# Cumulative Sociodemographic Risk Predicts Measures of Executive Function in Females

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## BACKGROUND

- Evaluating social determinants of health from a biopsychosocial perspective supports considering a person as a unit of mind, body, and spirit, embedded in and affected by their environment
- Sociodemographic risk impacts health and function, including executive function (EF) [1]
- EF is needed to manage daily life and regulate behavior [2]
  - Deficits can be both markers and consequences of psychopathology and impact physical health outcomes[3]
- Socioeconomic status[4], race[5], and trauma[6] have been associated with EF changes
- Stress may mediate this impact [4] and serve as a link between structure and function
  - Sex differences in stress susceptibility exist[7] and stress is cumulative[8]
  - Females are historically underrepresented in neuroscience and stress research[9] despite higher rates of nervous-system related disorders[10, 11]
- Little research evaluates how *cumulative* sociodemographic risk impacts EF in females
- **We thus investigate if and characterize how a cumulative sociodemographic risk (CSR) composite score predicts measures of EF in females**

## HYPOTHESIS

**High sociodemographic risk** will be associated with **decreased measures of executive function** (↓P300, ↑Reaction Time (RT), ↓Accuracy (Acc)).

## METHODS

**Participants**
- *N* = 151, Age 18-25 (mean = 20.7, SD 1.74)
- Mid-Michigan naturally cycling females

**Measures**
- CSR Composite Score, Fig. 1
  - Childhood Socioeconomic Status (CSES)
  - Self-reported Racial Identity
  - DSM-5 Post Traumatic Stress Disorder Criteria
- N-Back Working Memory task (0-, 2-, and 3-back, Fig. 2)
  - EEG data: P300, Fig. 5
  - Behavioral Data: Accuracy, Reaction Time, Fig. 4, bottom row

**Methods**
- 35-day longitudinal study
- Study intake demographics interview
- 4 lab visits across a menstrual cycle
  - N-Back Working Memory Task
  - Concurrent EEG
- Structured Clinical Interview for the DSM-5 (SCID) at study completion

**Analysis**
- Multilevel Modeling was used to account for repeated measures within individuals

| Cumulative Sociodemographic Risk (CSR) Score | | |
|---|---|---|
| | **0** | **1** |
| **CSES** | Total household income (THI) greater than 200% of the 2005 federal poverty line (FPL) | THI at or below 200% of the 2005 FPL |
| **Race** | White | Non-White |
| **Trauma** | No trauma reported | Any trauma exposure reported |

**Fig. 1.** CSR Composite score sub-measure binary breakdown

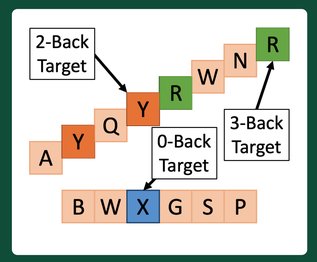



**Fig. 2.** Examples of the 0-, 2-, and 3-Back targets in the N-back working memory task (adapted)[12]

## High sociodemographic risk predicts decreased executive function measures across cognitive load levels

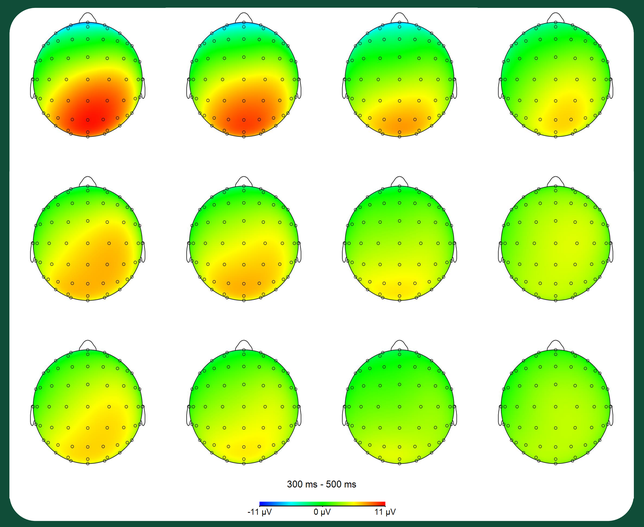
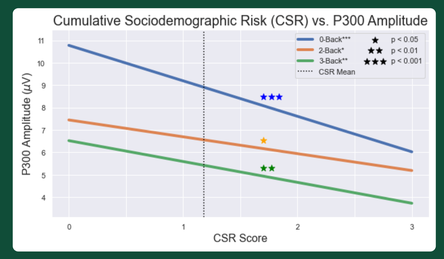
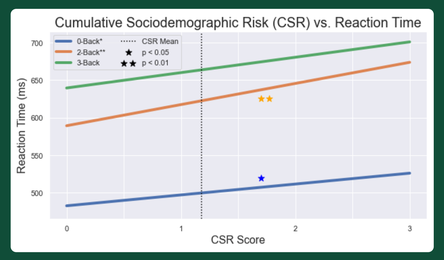



**Fig. 3.** Brain maps indicating electrical scalp distribution from 300-500ms averaged by CSR score for each N-Back task load.

**Cumulative Sociodemographic Risk**

| | P300 Amplitude (μV) | | Reaction Time (ms) | | Accuracy (%) | |
|---|---|---|---|---|---|---|
| **Load** | **Effect Size** | **p value** | **Effect Size** | **p value** | **Effect Size** | **p value** |
| **0-Back** | -1.585 | < 0.001*** | 14.471 | 0.024* | -0.6 | 0.550 |
| **2-Back** | -0.753 | 0.026* | 28.137 | 0.007** | -4.7 | 0.004** |
| **3-Back** | -0.932 | 0.005** | 20.454 | 0.089 | -3.8 | 0.017* |



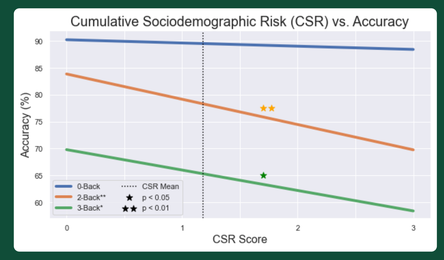




**Fig. 4.** Multilevel model results predicting P300 amplitude, reaction time, and task accuracy from CSR score (top left). Linear models illustrating the relationships between CSR score and P300 amplitude (top right), reaction time (bottom left), and accuracy (bottom right) at 0-, 2-, and 3-Back.

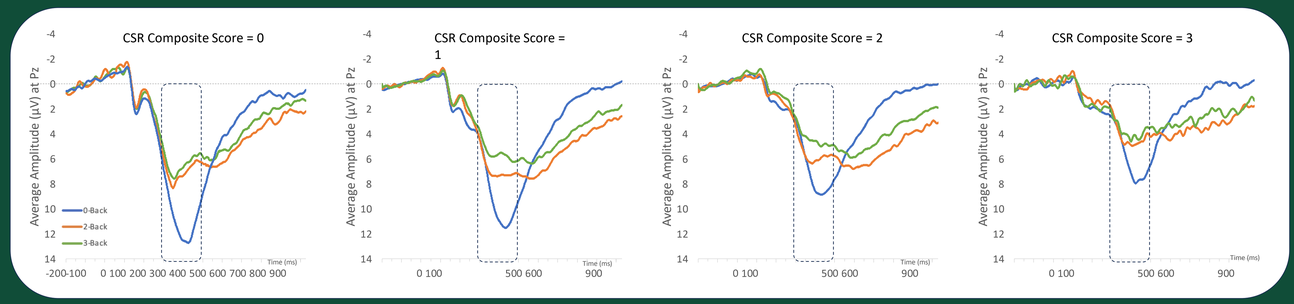



**Fig. 5.** ERP waveform at Pz averaged across individuals by CSR composite score. Figures include ERP waveforms from all 3 N-Back loads (0-, 2-, and 3-Back). Boxed regions indicate the P300 ERP, from 300-500ms at Pz.

**P300 was significantly impacted by CSR at all levels (0-, 2-, and 3-back) of cognitive load.**

**CSR's impact on reaction time only reached significance at 0- and 2-back.**

**CSR's impact on accuracy only reached significance at 2- and 3-back.**

**CSR's effects on 3-back reaction time and 0-back accuracy did not reach significance.**

## DISCUSSION

**Contribution**
- Data support that sociodemographic risk factors' effects on EF in females are *cumulative*
- Varied impacts between low (0-back) and high (3-back) working memory loads indicate changes in EF effects at different levels of cognitive load
- Impacts on the P300 may indicate scarcity of attentional resources as a mechanism for the impact of CSR on EF
- Contextualizing sociodemographic risk factors as social determinants of health may aid in predicting deficits in managing daily life and regulating behavior
- Findings have implications for how CSR may impact psychological and physical health
- Findings support holistic evaluation of patients that situates executive function, attention allocation and their documented impacts on physical health in the context of *cumulative* sociodemographic risk

**Limitations**
- Racial identity used as a proxy for likelihood of belonging to a minoritized group or experiencing discrimination;
  - Future work would benefit from measuring these factors directly
- Composite scores, while clinically valuable, are limited because of lost nuance and individual variance

**Future Directions**
- Future work could expand CSR to other sociodemographic risk factors known to impact EF and mental health (adult socioeconomic status and job security, prenatal stressors and maternal health, healthcare access, level of education, social support)[1]
- Evaluate additional biological markers (e.g. inflammatory and immune markers, heart rate variability, cortisol) and health outcomes associated with elevated allostatic load as an integrative model of cumulative stress and its impact on EF [13]

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