The Developing Brain Research Program scientists Josepheen DeAsis-Cruz & Marine Bouyssi-Kobar are among the top 10 who are recognized for the 2017 Children's National Research Discoveries.

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Innovative Research Studies

Development of functional brain networks in healthy and high-risk fetuses and newborns

What is the study about?

This study traces the developmental trajectories of resting state functional connectivity networks in healthy brains and contrasts these with functional development in fetuses and newborns diagnosed with complex congenital heart disease (CHD). Newborns with CHD face an increased risk for neurodevelopmental disabilities. Objective, early and non-invasive evaluation of brain dysfunction in CHD is needed to initiate timely interventions and minimize long-term neurologic issues.

To assess brain function, we use resting state functional connectivity MRI (rs-fcMRI). Using rs-fcMRI, our main goals are to describe baseline measures of brain function in our neurotypical cohorts, detect the earliest onset of deviations from these healthy patterns in CHD, and describe what these alterations are.

Josepheen Cruz, PhD
Staff Scientist III

What are the implications of mature functional networks in newborns?

This finding suggests that some functional networks critical for cognition emerge during the perinatal period, likely during the third trimester of pregnancy when there is rapid brain development.

Why is it important to use resting state functional connectivity to assess brain function?

Resting state fMRI (rs-fcMRI) allows us to non-invasively and rapidly probe the functional organization of the brain in pediatric populations.

How is functional connectivity MRI relevant to the work that we do in the Developing Brain Research Program (DBRP)?

At the DBRP, our goal is to describe healthy brain development and identify deviations from this trajectory in fetuses and newborns using advanced MRI techniques. In line with this, rs-fcMRI provides in vivo assessment of brain function and allows us to probe developing neural circuits that may potentially be used as early biomarkers of brain dysfunction.

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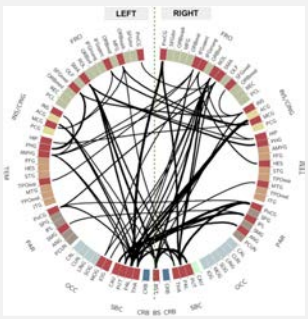

Figure 1. Reduced connectivity in a sub-network of nodes in CHD

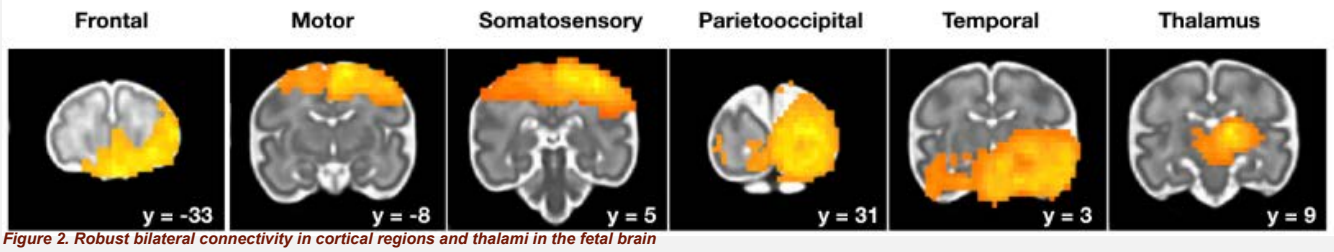

Figure 2. Robust bilateral connectivity in cortical regions and thalami in the fetal brain

ONESIE Story of Amarie

"If we can be a blessing to someone else, we should," Michelle says.

The family was excited to participate in a research study that aims to answer questions raised by both preterm births in their family.

"I want to know if there is that much of a difference. I know there is a difference in physical size. Cognitively, is there any difference?" Kiara adds. "I feel like Amarie started out really small. But she can catch up with kids born around her age. Just because they're born preemies doesn't mean they can't learn like everyone else. Just because they're born preemies doesn't mean they can't do all the things they're supposed to do at their age."

Research Impact

ISMRM Workshop on Machine Learning

Xue F, **Zhao L.** Automatic Neonatal and Infant Brain Segmentation Using 3D Deep Convolutional Neural Network. ISMRM Workshop on Machine Learning, Part II (Submitted)
You W. Automatic Segmentation of the Fetal Brain Using Multi-Scale 3D Convolutional Neural Network: A Pilot Study. ISMRM Workshop on Machine Learning, Part II (Submitted)

International Symposium of the Fetal Brain

Wu Y. Impaired Global and Regional Brain Growth in Fetuses with Complex Congenital Heart Disease.
Schlatterer S. The Placenta-Heart-Brain Connection: Placental Pathology and Brain MRI Findings of Neonates with Congenital Heart Disease.
Krishnamurthy D. Integrated Research Information System (IRIS) - Real-time Multi-Platform Fetal and Neonatal Brain MRI processing and visualization toolkit.
Park J. Rapid Anatomical T2-W 3D MRI for fetal brain.
De Asis-Cruz J. Thalamocortical functional organization in the developing fetal brain.
Zhao L. Improved Image Resolution and Speed in Fetal MRI.
Pradhan S. Feasibility of detecting in utero placental Magnetic Resonance spectroscopy.
Pradhan S. Non-invasive Measurement of Biochemical Profiles in the Developing Fetal Brain.
Zun Z. MR susceptibility imaging of the human placenta in vivo: Preliminary results in healthy pregnancies.

Research Publication

Krishnan A, Tague L, Rudra H, Schidlow D, Pradhan S, Vezina G, **Limperopoulos C**. "Clinical course of a fetus with hypoplastic left heart syndrome and premature ductal constriction". *Cardiology of the Young.* (Accepted)

Welcome New Brain Team Member

Devon Fischer
Clinical-Research Coordinator

Congratulations!!

Li Zhao, PhD for his recent Alzheimer's Association Research Fellowship Program (AARF) award.

Featured Press

- Safeguarding fetal brain health in pregnancies complicated by CHD
- Project ONESIE: Protecting the vulnerable preterm cerebellum
- Developing Brain Research Laboratory
- Brain food for preemies" in CNHS Innovation District. May 23, 2018
- Preterm Infants Need Optimized Nutrition For Maximal Brain Growth

Upcoming Events

- International Symposium of the Fetal Brain ISFB November 1-2, 2018 Washington, DC
- Race for Every Child October 20, 2018 Washington, DC

Summer Interns | Class of 2018

Tips for a healthy Fall

- Get your flu shot
- Hydrate with tons of water
- Head outside for a workout
- Always buy food in-season
- Enjoy a healthier meal