires DNA

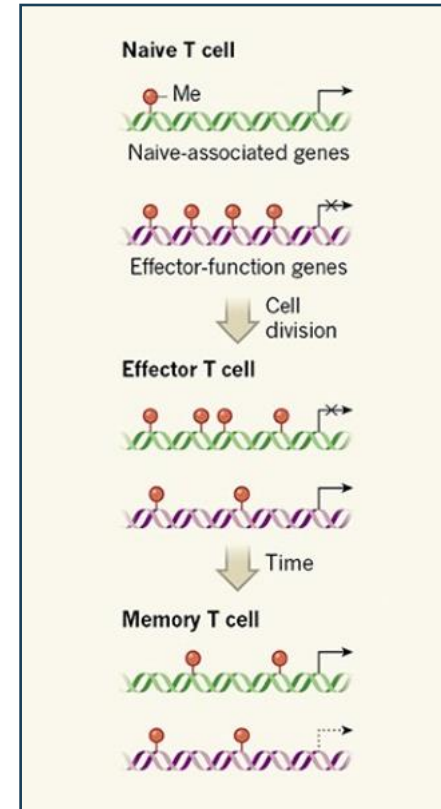


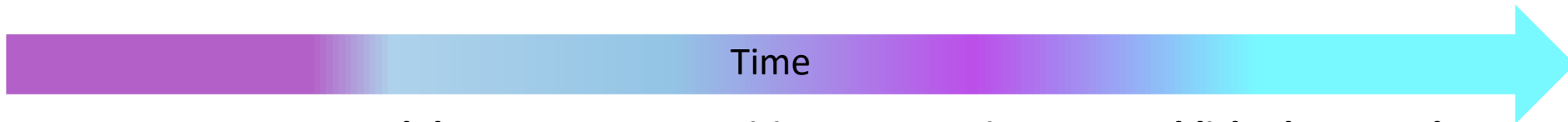
Figure adapted from Omilusik, K.D. and Goldrath, A.W., 2017. The origins of memory T cells.

- DNAm patterns are specific to cell types
- Can use patterns to estimate of proportions of cell types in sample



What is the association between social environment and specific cellular measures of immunosenescence in U.S. adults?

Add Health Timeline and Data Collection



	Time					
	Adolescents		Transition to Adult	Emerging Adults	Established Adults	Early Midlife*
Wave Years	I 1994-95	II 1996	III 2001-02	IV 2008	V 2016-18	VI 2021-25
Grade/Age	7-12th	8-12th	18-26	24-33	33-44	39-49
Survey N	20,745	14,738	15,197	15,701	12,300	13,694
Biomarker N			Urine 14,012	Blood Spot 14,687	V Blood 5,269	V Blood 8,050
Parent N	17,670				3,000	5,506

*Goal for ongoing data collection, V blood= venous blood

Methods

- Add Health Wave V Home Exam
- Methods from Salas et al. 2022¹ were used to estimate immune cell distributions
 - T-helper CD4+ Memory/CD4+ Naïve cell ratio (**Median=1.70, Range (0.007, 238.3)**)
 - Log-transformed
- Exposures of interest:
 - Total Household Income (Wave V)
 - Educational Attainment (Wave V)
 - Life Course SES
 - > Based on educational attainment
 - Social Relationships (Wave V)

Established Adulthood
Low SES
(Wave V)

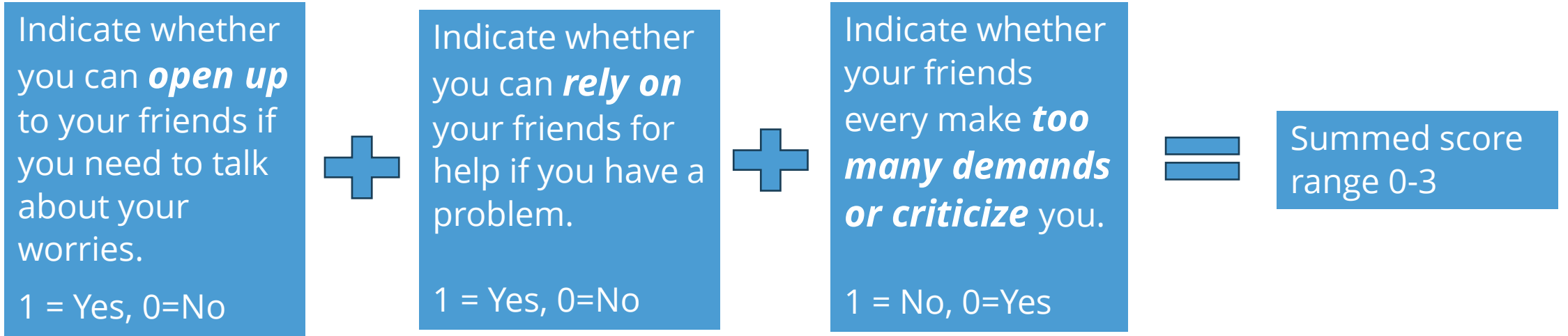
Early Life
Low SES
(Wave I)

	No	Yes
No	2530 (57%)	270 (8%)
Yes	891 (23%)	386 (12%)

¹Salas LA, Zhang Z, Koestler DC, et al. Enhanced cell deconvolution of peripheral blood using DNA methylation for high-resolution immune profiling. *Nature Communications*. 2022;13(1):761. doi:10.1038/s41467-021-27864-7

Social Relationship Measures (Wave V)

Quality Variables or Spouse/Partner, Friends, Relatives:



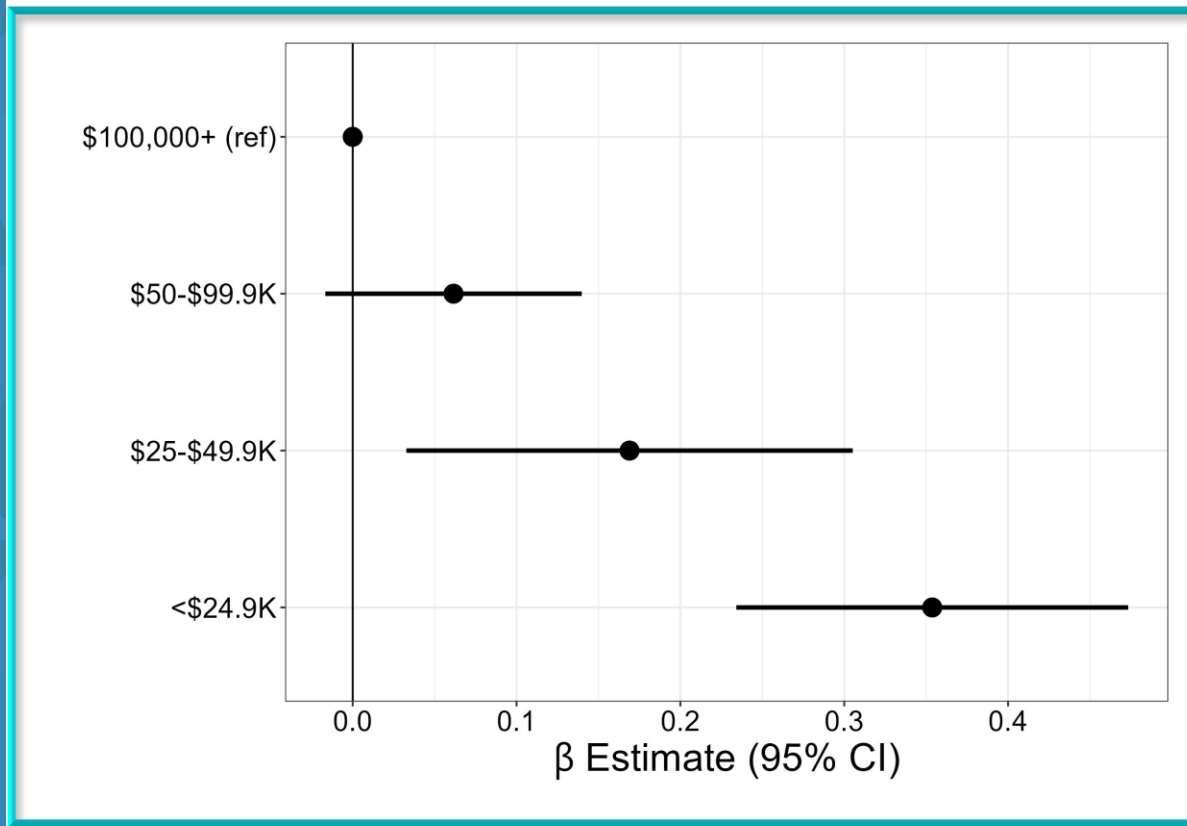
Type	Score=3 (High Quality)
Spouse/Partner (N=3575)	66.7%
Relatives (N=4220)	59.2%
Friends (N=4151)	72.7%

Table 1. Weighted Sample Characteristics

	Wave V Home Exam (N=5,269)	Analytic Sample (N=4,481)
Age, median (SE), years	37.4, (0.19)	37.4, (0.19)
Race/Ethnicity, n (%)		
American Indian/Alaska Native	37, 0.9%	31, 0.2%
Asian	262, 2.6%	204, 2.4%
Black/African American	1035, 17.3%	858, 17.2%
Hispanic	528, 8.4%	460, 8.6%
Pacific Islander	27, 0.2%	24, 0.2%
Some other race or origin	17, 0.4%	14, 0.4%
White	3363, 70.2%	2890, 70.2%
Training		
College Degree or higher	2449, 41.3%	2080, 41.6%
Recent Infection/Inflammatory Condition	734, 13.9%	622, 13.9%

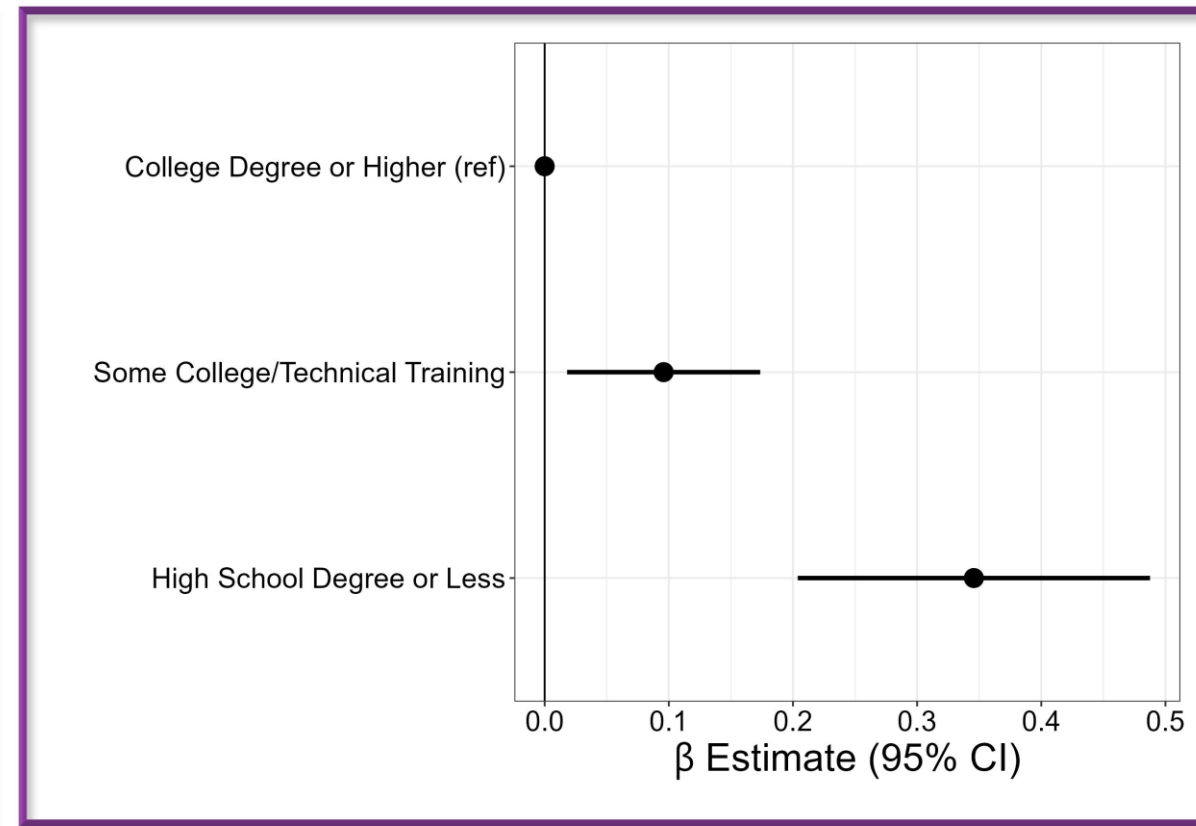
Association between Income and Education with CD4+ Memory/Naïve Immune Cell Ratios

Total Household Income



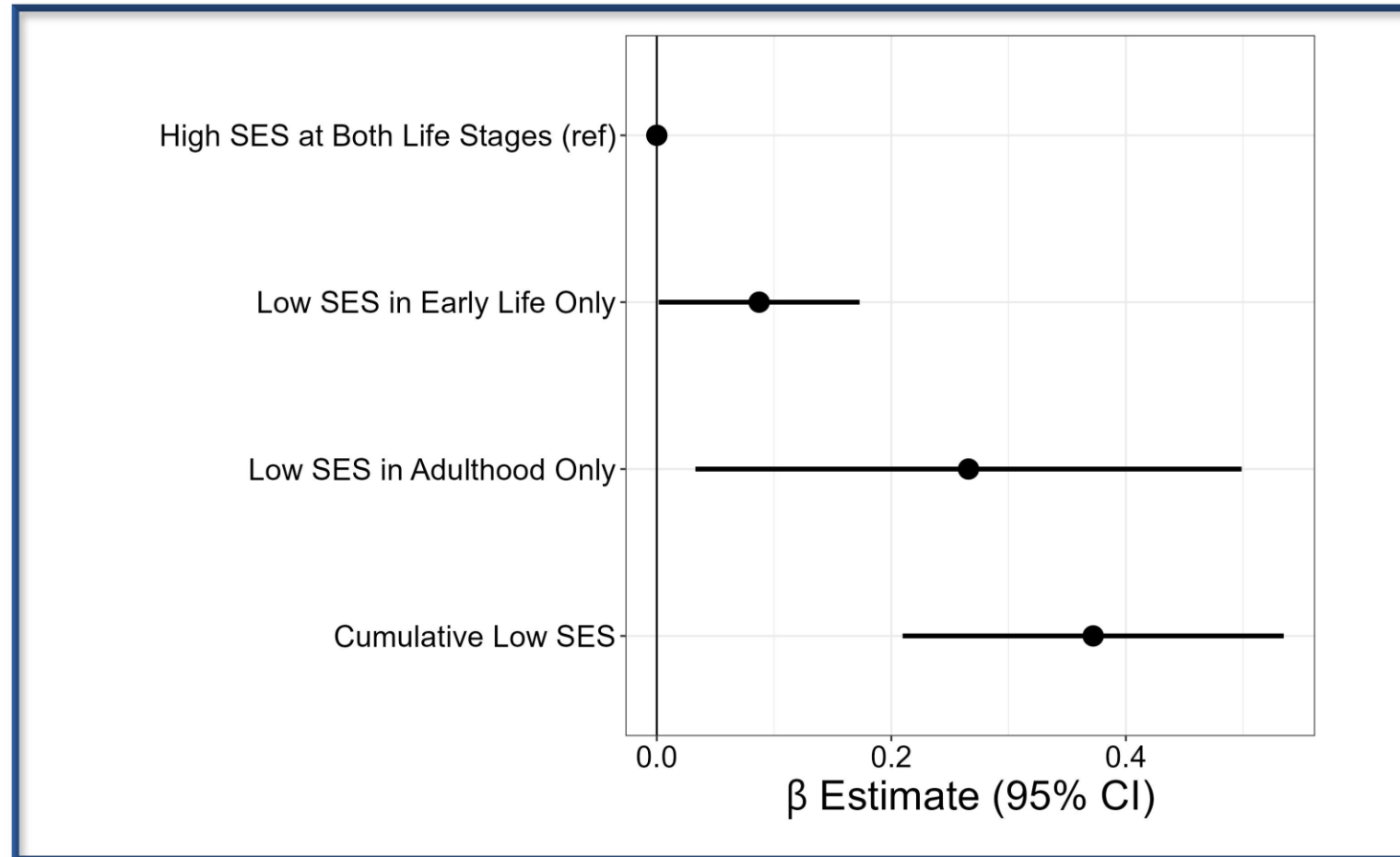
Ref= \leq \$100,000
N=4443

Educational Attainment



Ref=College Degree or Higher
N=4481

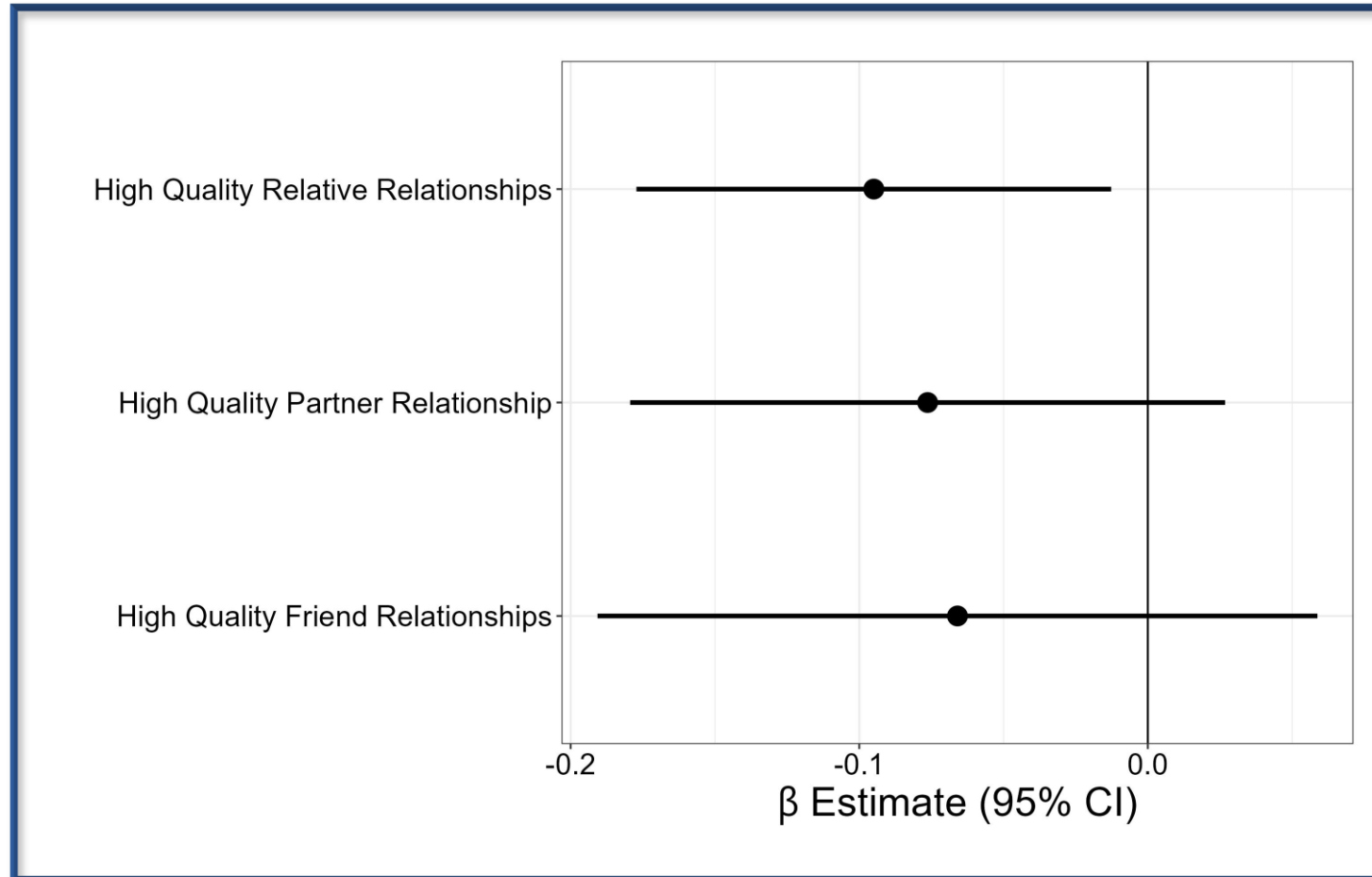
Association between Life Course SES and CD4+ Memory/Naïve Immune Cell Ratios



Ref=High SES at both life stages
N=4077

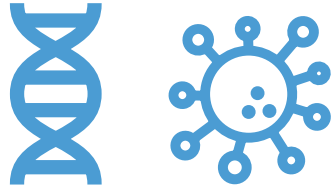
Association between Quality of Social Relationships and CD4+ Memory/Naïve Immune Cell Ratios

Ref=Quality Score < 3



N=3575 - 4220

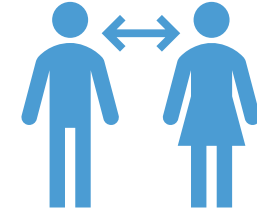
Conclusions



Lower socioeconomic status was associated with increased cellular immunosenescence



Low SES may have a cumulative effect on cellular immunosenescence over the life course



There are ways we might be able to buffer some of the adverse exposures with respect to immune system aging. High quality relationships might be protective

Limitations and Next Steps

Surrogate measures of immunity

Limited power for observing EMM

Other social exposures and other immune cell types

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Questions?

Thank you

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