

Decreased Brain Volume in Infants with Prenatal Opioid Exposure

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Background/Objective: Previous small studies have shown that prenatal opioid-exposed infants and older children display decreased cerebral, cerebellar, or subcortical brain volumes. However, these studies are plagued by suboptimal reference standards or were unable to correct for the influence of other environmental factors in older children. Therefore, our goal was to study differences in brain volume of prenatal opioid-exposed infants when compared to a geographically matched population. We hypothesized that there would be a significant decrease in total brain volume of the prenatal opioid-exposed infants in comparison to the non-opioid exposed control infants. Secondly, we evaluated whether supratentorial or infratentorial brain volumes were significantly different between prenatal opioid exposed and opioid non-exposed infants.

Methods: This was an IRB approved prospective study of mothers and infants with prenatal opioid exposure and controls without prenatal opioid exposure. All recruited infants underwent MRI scans of the brain before they reached a corrected age of 2 months. For this project, the T1-weighted MRI images were analyzed using Infant FreeSurfer and segmented into regions of interest. The segmentations were manually checked and edited. An ANOVA analysis was performed to compare the extracted cerebellar and total brain volume datasets. We corrected for sex and corrected gestational age at MRI scan.

Results: 42 infants were included in the study, 21 with prenatal opioid exposure and 21 control infants. There was a significant difference in the mean gestational age of prenatal opioid-exposed infants (38.28 w \pm 2.13) compared to control infants (39.42 w \pm 0.72). On quantitative MRI brain volume analysis, the prenatal opioid-exposed infants had a significantly reduced total brain, supratentorial, and cerebellar volumes compared to the non-opioid exposed control infants. Besides the brain volume reductions, there were no macro-structural abnormalities on visual inspection of the images.

Conclusion: In human infants, prenatal opioid exposure is associated with significantly smaller global brain, supratentorial, and cerebellar volumes compared to non-opioid exposed controls. Long-term clinical and developmental implications of these MRI changes in opioid exposed children need to be further studied.

Jonathan Dietrich is a third year medical student currently interested in Neuroradiology.

What is your most important takeaway from your research experience?

"My research showed decreases in the brain volume of prenatal opioid-exposed infants when compared to a geographically matched population. Detailed findings of significant brain volume loss would be an important step for the field towards understanding the effect of opioids on prenatal brain development and its downstream behavioral consequences. My results lay the groundwork for further scientific and public health research programs on prenatal and pediatric health as it intersects with the opioid epidemic."