

Age at Surgery is Associated with Neurodevelopmental and Ophthalmologic Outcomes in Sagittal Craniosynostosis

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Background

- Sagittal craniosynostosis (CS) phenotypically produces scaphocephaly, characterized by an elongated head and biparietal narrowing (**Figure 1**)
- Long-term outcomes are generally favorable, however some studies do report increased rates of learning disabilities, language delays, and visuospatial deficits in patients with sagittal CS
- The relationship between surgical timing and neurodevelopmental outcomes remain debated and phenotypic severity does not consistently correlate with neurocognitive deficits
- Early surgical correction is advocated; however, the relative contributions of phenotypic severity and timing of intervention to long-term outcomes remain incompletely defined

Study Purpose: Evaluate the independent associations of morphological severity and age at surgery with neurodevelopmental and ophthalmologic outcomes in patients with non-syndromic sagittal CS

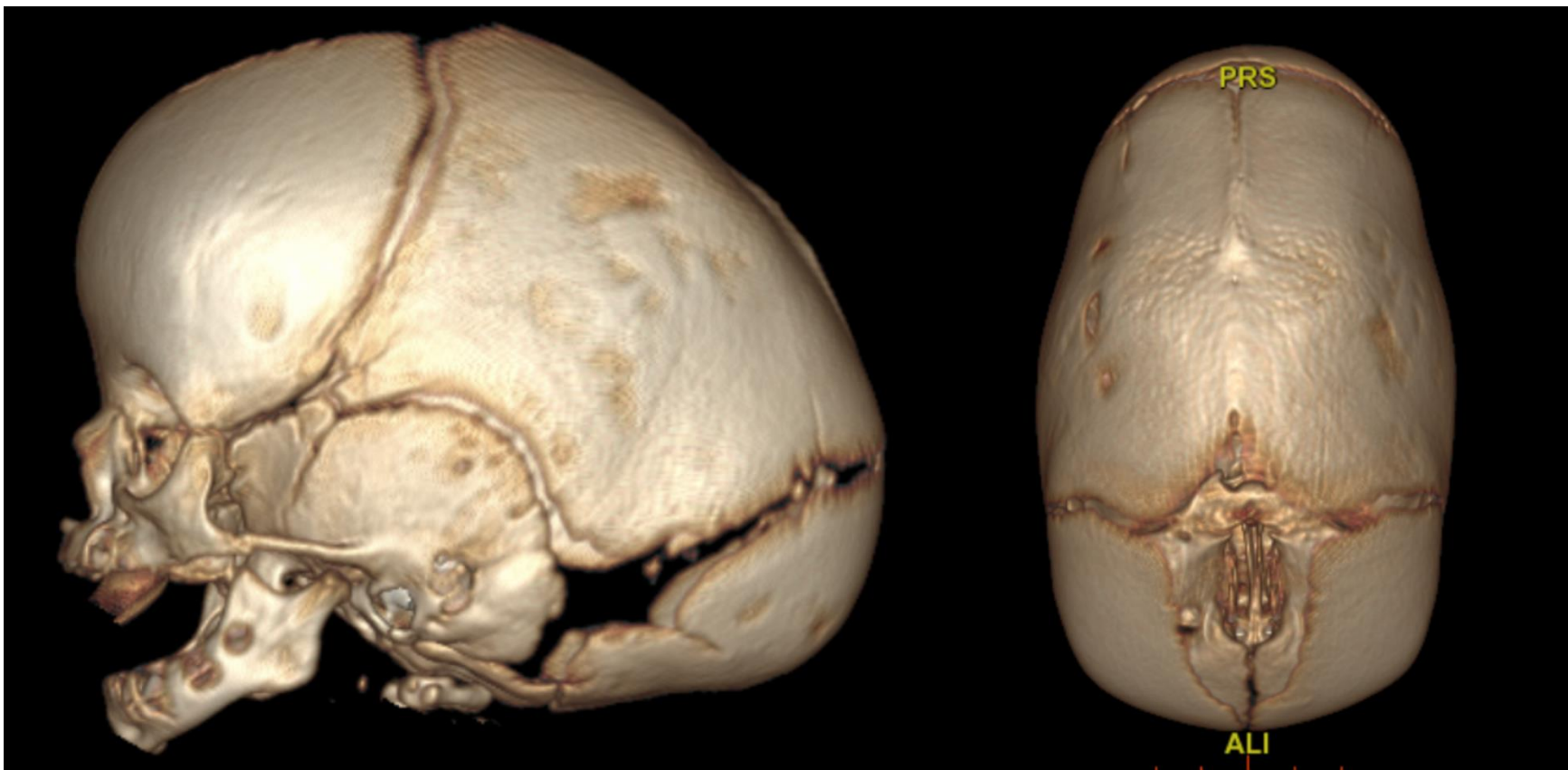


Figure 1. Scaphocephalic Head Shape Seen in Sagittal CS

Methods

- IRB-approved retrospective cohort study conducted on patients who underwent surgical correction for non-syndromic sagittal CS (2021-2024)
- Preoperative phenotypic severity quantified using cephalic index = biparietal diameter/occipitofrontal diameter (**Figure 2**) measured by two independent graders (ICC = 0.952)
- Odds ratios (OR) with 95% confidence intervals (CI) derived from logistic regression models that assessed associations between phenotypic severity, surgical age, and outcomes
- Continuous variables were non-normally distributed and reported as median [IQR] or mean $\pm$ SD

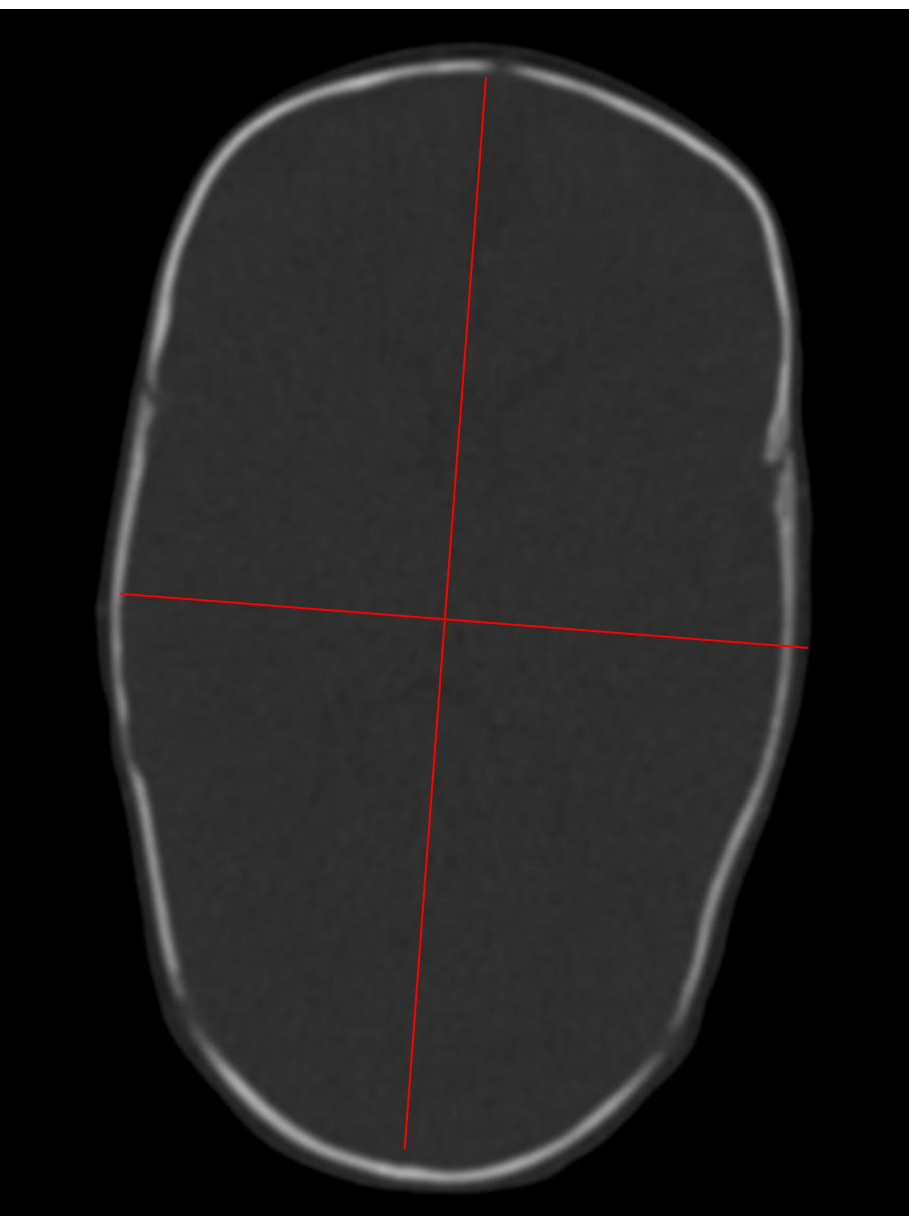


Figure 2. Phenotypic Severity Determined by Cephalic Index

Results

- 136 patients were included
- Median age at surgery was 5.5 [4.33, 11.83] months and 76% of patients were male
- Mean cephalic index for the cohort was 72.64 ± 5.11
- Summary of neurodevelopmental and ophthalmologic findings at multi-disciplinary follow-up appointments in **Figure 3**
- Increasing surgical age was associated with higher odds of developmental delay, ADHD, autism, funduscopy abnormalities, and optic nerve abnormalities (**Figure 4**)
- Associations with developmental delay ($p=0.003$), ADHD ($p=0.01$), autism ($p=0.01$), funduscopy abnormalities ($p=0.003$), and optic nerve abnormalities ($p=0.04$) persisted *after adjusting for phenotypic severity*
- Phenotypic severity alone was *not* predictive of any outcome

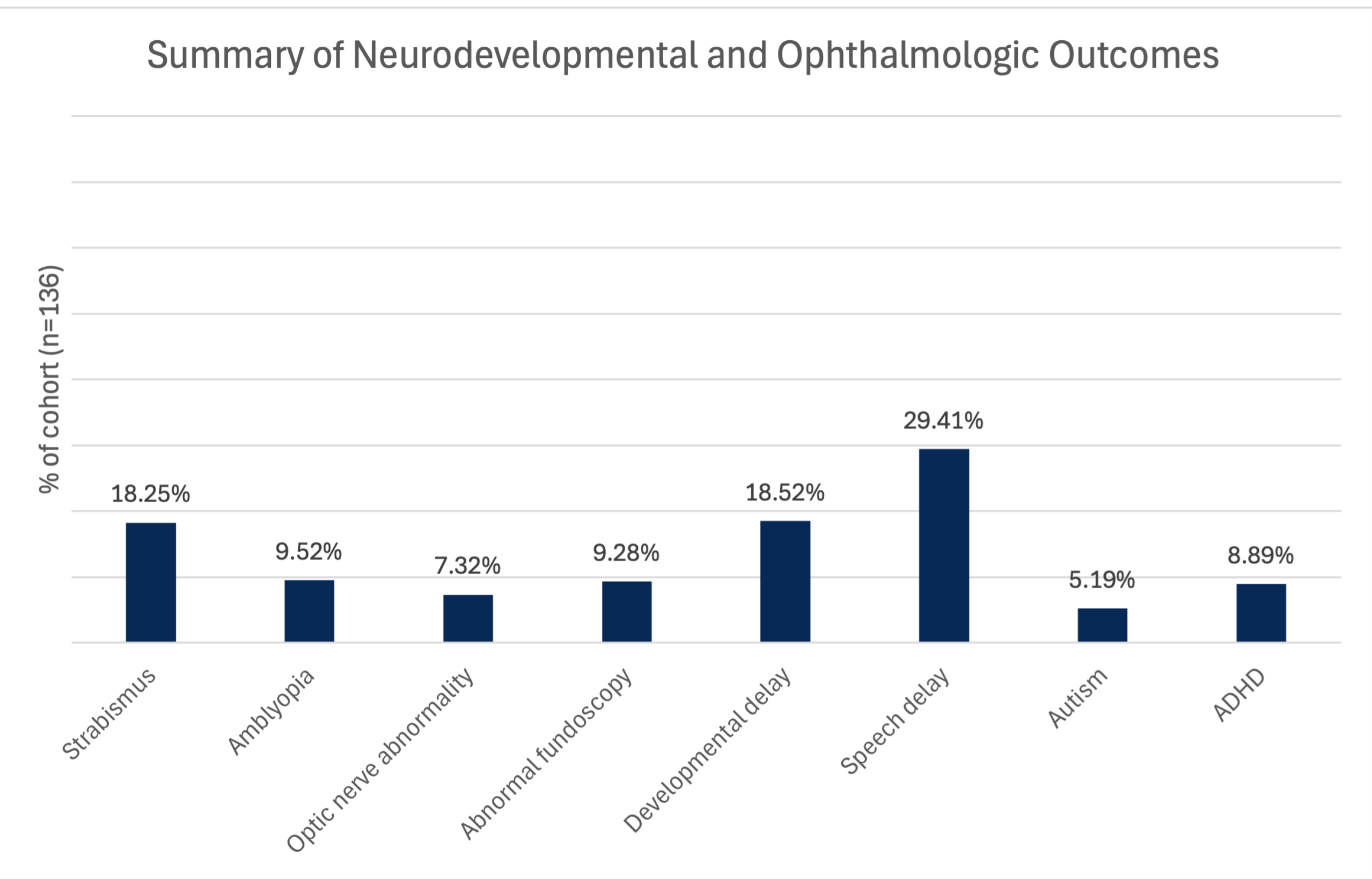


Figure 3. Summary of Neurodevelopmental and Ophthalmologic Outcomes Found in the Cohort

Conclusion

- Later surgical correction for sagittal CS was associated with increased odds of neurodevelopmental and ophthalmologic diagnoses
- The association with later surgical correction and neurodevelopmental and ophthalmologic outcomes persisted even after adjusting for phenotypic severity and severity alone was not predictive of outcomes
- These findings suggest clinical utility in early surgical intervention
- Limitations and future directions: cephalic index may not be a reliable indicator for severity and future studies may want to consider other anthropometric metrics for analysis

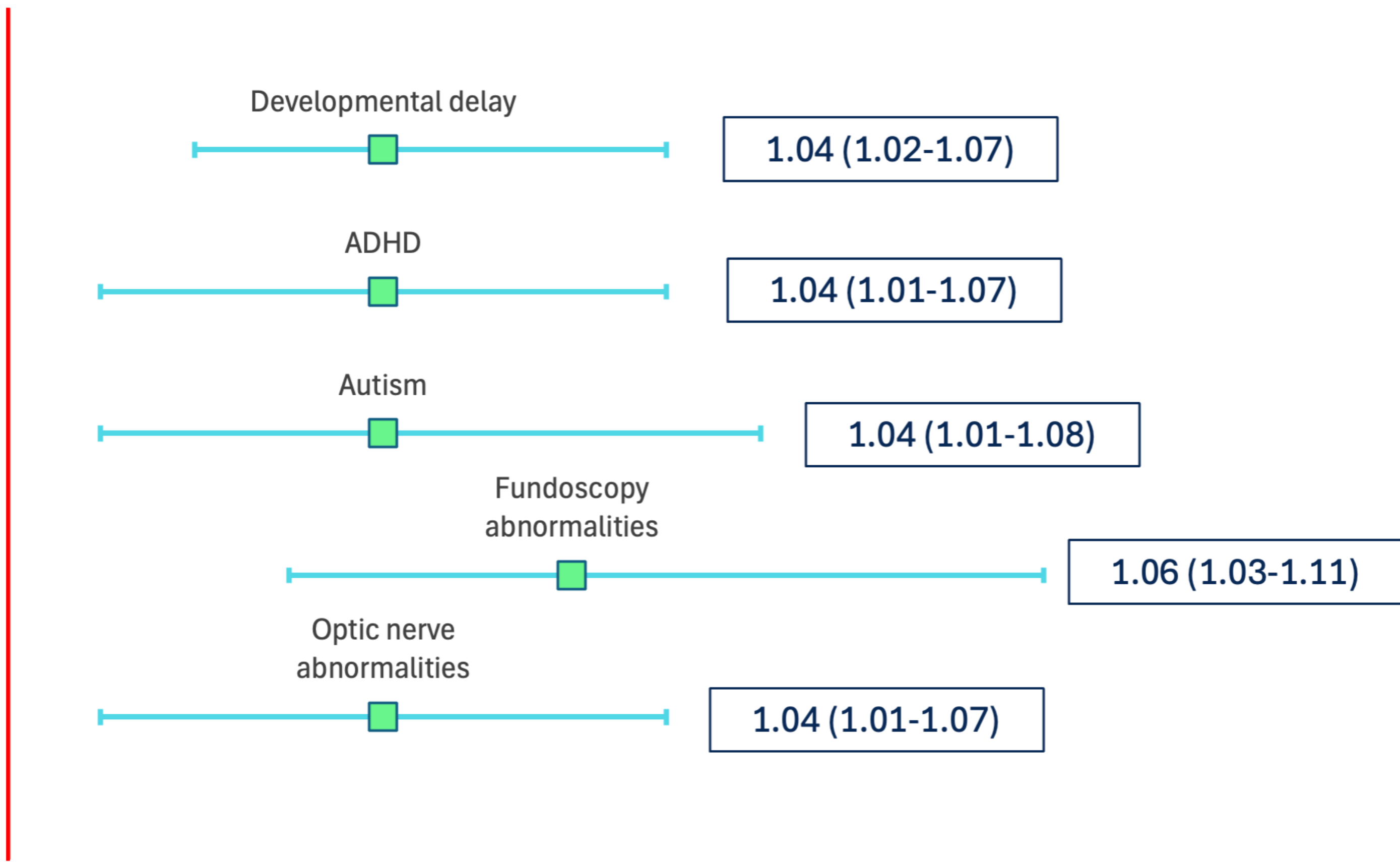


Figure 4. Increasing Surgical Age is Associated with Higher Odds of Neurodevelopmental and Ophthalmologic Outcomes

References

