

Cortisol and Experiences of Discrimination Modulate Medial Temporal Lobe Structures in Older Adults

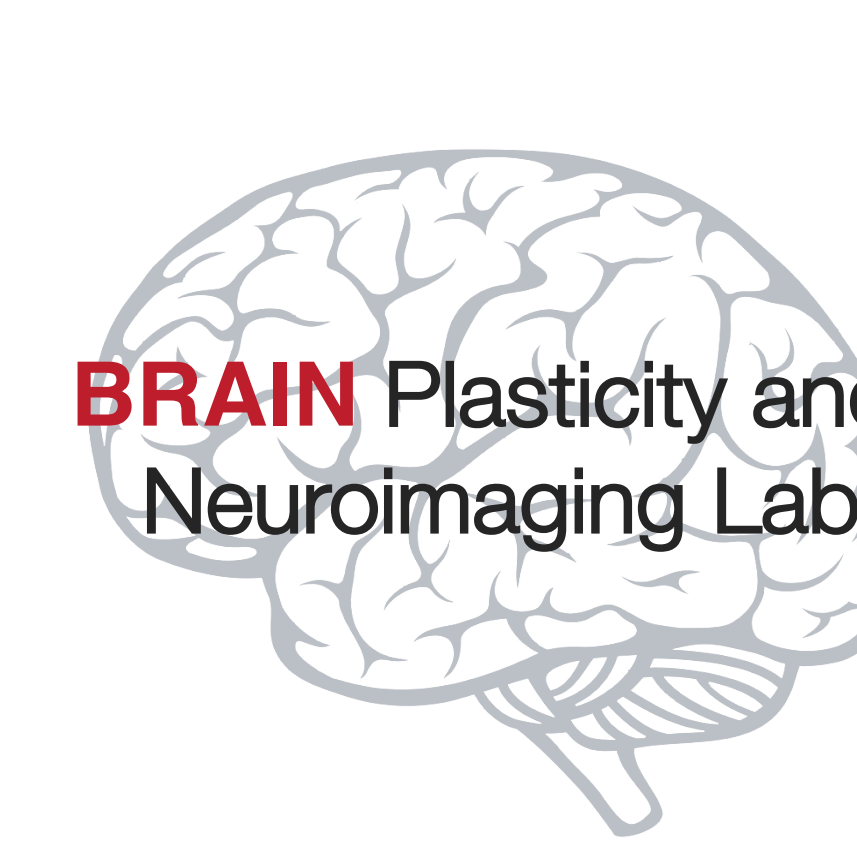
Michael A. Rosario^{1,2,3}, Amara Ayoub^{2,3}, Razan Alotaibi^{2,3}, Karin Schon^{1,2,3,4}

¹ Graduate Program for Neuroscience, Boston University School of Medicine, Boston, MA

² Center for Systems Neuroscience, Boston University, Boston, MA

³ Department of Anatomy and Neurobiology, Boston University School of Medicine, Boston, MA

⁴ Center for Memory and Brain, Boston University, Boston, MA



Background

The medial temporal lobes are modifiable by experience¹.

Animal models of environmental enrichment and chronic stress have shown structural modulation of the hippocampi and amygdalae. These structures play a critical role in regulation of the hypothalamic-pituitary-adrenal (HPA) axis.

Perceived discrimination (racism, ageism, sexism, etc.) are chronic psychosocial stressors²:

Associated with negative health outcomes
May disrupt the body's ability to regulate the stress response.

Recent research has shown an association between³:

Perceived discrimination and aberrant amygdala activity
Perceived discrimination and amygdalar functional connectivity.

Our research investigates brain structure-behavior relationships between medial temporal lobe volumes, HPA-axis function, and perceived discrimination:

Hypothesis 1: Higher levels of cortisol will be associated with hippocampal and amygdala volumes.

Hypothesis 2: Perceived discrimination will be negatively associated with reduced hippocampal and amygdala volumes.

Methods

Data for this project was compiled from two separate studies which seek to investigate the impact of experiences of discrimination on cognition and brain structural integrity:

Experimental Study 1 (ES1) (n = 10; 60% female, 100% Black)
Experimental Study 2 (ES2) (n = 25; 64% female, 100% White)

Participant Demographics:

Results are presented as mean ± SD. Comparisons by group calculated using Wilcoxon Rank-Sum Test. †p < .10 *p < .05, ** p < .01, **** p < .0001

Demographics	Range	Mean	Mean _{ES1} N = 10	Mean _{ES2} N = 25
Age (yrs.)	55 – 86	70.97 (6.87)	66.3 (8.74)	72.84 (5.05) [†]
Education	12 – 20	16.4 (2.17)	14.7 (1.7)	17.08 (1.98)**
MoCA	22 – 29	26.83 (1.99)	24.4 (1.78)	27.8 (1.0)****
Perceived Disc.	0 – 5	1.63 (1.55)	2.40 (1.58)	1.32 (1.46) [†]
Cortisol (pg/ml)	0.06 – 0.66	.33 (0.13)	0.18 (0.07)	0.35 (0.12)*
EICV (mm ³)	1181861.9 – 2006462.7	1443687.8	1404970.42	1459426.74
		(191287.6)	(197984.93)	(190408.3)

EICV: estimated intracranial volume; MoCA: Montreal Cognitive Assessment; Perceived Disc.: Perceived Discrimination

Experiences of Discrimination Questionnaire⁴

Participants were asked 9 questions related to their experiences:

- 1) At any time in your life, have you ever been unfairly fired?
- 2) Have you ever been unfairly stopped, searched, questioned, physically threatened or abused by the police?
- 3) Have you ever been unfairly discouraged by a teacher or advisor from continuing your education?

If participants stated yes, they were then asked to identify the reason for this experience (e.g., gender, race, age, etc.)

Scores were summed for a minimum score of 0 and maximum score of 9⁵

Cortisol

For both studies, saliva was collected at one timepoint, between 8 and 10 AM. Saliva was analyzed in duplicate by Salimetrics® to obtain cortisol levels (pg/ml)

Methods Cont.

MRI Data Acquisition:

T1-weighted MPRAGE structural (1mm³ isotropic voxels)
MRI to measure bilateral hippocampal and amygdala volume

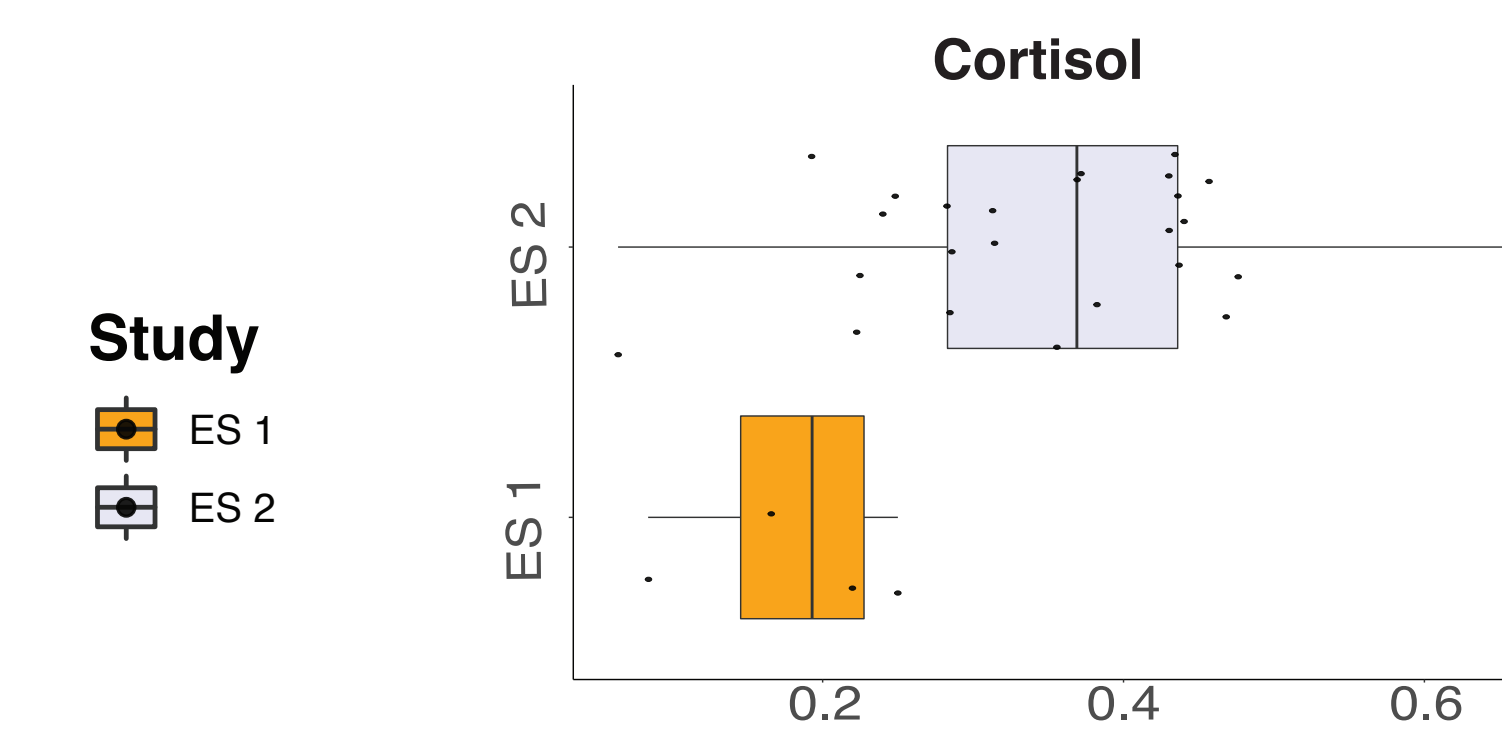
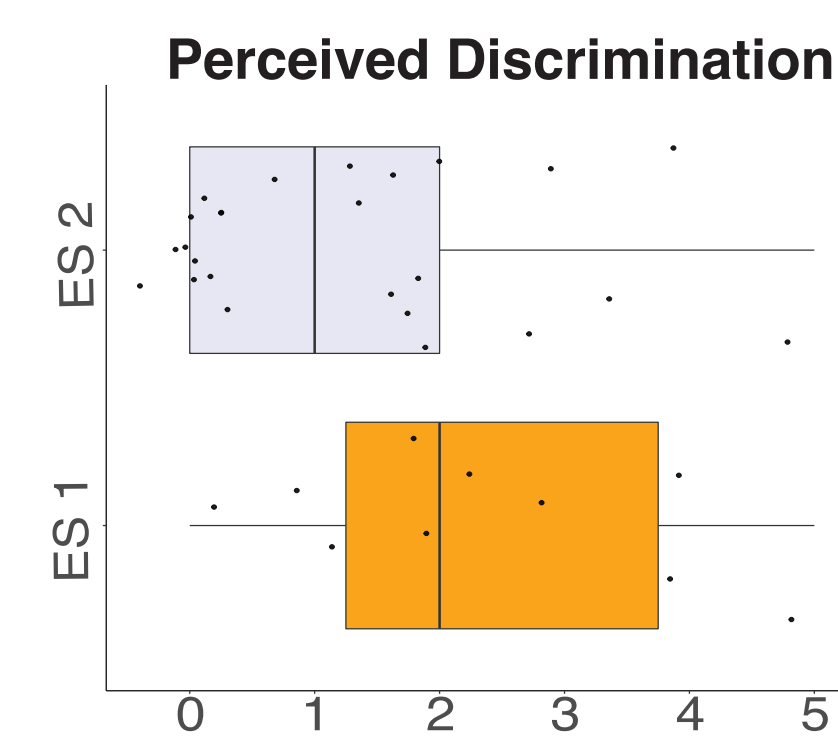
FreeSurfer automatic segmentation tool⁶

Outcome Variables:
Hippocampal and Amygdala Volumes

Results

Distribution of Perceived Discrimination and Cortisol by Study Group

(Significant differences calculated using Wilcoxon Rank-Sum Test *p < .05)



Multiple Regression Coefficient Plot: Perceived Discrimination Predicts Left and Right Amygdala Volume

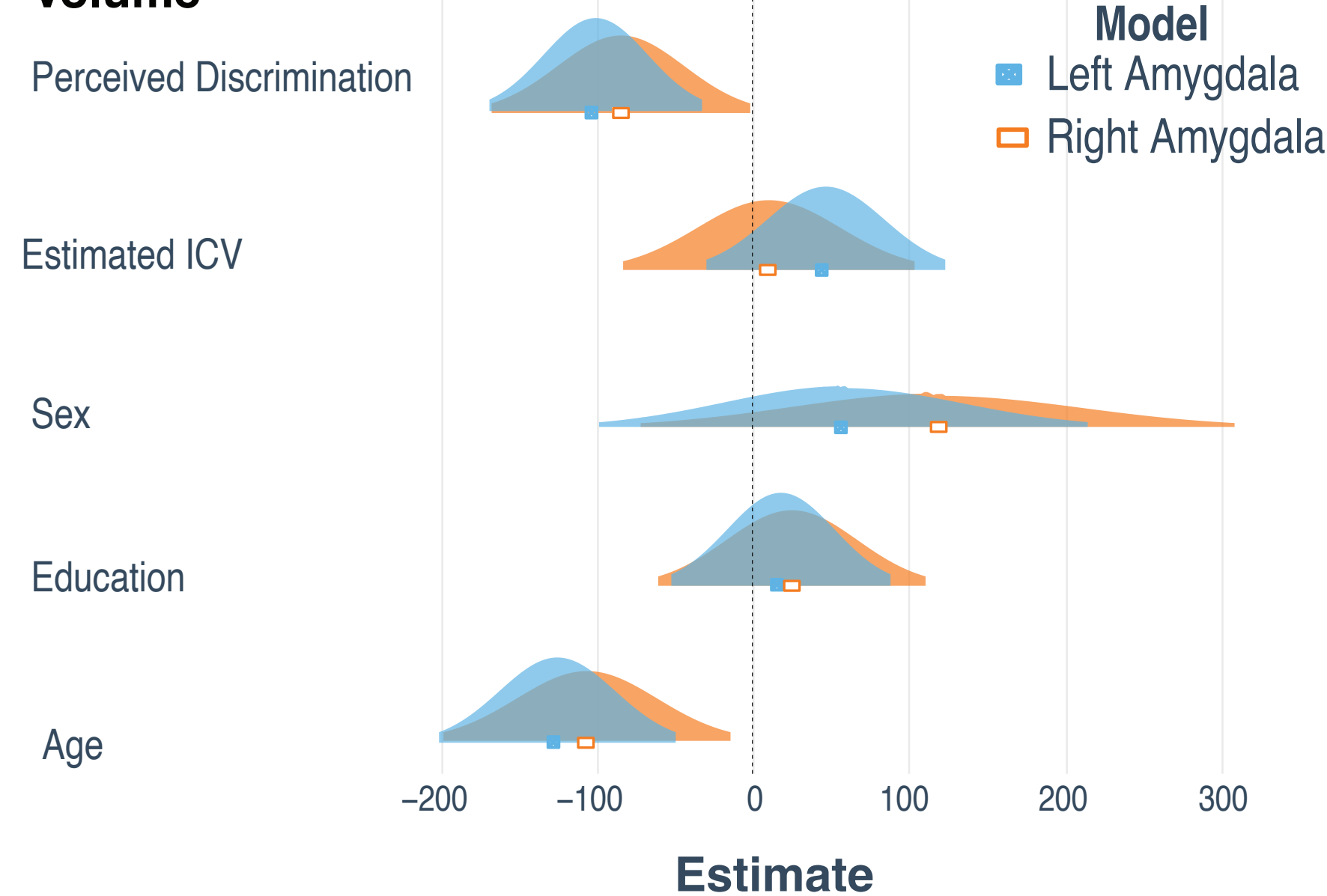


Fig. 1. In line with our prediction, a multiple regression analysis showed that perceived discrimination predicted a reduction in both left and right amygdala volume when controlling for estimated ICV, Sex, Education, and Age.

Multiple Regression Coefficient Plot: Perceived Discrimination does not Predict Left or Right Hippocampal Volume

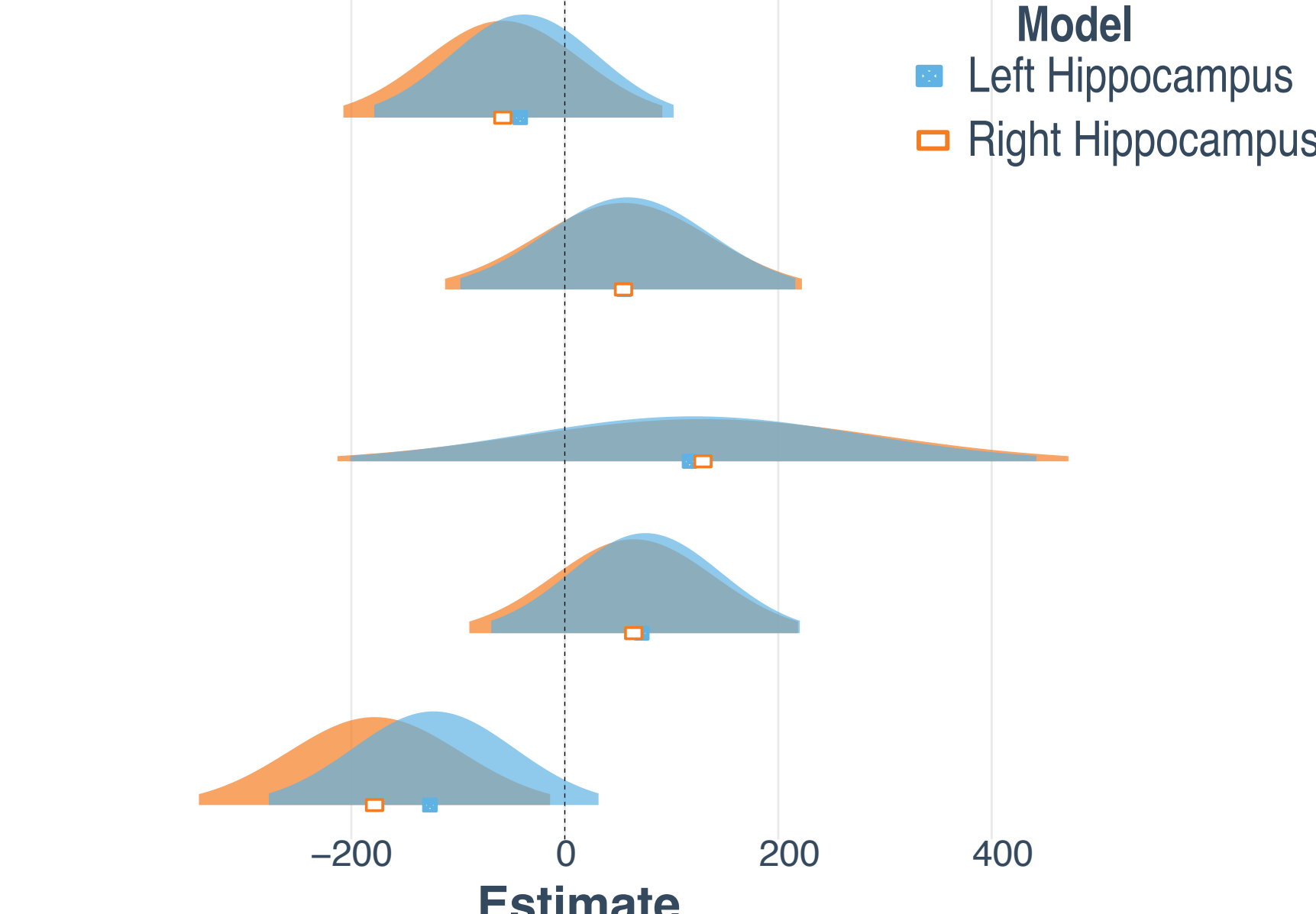


Fig. 2. In contrast to our prediction, a multiple regression analysis showed that perceived discrimination did not predict a reduction in either left or right hippocampal volume when controlling for estimated ICV, Sex, Education, and Age.

Multiple Regression Coefficient Plot: Cortisol Predicts Left but not Right Amygdala Volume

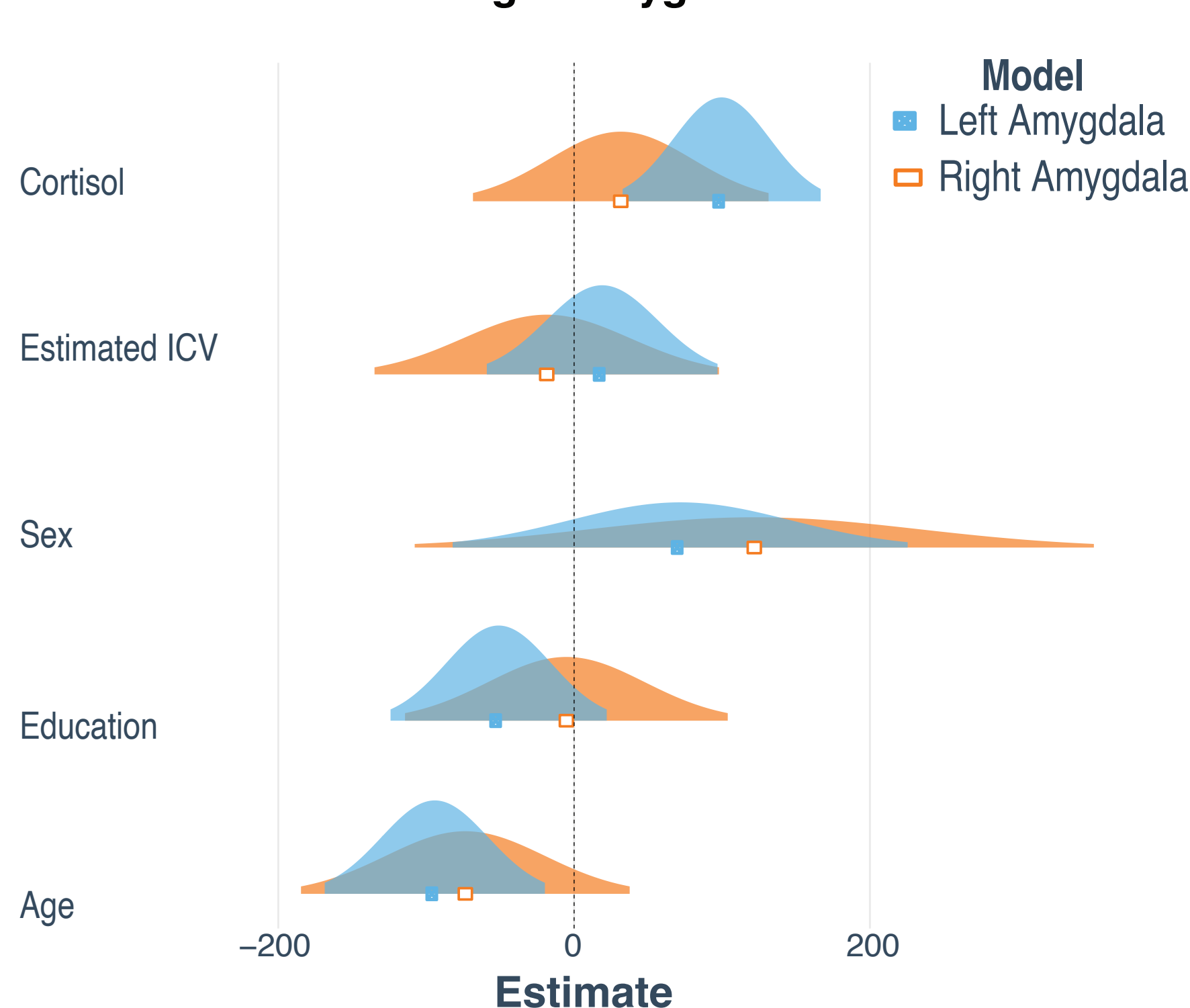


Fig. 3. In line with our prediction, a multiple regression analysis showed that cortisol was associated with left amygdala volume when controlling for estimated ICV, Sex, Education, and Age.

Multiple Regression Coefficient Plot: Cortisol Predicts Right but not Left Hippocampal Volume

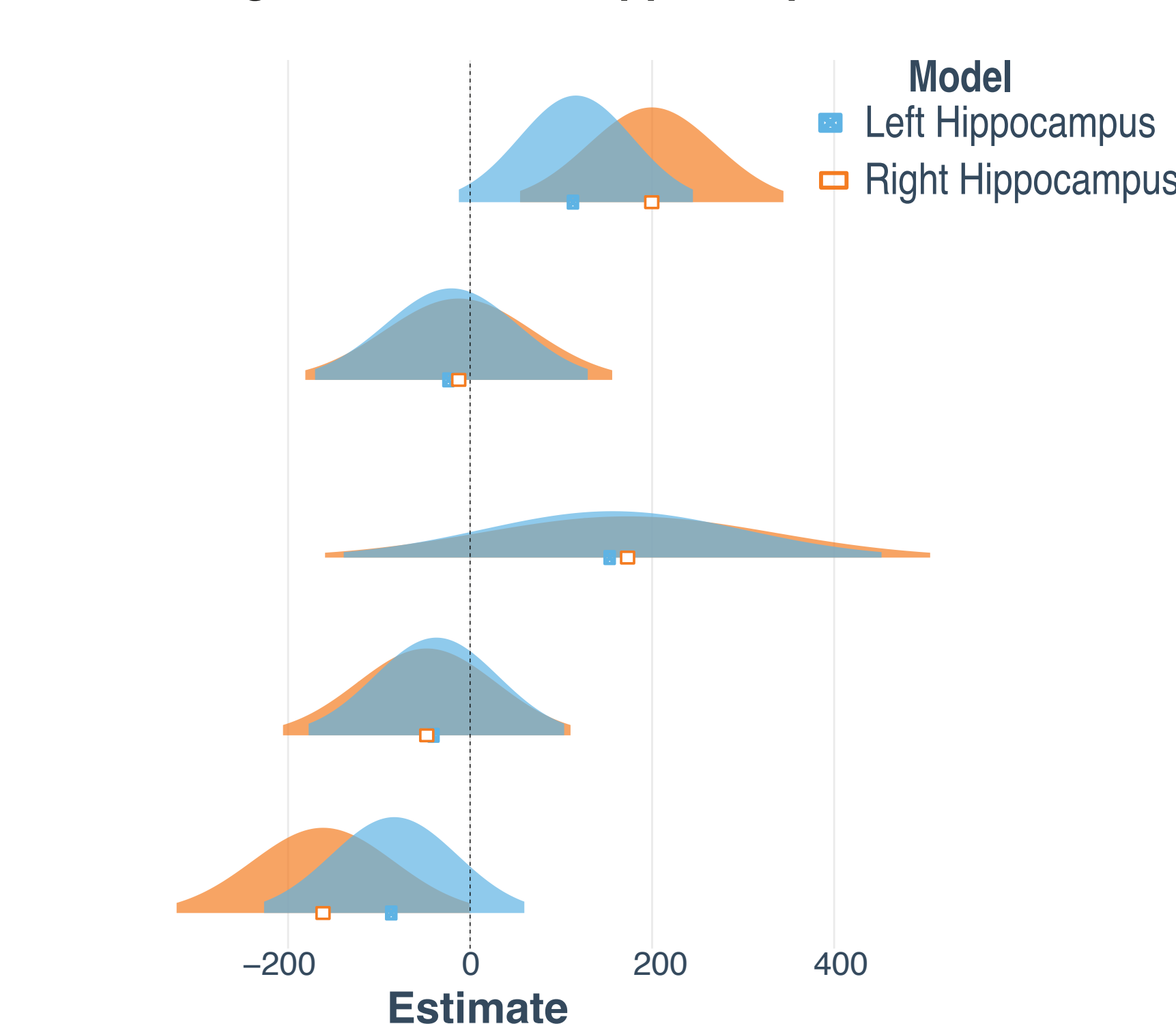


Fig. 4. In line with our prediction, a multiple regression analysis showed that cortisol was associated with right hippocampal volume when controlling for estimated ICV, Sex, Education, and Age.

15s-Summary

Question: Does cortisol and perceived discrimination modulate brain volume of medial temporal lobe structures?

Methods: Magnetic resonance structural imaging (3T Philips Achieva Scanner, 1mm³ isotropic) processed using FreeSurfer, an automatic segmentation and reconstruction tool.

Results: Perceived discrimination was negatively associated with left ($p < .001$, $t(30) = -4.073$) and right ($p < .05$, $t(30) = -2.116$) amygdala volumes. Cortisol was positively associated with right hippocampal ($p < 0.005$, $t(24) = 2.915$) and left amygdala ($p < .0003$, $t(24) = 4.282$) volumes.

Discussion: This work extends previous research on the impact of experiential factors to the impact of perceived discrimination on structural integrity of the medial temporal lobes.

Summary/Future Directions

Our results show a negative association between perceived discrimination and bilateral amygdala, but not hippocampal, volumes.

Additionally, cortisol positively predicted right, but not left, hippocampal volume and significantly predicted left, but not right, amygdala volumes. Since these data are obtained from two separate studies, a major limitation of these analyses is that cortisol was collected using two different methods: swab (ES 1) and passive drool (ES 2), which may confound results. Additionally, collection of cortisol at only one time point limits interpretation of the role of cortisol in these relationships.

The medial temporal lobes support episodic memory performance. Investigating the role of negative social and societal determinants of brain health and how they impact structural integrity is integral to developing clinical interventions to ameliorate their impact to positively influence brain health across the lifespan.

Future research will examine the association between brain morphometric measures and neurocognitive outcomes, and whether this association is mediated by cortisol levels focusing specifically on the impact of racial discrimination on functional and structural integrity of the medial temporal hippocampal memory system in Black seniors.

References

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Acknowledgments

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