The NIH MRI Study of Normal Brain Development

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Introduction: The NIH MRI Study of Normal Brain Development is the most comprehensive and rigorous study of human brain and behavioral development ever conducted. This is a multi-site research project using a combined longitudinal and cross-sectional design to map brain-behavioral development of normal children from birth through 18 years of age. The project is funded by NIH (NINDS, NICHD, NIMH, and NIDA), and includes seven Medical Centers (Boston, Philadelphia, St. Louis, Cincinnati, Houston, Los Angeles, and Montreal). This abstract deals with Objective-2 of this project, which covers children from birth through 4.5 years of age.

Methods: A demographically-representative sample of 64 children (to date) have received repeated brain scan plus behavioral studies between birth through 4.5 years of age. Infants and children were recruited via hospitals and community organizations, and each subject received at least three ‘scans plus testing’ at 3, 6, or 12 month intervals. A comprehensive neurobehavioral testing battery includes age-appropriate standardized and experimental assessments and was administer to each child to validate “normal/typical” neurobehavioral development of the study sample. Neurobehavioral testing: The neurobehavioral testing battery included assessments of neurological status, development, intelligence, cognition, language and verbal fluency, learning and memory (both language and performance), problem solving, and fine-gross motor abilities in infants and young children. The neurobehavioral testing battery was given in three separate acquisitions: b=0, 1000 s/mm2, and b=4000 s/mm2. The neurobehavioral testing battery included assessments of neurological status, development, intelligence, cognition, language and verbal fluency, learning and memory (both language and performance), problem solving, and fine-gross motor abilities in infants and young children. The neurobehavioral testing battery was given in three separate acquisitions: b=0, 1000 s/mm2, and b=4000 s/mm2. The neurobehavioral testing battery included assessments of neurological status, development, intelligence, cognition, language and verbal fluency, learning and memory (both language and performance), problem solving, and fine-gross motor abilities in infants and young children. The neurobehavioral testing battery was given in three separate acquisitions: b=0, 1000 s/mm2, and b=4000 s/mm2. The neurobehavioral testing battery included assessments of neurological status, development, intelligence, cognition, language and verbal fluency, learning and memory (both language and performance), problem solving, and fine-gross motor abilities in infants and young children. The neurobehavioral testing battery was given in three separate acquisitions: b=0, 1000 s/mm2, and b=4000 s/mm2.

Discussion: Initial segmentation will be performed manually as there are no automated algorithms to accurately segment the MR scans from young children. Volumes obtained will provide data suitable for construction of growth curves that span then entire project (1 week to 18 years of age). Future work will focus on development and validation of automatic image segmentation methods. Established algorithms will be used to quantify T1 and T2 relaxation times. The combination longitudinal and cross sectional design will help establish the definitive reference for relaxation times in children between 1 week and 4 years 5 months of age. The isotropic spatial resolution and whole brain DTI acquisition will allow unbiased characterization of white matter maturation from infancy through adolescence. Analysis of the moderate TE MRS from the voxels in the white matter, cortical gray matter, and thalamus will provide the reference standard for Choline Creatine and N-acetylaspartate throughout brain development.

Conclusion: The results of this project will include determination of normal brain growth curves, and associations among growth of the brain and specific brain regions and neurobehavioral testing performance scores With about 50% of the Objective 2 cohort enrolled and 70% of the scans performed, we have demonstrated definitively that is feasible to obtain high quality MR scans from unsedated children under 5 years old. The database under construction will serve as standard and as a resource for future studies involving MR scanning of young children. Support contributed by NS-92319.