

Cerebral Metabolic Factors Associated with Cognitive Aging

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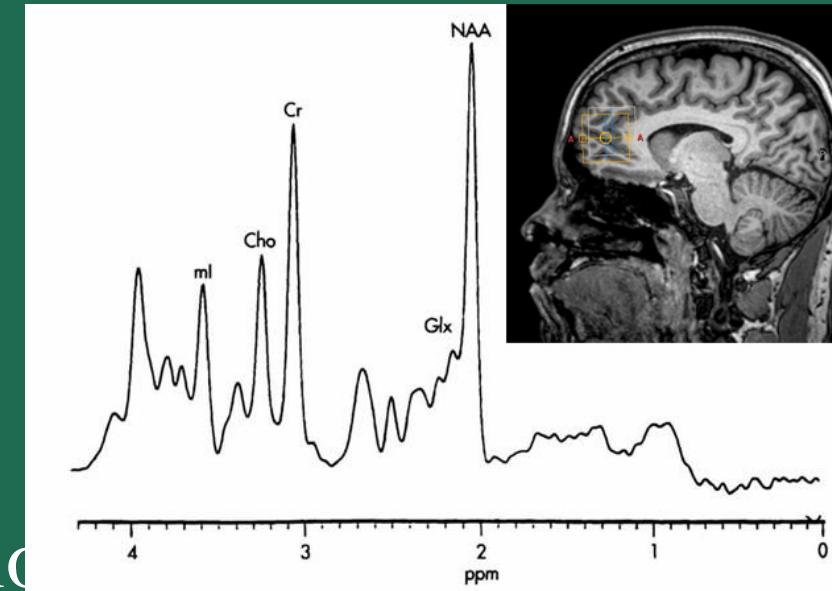
Cognitive Aging and Memory Clinical Translational
Research Program
Institute on Aging

Evelyn F. and William L. McKnight Brain Institute
University of Florida

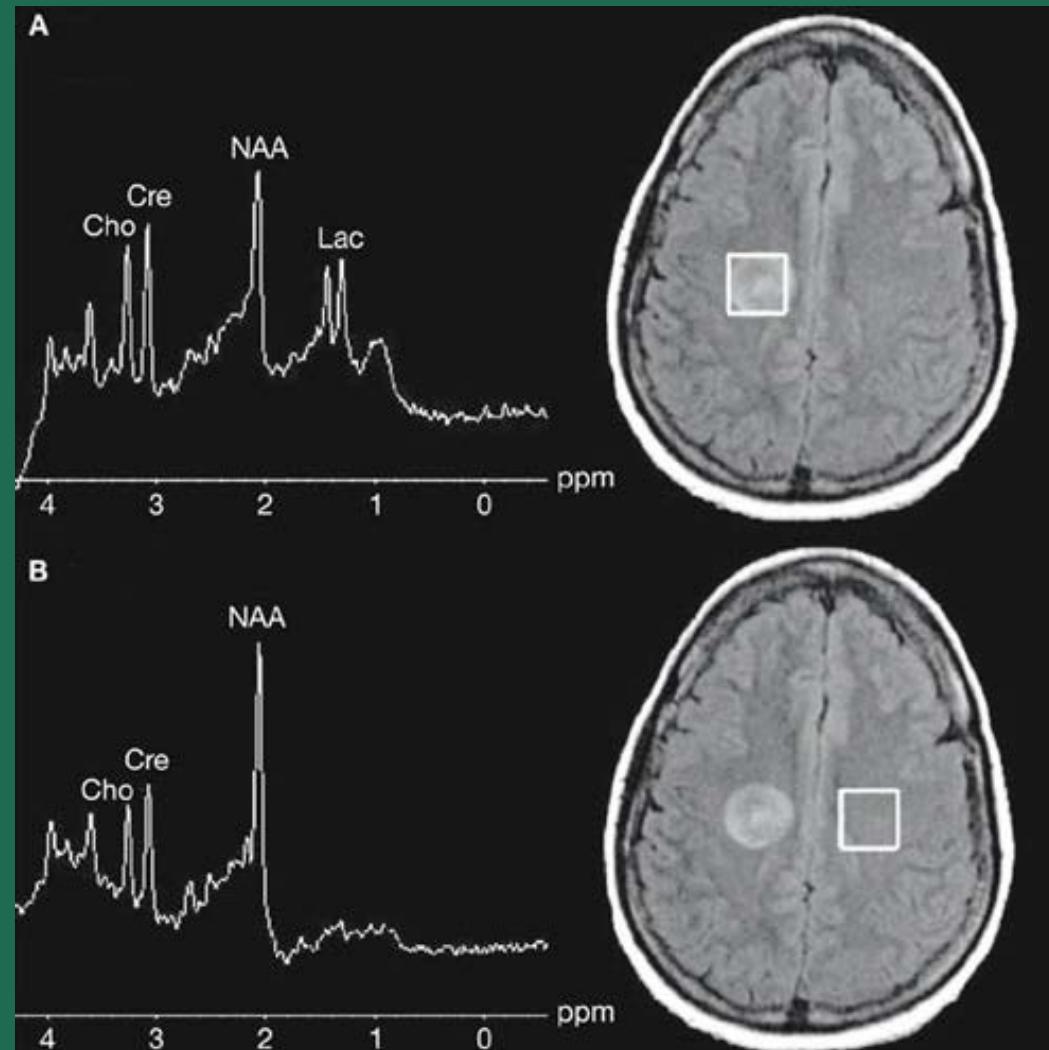


Magnetic Resonance Spectroscopy (MRS)

- A technique that exploits the magnetic properties of certain nuclei to study brain chemistry
 - Proton: ^1H
 - Phosphorous: ^{31}P
 - Sodium: ^{23}Na
 - Carbon: ^{13}C
- Clinical and Research Applications

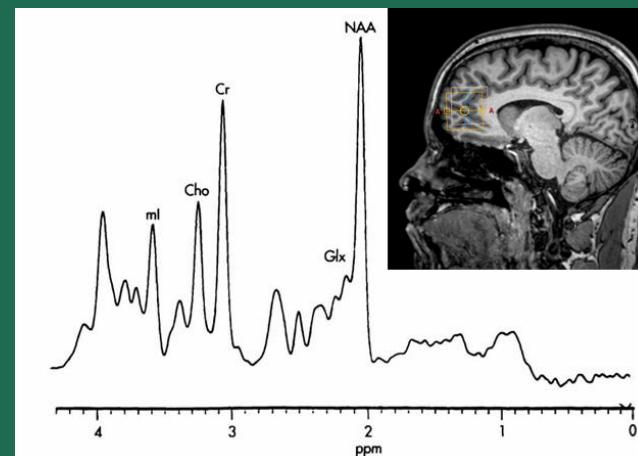


Clinical Applications: ^1H MRS

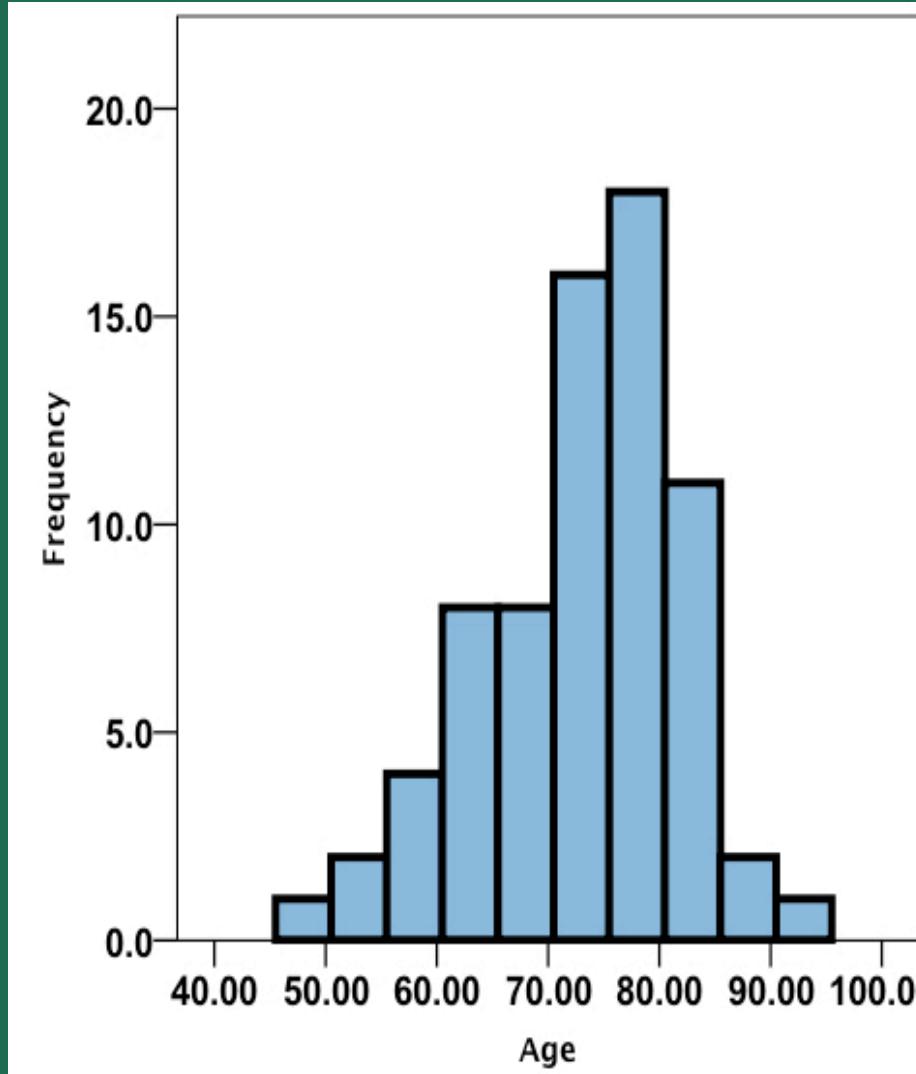


Cerebral Metabolites from ^1H -MRS

- **N-Acetyl aspartic acid (NAA):**
 - Neuron integrity
- **Choline (Cho):**
 - Cell membrane integrity/demyelination/inflammation
- **Creatine (Cr):**
 - Brain energy metabolism
- **Myo-Inositol (mI):**
 - Glial cell integrity
- **Glutamate/Glutamine (GLX):**
 - Neurotransmitter concentration



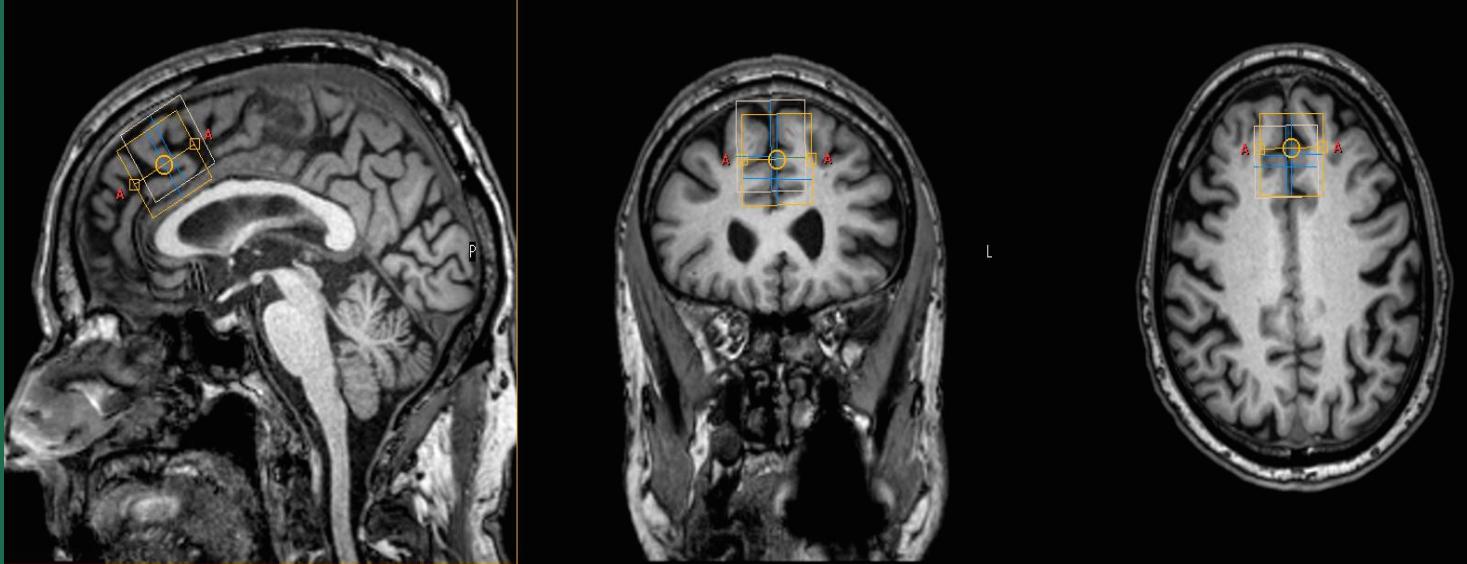
Active Brain Study Successful Aging Cohort



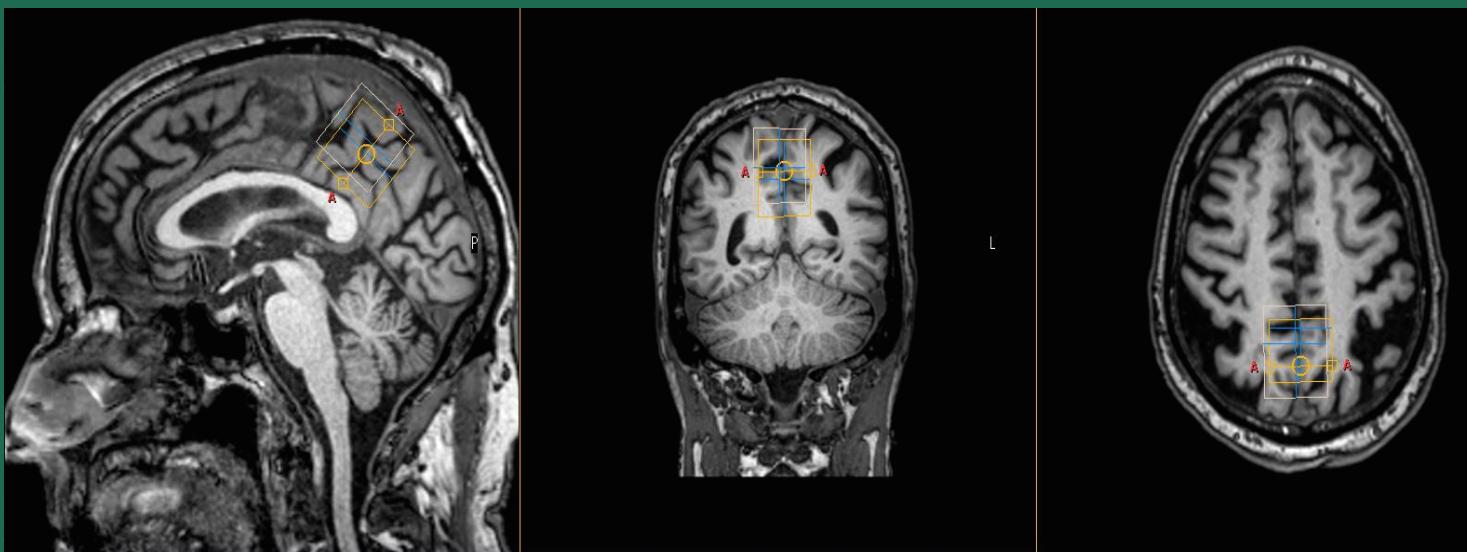
- $n = 71$ (Female = 43)
- Mean age = 73.2 ± 8.8
- Range = 48-92 years
- Education = 16 ± 8.8
- No history of neurodegenerative disease, brain injury, or major psychiatric disorders

Voxel Placement (3cm^3)

Frontal

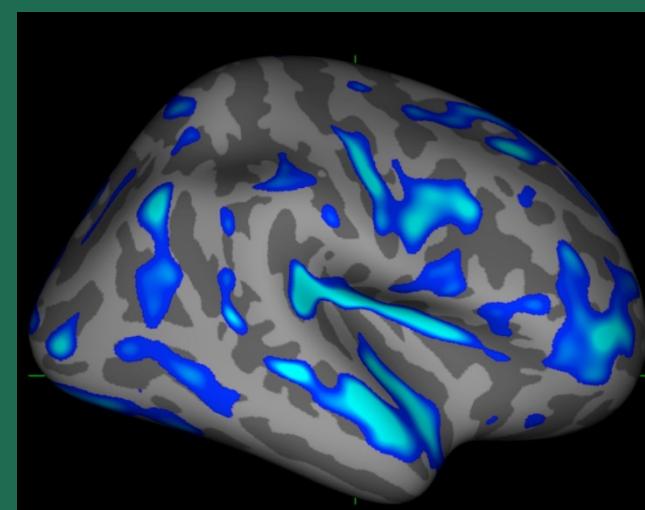
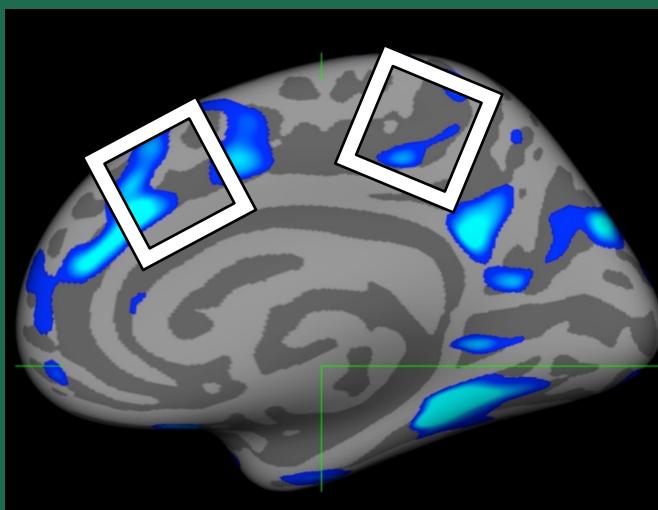
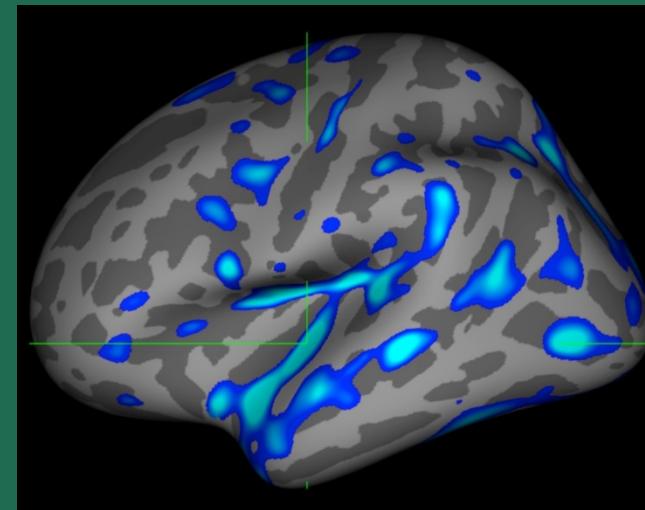
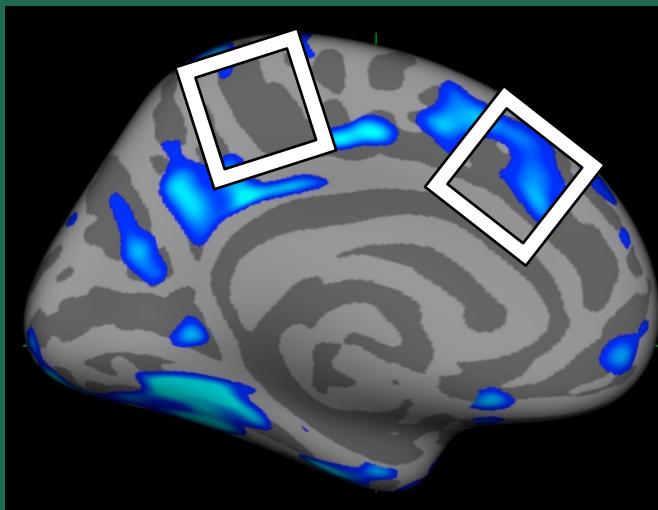


Posterior



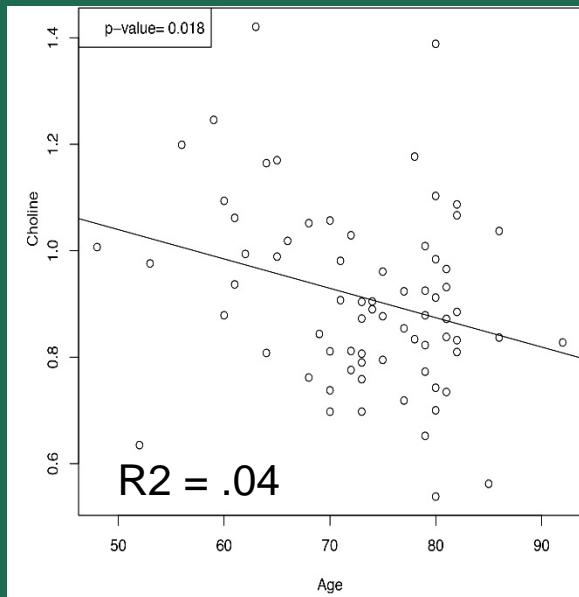
Change in cortical thickness with age

Left Hemisphere
Right Hemisphere

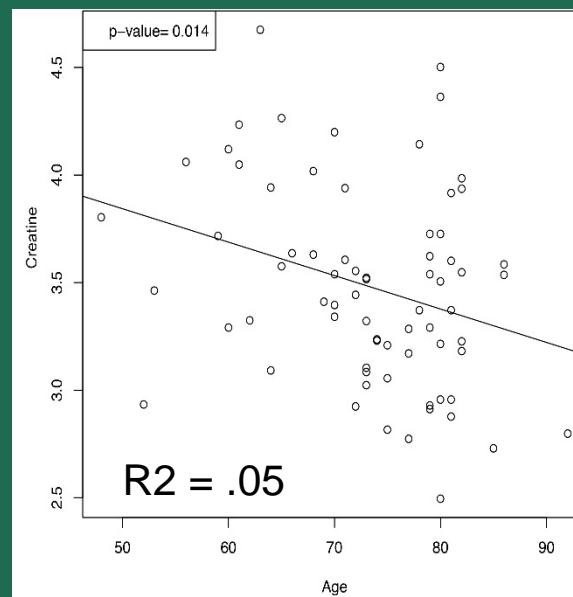


Cerebral metabolic changes with age: Frontal

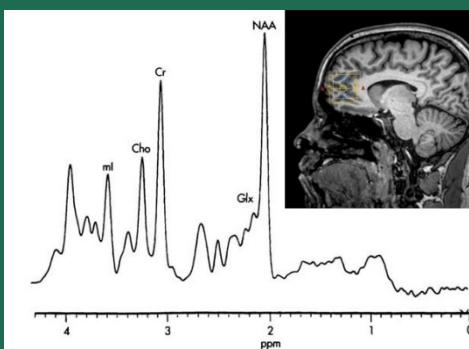
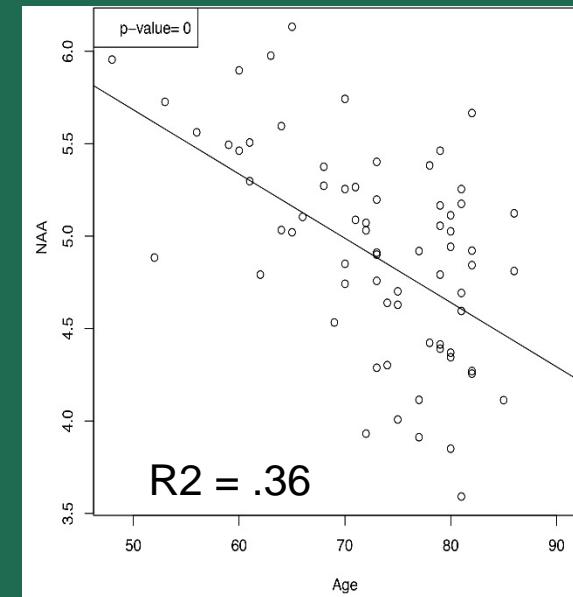
Choline*



Creatine*



NAA*



* $p < .05$

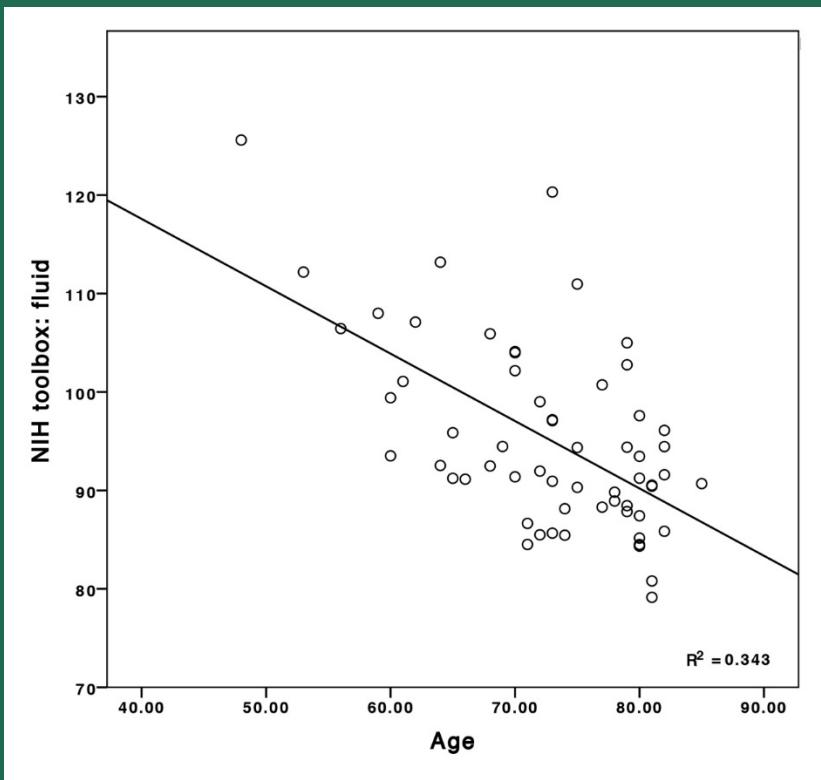
NIH Toolbox: Cognitive

- NIH-funded development
- Battery of 8 core cognitive tests assessing six cognitive domains
 - Fluid Cognition
 - Attention
 - Executive Function
 - Working Memory
 - Processing Speed
 - Episodic Memory
 - Crystallized Cognition
 - Language
- Norms for 8-85 years of age

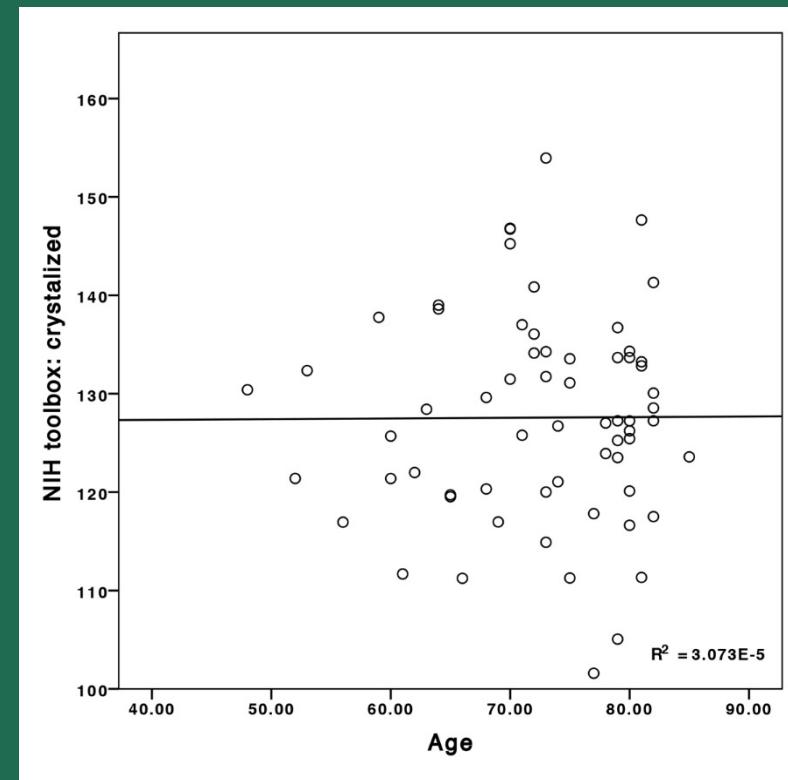


NIH Toolbox: Cognitive Aging

Fluid Score*



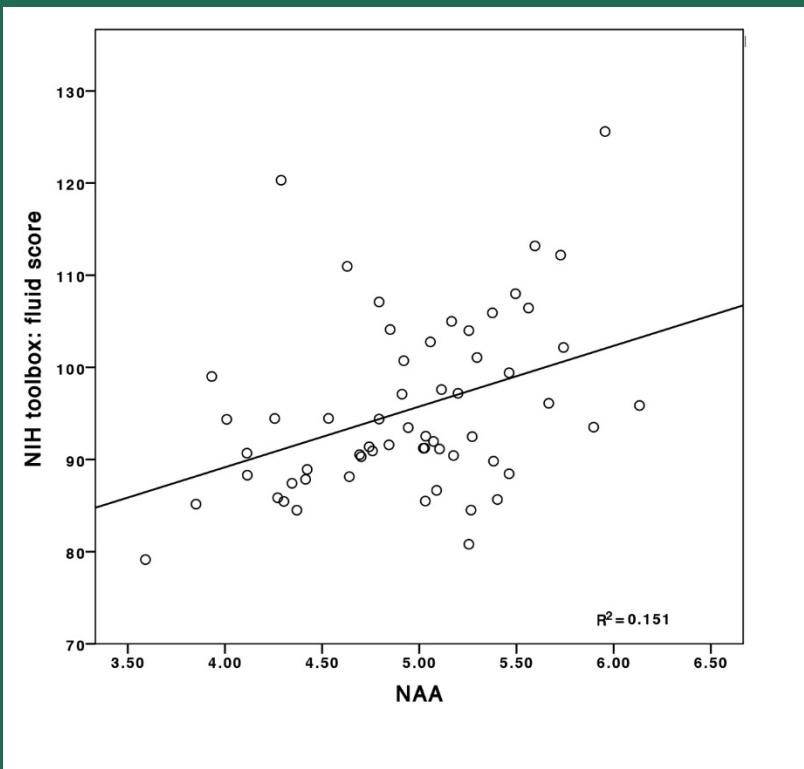
Crystalized Score



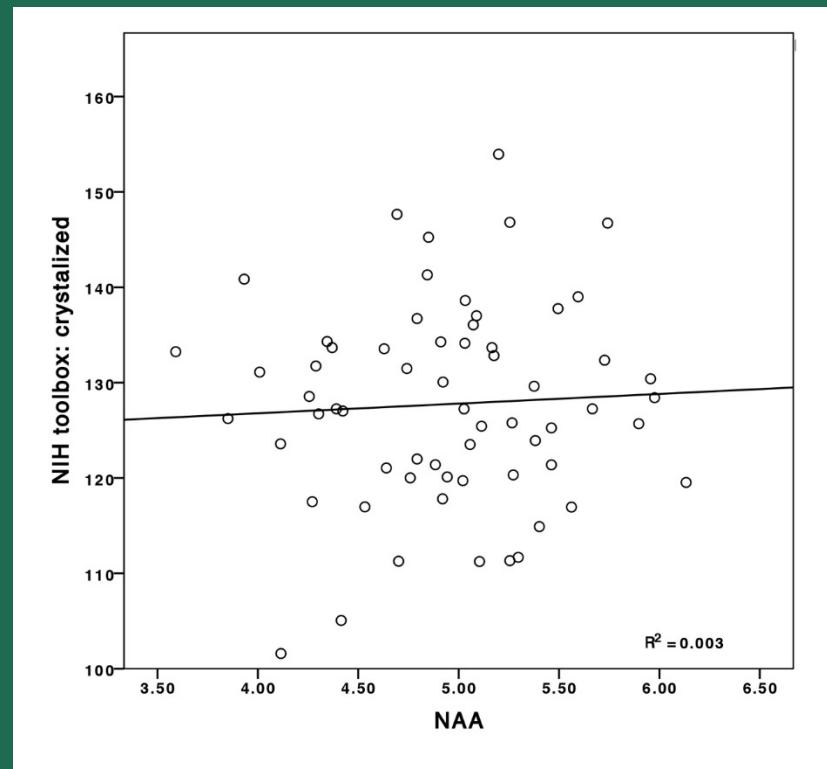
* $p < .05$

NIH Toolbox: NAA

Fluid Score*



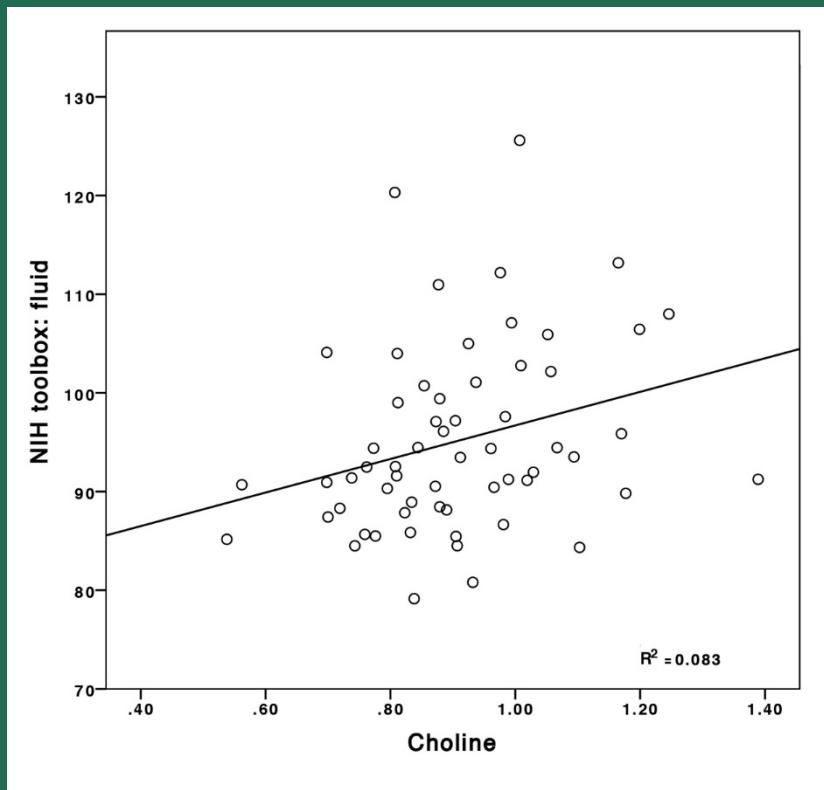
Crystallized Score



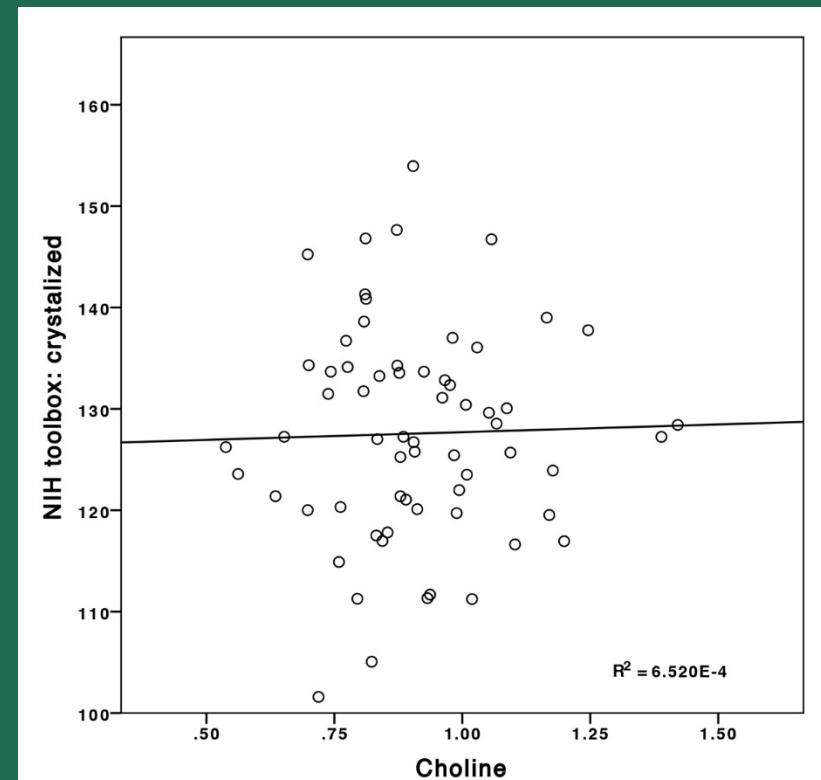
* $p < .05$

NIH Toolbox: Choline

Fluid Score*



Crystallized Score



* $p < .05$

Future Directions

- Focused enrollment of participants 85+ years of age
- Leverage multimodal imaging expertise across sites
 - Structural neuroanatomy (T1)
 - Functional brain response (BOLD)
 - White matter connectivity (DTI/HARDI)
 - Cerebral perfusion (ASL)
 - White matter hyper-intensities (FLAIR)
- Relationship to a broader battery of cognitive measures
- Additional markers and nuclei
 - GABA (1H)
 - 31P

Collaborators

- University of Florida
 - Ron Cohen, PhD
 - John Williamson, PhD
 - Eric Porges, PhD
 - Damon Lamb, PhD
 - Erik Middlebrooks, MD
 - Huaihou Chen, PhD
 - Kenneth Heilman, MD
 - Natalie Ebner, PhD
 - Amanda Garcia
 - Talia Seider
 - Vaughn Bryant
 - Lindsey Richards
 - Nicole Nissim
- University of Miami
 - Clinton Wright, MD
- University of Arizona
 - Gene Alexander, PhD
- University of Alabama at Birmingham
 - Kristina Visscher, PhD