



# Extra-axial Cerebrospinal Fluid Volume Normalizes with Age in Autistic Individuals

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## Introduction

Autism spectrum disorder has been associated with a variety of organizational and developmental abnormalities within the brain. Previously, an increase in extra-axial CSF volume has been reported in autistic individuals between the ages of 6 months and 4 years (Shen et al., 2013; Shen et al., 2017; Shen et al., 2018). In each of these studies, the increased extra-axial CSF volume was predictive of the diagnosis and severity of the autism symptoms, irrespective of whether or not the individual came from a simplex or multiplex family. However, it is unknown how the trajectory of extra-axial CSF volume changes over the course of the lifespan in both autism and typical development.



Figure 1. For the present study, extra-axial CSF (shown above in blue) was operationalized as the volume of CSF superior to the anterior commissure - posterior commissure (AC-PC) line within the subarachnoid space.

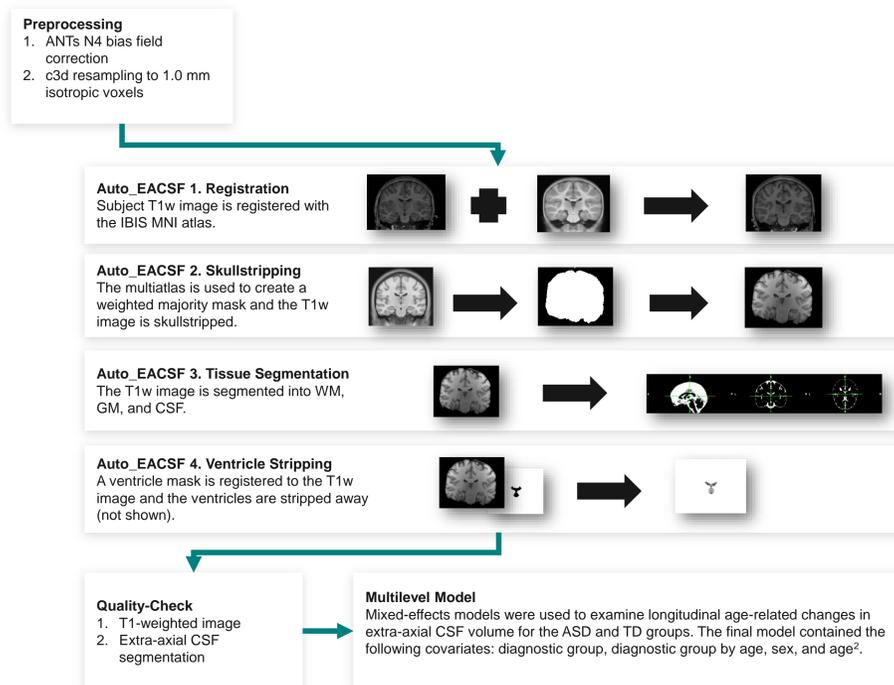
## Hypothesis

We hypothesized that an elevated extra-axial CSF volume would be found in autistic individuals compared with controls, with that difference persisting throughout the lifespan.

## Data

- Accelerated multi-cohort design
- 199 individuals (101 autistic, 98 TD)
- 1-5 observations per individual, separated by 2-3 years
- 452 total T1-weighted MRI images included in analysis

## Methods



## Results

**We found no group difference in extra-axial CSF volume from 3 to 42 years.**

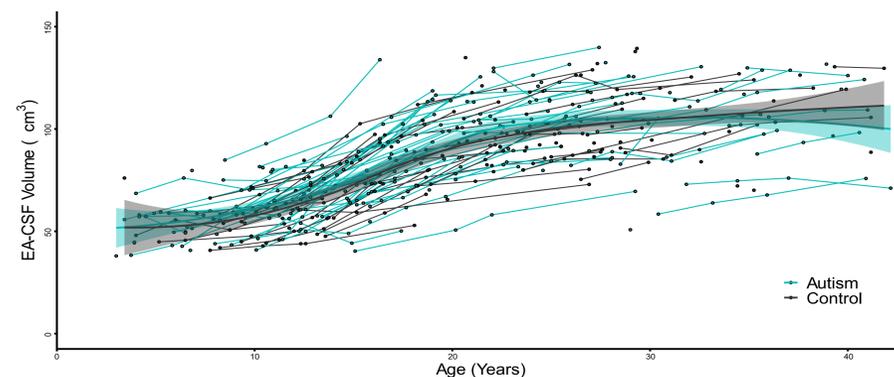


Figure 2. Depicted above is the nonlinear trajectory of the extra-axial CSF volumes between 3 and 42 years. No significant difference between the autism and control groups was found (group x age interaction,  $t(250) = -0.71, p = 0.48$ ). A loess smoother was used to fit the developmental trajectories for both groups. Each scan is represented by a circle and repeated scans for a participant are connected by a line.

## Results Cont.

- Extra-axial CSF volume doubles in size from childhood to adulthood before plateauing
- The developmental trajectory for extra-axial CSF in autism normalizes after age 4

## Limitations

- Ventral boundary at the AC-PC line
- Use of the Auto\_EACSF pipeline on scans from older children to adults

## Future Directions

- Examine the specificity of increased volume of extra-axial CSF to autism
- Cross-sectional dataset (Alexander et al., 2017) of 2034 T1-weighted scans, children and adolescents ages 5 to 22 years

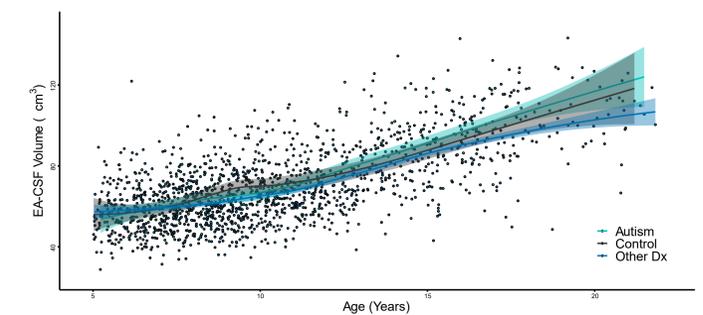


Figure 3. Depicted is the nonlinear trajectory of the extra-axial CSF volumes between 5 and 22 years. Neither the raw T1w images nor the extra-axial CSF segmentations have been quality-checked. A loess smoother was used to fit the developmental trajectories for each group, and each scan is represented by a circle.

## Acknowledgements

This work was supported by the National Institute of Mental Health of the National Institutes of Health under Award Numbers R01MH080826 and K08 MH100609.

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