AGE2HIE: TRANSFER LEARNING FROM BRAIN AGE TO PREDICTING NEUROCOGNITIVE OUTCOME FOR INFANT BRAIN INJURY

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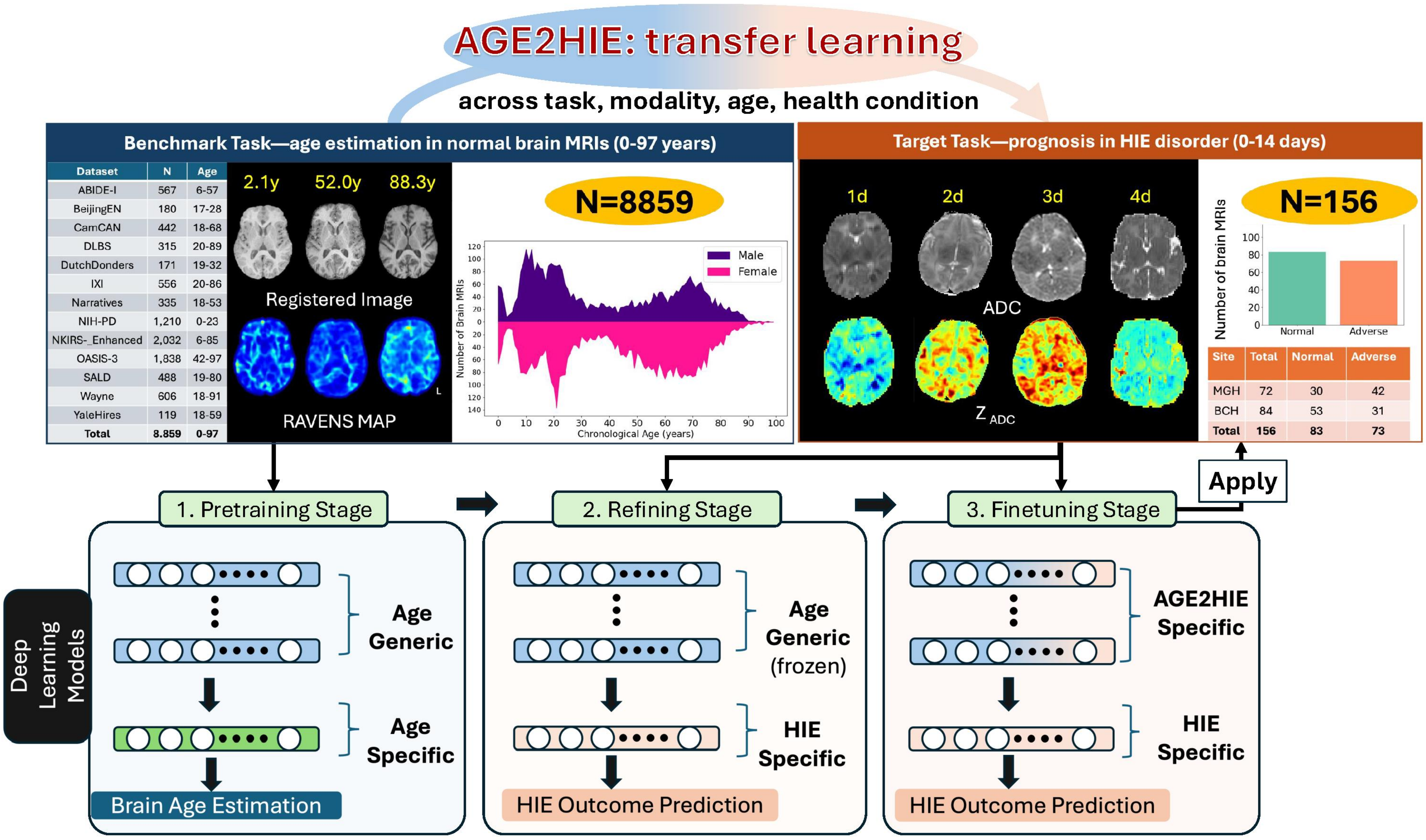

INTRODUCTION

- Hypoxic-Ischemic Encephalopathy (HIE) affects **1-5 /1,000** newborns, with **30% to 50%** of cases resulting in **adverse neurocognitive outcomes**. However, these outcomes can only be reliably assessed **as early as age 2**.
- Early and accurate prediction of HIE-related neurocognitive outcomes using deep learning models is **critical for improving clinical decision-making**, guiding treatment decisions and assessing novel therapies.
- A major challenge in developing deep learning models for this purpose is **the scarcity of large, annotated HIE datasets**.

Results

- AGE2HIE with transfer learning improves accuracy.
- AGE2HIE with transfer learning enhances generality.
- Existing studies primarily rely on private datasets with limited sample sizes. Our results from a two-site dataset (N=156) demonstrated a sensitivity of 0.7735 and specificity of 0.6683.

Methodology

- We have assembled the first and largest public dataset, however it contains only 156 cases with 2-year neurocognitive outcomes.
- We have collected 8,859 normal brain MRIs with 0-97 years of age that are available for brain age estimation using deep learning models.

Table 1. Accuracy without (×) vs with (✓) transferring age-pretrained model to HIE outcome prediction.

	Setting	Transfer	Accuracy (%)	Sensitivity (%)	Specificity (%)
Train/Test within the same site	Training on MGH (N=72)	×	72.28±17.92	70.00±29.15	71.21±18.26
	Testing on MGH	✓	74.85±9.21	74.76±21.27	75.50±17.51
	Training on BCH (N=84)	×	51.24±8.47	58.29±18.35	41.33±18.73
	Testing on BCH	✓	54.38±12.19	66.92±23.46	46.05±20.07
	Training on MGH+BCH (N=156)	×	68.66±8.5	78.82±12.95	66.52±16.27
	Testing on MGH+BCH	✓	70.45±9.1	77.35±14.28	66.83±15.16

Table 2. Generality without (×) vs with (✓) transferring age-pretrained model to HIE outcome prediction.

	Setting	Transfer	Accuracy (%)	Sensitivity(%)	Specificity(%)
Train/Test cross-site	Training in MGH (N=72)	×	57.14±18.99	90.00±20.00	49.36±19.78
	Testing in BCH (N=84)	✓	62.57±9.79	84.29±13.93	52.21±17.56
	Training in BCH (N=84)	×	72.50±11.27	60.00±13.33	75.88±18.69
	Testing in MGH (N=72)	✓	77.21±8.55	64.43±11.27	82.57±14.92

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