

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Georgieff, Michael Kara

eRA COMMONS USER NAME (credential, e.g., agency login): MICHAEL_GEORGIEFF

POSITION TITLE: Professor of Pediatrics and Child Psychology

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.*)

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
Yale University; New Haven, CT	B.A.	05/1975	Psychology
Washington University- St. Louis, MO	M.D.	05/1979	Medicine
Children's Hospital of Philadelphia- Philadelphia, PA	Pediatric Residency	06/1982	Pediatrics
Children's Hospital of Philadelphia- Philadelphia, PA	Fellowship	06/1983	Neonatal Medicine
University of Minnesota- Minneapolis, MN	Fellowship	06/1984	Neonatal Medicine

A. Personal Statement

I am an internationally recognized expert on the effects of nutrition on the developing brain, and specifically the effects of iron and choline status on neural circuits involved in learning and memory processing. My career in this area has spanned 30 years and includes investigations of brain function in humans and pre-clinical models. I have conducted multiple studies on the effect of fetal and neonatal iron deficiency and neonatal anemia on developing brain regions and behavior. My clinical research expertise is in neonatal nutrition and neurodevelopmental outcomes, specifically the use of event-related potentials to assess early life brain function. I am a multi-PI on a choline intervention trial in children with Fetal Alcohol Spectrum Disorder. My expertise in bench laboratory science includes conditional knock-out technology, neurometabolism, neuronal structural analysis, electrophysiology, gene expression and animal behavior. I co-founded and direct the University of Minnesota's Center for Neurobehavioral Development, an interdisciplinary research center with a team of 40 faculty members that I lead. The Center group spans 11 departments and has expertise in multiple-level assessment of brain development from molecular neuroscience to educational psychology. Nationally, I serve as an advisor to the Pediatric Nutrition and Growth Branch of NICHD, sit on the review panel for the NICHD Neonatal Research Network, was a consultant to NICHD about Future Directions in Cognitive Research, was a member of the BOND (Biomarkers of Nutrition for Development) Iron Workgroup for NICHD and of the NICHD Global Health Consultation Workgroup. Internationally, I have served as a consultant to the New York Academy of Sciences, UNICEF, IOM and the Sackler Institute on the role of nutrition and iron deficiency anemia in neurodevelopment.

B. Positions and Honors**Positions and Employment**

1985-1986	Instructor, Neonatology, Department of Pediatrics, University of Minnesota, Minneapolis, MN
1985-present	Director, Neonatal Intensive Care Follow-up Clinic, University of Minnesota Medical Center, Minneapolis, MN
1985-present	Staff Neonatologist, University of Minnesota Masonic Children's Hospital, Minneapolis, MN
1985-2016	Director, Neonatal Nutrition Support Service, University of Minnesota Masonic Children's Hospital, Minneapolis, MN
1986-1991	Assistant Professor, Division of Neonatology, Department of Pediatrics, University of Minnesota, Minneapolis, MN

1991-1998	Associate Professor, Division of Neonatology, Department of Pediatrics, University of Minnesota, Minneapolis, MN
1997-1998	Associate Professor, Institute of Child Development, University of Minnesota, Minneapolis MN
1998-present	Professor, Division of Neonatology, Department of Pediatrics and Institute of Child Development, University of Minnesota, Minneapolis, MN
1999-present	Director and Co-founder, Center for Neurobehavioral Development, University of Minnesota, Minneapolis, MN
2001-present	Full Member, Graduate Faculty in Neuroscience
2006-present	Director, Division of Neonatology, Department of Pediatrics, University of Minnesota, Minneapolis, MN
2010-present	Martin Lenz Harrison Land-Grant Chair in Pediatrics, University of Minnesota, Minneapolis MN
2011-present	Executive Vice Chair, Department of Pediatrics, University of Minnesota, Minneapolis, MN

Other Experience and Professional Memberships

2000-present	Reviewer, NIH, Nutrition Study Section (permanent member 2001-2005; ad hoc since)
2006	Reviewer, NIH, Neurobiology of Disease T32 Study Section (ad hoc reviewer)
2008-2009	Reviewer, NIH, NAME Study Section (ad hoc reviewer)
2009	Expert Advisory Panel, NIH/NICHD, Pediatric Nutrition and Growth Branch
2011	Expert Advisory Panel, NIH/NICHD, Cognition
2011-present	Advisory Panel, NICHD Neonatal Research Network
2014-2015	Pre-B NICHD Working Group
2014	Organizer, 5 th Aspen Brain Conference
2014-2017	NICHD Global Health Consultation Workgroup
2016	Iron Screening and Supplementation Workgroup, NICHD
2017	NIH Nutrition Research Task Force, NIDDK

Professional Memberships

1984-present	American College of Nutrition (Pediatric Council 1987)
1985-present	American Academy of Pediatrics (Committee on Nutrition 1993-1999)
1985-present	American Federation of Clinical Research
1988-present	Society for Pediatric Research
1993-present	Perinatal Research Society (Pediatric Council 2000-2003)
1998-present	Federation of American Societies for Experimental Biology (FASEB)
2001-present	American Pediatric Society

Honors

2001	Pfizer Professor, State University of New York-Downstate Medical Center, Brooklyn, NY
2009	Distinguished Alumni Award, Washington University Medical School, St. Louis, MO
2010	Peter Auld Distinguished Professor, Cornell University, New York, NY
2010	Founders Award, Midwest Society for Pediatric Research
2010-present	Martin Lenz Harrison Land-Grant Chair in Pediatrics, University of Minnesota, Minneapolis, MN
2014	Samuel J Fomon Nutrition Award (American Academy of Pediatrics)
2015	Mentor of the Year Award; Department of Pediatrics, University of Minnesota, Minneapolis, MN
2016	Carole J Bland Faculty Mentor Award; University of Minnesota School of Medicine, Minneapolis

C. Contribution to Science

- My major contributions to science have been in the field of fetal and neonatal iron nutrition, anemia and neurodevelopment. This work encompasses studies in humans, preclinical models from mice to non-human primates, and cell culture. It uses human behavioral and electrophysiologic techniques, and genomic, proteomic, metabolomics, structural, electrophysiologic and behavioral analyses in mice and rats. My laboratory was the first to demonstrate principle that iron deficiency and anemia cause differential effects on the hippocampus and on learning and memory function. We have utilized ERPs in human subjects from newborns through 5 year olds to assess memory and processing deficits.
 - Kennedy BC, Tran PV, Kohli M, Maertens JJ, Gewirtz JC, **Georgieff MK**. Beneficial effects of postnatal choline supplementation on long-term neurocognitive deficit resulting from fetal-neonatal iron deficiency. *Behavioural Brain Research*, 336:40-43, 2018.

- b. Wozniak JR, Fuglestad AJ, Eckerle JK, Fink BA, Hoecker CJ, Radke J, Kroupina MG, Miller NC, Brearley AM, Zeisel SH, **Georgieff MK**. Choline supplementation in children with Fetal Alcohol Spectrum Disorders (FASD) improves memory performance in 2-3 year olds: A randomized, double-blind, placebo-controlled trial. *Am J Clin Nutr*, 102:1113-25; 2015. PMID 26447156.
 - c. Wozniak JR, Fuglestad AJ, Eckerle J, Kroupina MG, Miller NC, Boys CJ, Brearley AM, Fink BA, Hoecker HL, Zeisel SH, **Georgieff MK**. Choline supplementation in children with fetal alcohol spectrum disorders (FASD) has high feasibility and tolerability. *Nutrition Research*, 33: 897-904; 2013. PMC3815698
 - d. Riggins T, Miller NC, Bauer PJ, **Georgieff MK**, Nelson CA. Electrophysiological indices of memory for temporal order in early childhood: implications for the development of recollection. *Dev Sci*. 12(2):209-19, 2009. PMCID: PMC 2771175
2. In addition to my work in iron and neurodevelopment, I have published more broadly on early life nutritional status and neurodevelopment. Much of this work has centered on the role of nutritional and non-nutritional factors in determining linear growth and the relationship of growth stunting to neurodevelopmental trajectory. This work encompasses studies of preterm infants, internationally adopted children and children in orphanages in developing countries. The work demonstrates that infectious and non-infectious stress alters nutrient uptake utilization and trafficking, thus resulting abnormal body habitus (stunting) and poorer neurodevelopment.
- a. **Georgieff MK**, Brunette KE, Tran PV. Early life nutrition and neural plasticity. *Dev Psychopathol* 27: 411-23; 2015. PMC: 4443711
 - b. Ramel SE, Demerath EW, Gray HL, Younge N, Boys C, **Georgieff MK**. The relationship of poor linear growth velocity with neonatal illness and two-year neurodevelopment in preterm infants. *Neonatology* 102:19-24; 2012. PMID 22441508.
 - c. **Georgieff MK**. Nutrition and the Developing Brain: Nutrient Priorities and Management. *Am J Clin Nutr*, 85:614S-620S, 2007.
3. A broader aspect of my research has been on the subject of timing of interventions to improve child development. This work relies on the principle that the brain is not a homogenous organ; rather it is constituted of distinct regions, processes and cell types. The impact of early life stressors, nutrient deficiency and other, is a function of which brain regions are growing most rapidly and have the highest metabolic demand at the time of the insult. This work has had an impact on public policy in the US (eg, Committee on Nutrition of the American Academy of Pediatrics) and world-wide (UNICEF).
- a. Cusick SE, **Georgieff MK**. The role of nutrition in brain development: The golden opportunity of the first 1000 days. *J Pediatrics*, in press 2016. NIHMS786010.
 - b. Wachs TD, **Georgieff M**, Cusick S, McEwan B. Issues in the timing of integrated early interventions: contributions from nutrition, neuroscience and psychological research. *Annals of the New York Academy of Sciences*, 1308: 89-106, 2014. PMC4075015.
 - c. Monk C, Osterholm E, **Georgieff MK**. Maternal prenatal distress and poor nutrition: A two way street affecting infant neurocognitive development. *Journal of Child Psychology and Psychiatry* 54(2):115-30, 2013. PMC 3547137.
 - d. Pylipow M, Spector LG, Puumala SE, Boys C, Cohen J, **Georgieff MK**. Early postnatal weight gain, intellectual performance, and body mass index (BMI) at seven years of age in term infants with intrauterine growth-restriction (IUGR). *J. Pediatr*, 154(2): 201-6, 2009. PMID 18823908.

Complete List of Published Work in My Bibliography (from a total of 256 peer-reviewed publications):
<http://www.ncbi.nlm.nih.gov/sites/myncbi/michael.georgieff.1/bibliography/41065922/public/?sort=date&direction=ascending>

My H-index is 62

D. Research Support

Ongoing Research Support

R01 HD094809 Georgieff (PI)

07/01/2018 - 06/30/2023

NIH/NICHD

'Newborn Iron Deficiency'

Major Goals: To determine 1) whether neuronal iron deficiency during hippocampal development reduces mitochondrial function and alters neuronal structure and efficacy and 2) whether therapies that improve mitochondrial function during development prevent long-term neuronal dysfunction.

Role: Principal Investigator

P01 HL046925 Georgieff (PI)/Sola-Visner (Prime PI) 09/01/2018 - 06/30/2023

Boston Children's Hospital (NIH/NHLBI Prime)

'Immunologic and Neurodevelopmental Consequences of Neonatal Anemia and Thrombocytopenia and Their Treatments; Project 3: The Effect of Neonatal Anemia and Its Treatment on Brain Development'

Major Goals: To evaluate whether rHuEPO treatment or RBCTX to relieve phlebotomy induced anemia (PIA) in the newborn mouse pup between postnatal days (P) P3 and P13 improves regional brain development and function in the neonatal period and in young adulthood following resolution of anemia.

Role: Subaward Project Leader

R01 HD092391 Cusick (PI)

07/05/2018 – 05/31/2023

NIH/NICHD

'Optimizing Benefits While Reducing Risks of Iron in Malaria-endemic Areas'

Major Goals: To establish the optimum sequencing of iron and antimalarial treatment for managing concurrent iron deficiency and malaria, thus guiding future iron intervention programs in malaria-endemic and high-infection settings.

Role: Co-Investigator

No Sponsor Award # Georgieff (PI)/Duncan (Prime PI) 09/15/2017 - 07/31/2022

University of California, Irvine (Smith Richardson Foundation Prime)

'Household Income and Child Development in the First Three Years of Life'

Major Goals: To understand whether financial support of low income pregnant women improves neurodevelopmental outcome of their offspring.

Role: Subaward Principal Investigator

R01 HD089989 Rao, Georgieff, and Coe (PIs)

09/22/2017 - 06/30/2022

NIH/NICHD

'Detection and Correction of Iron Deficiency Induced Abnormal Brain Metabolism'

Major Goals: To 1) demonstrate that serum proteomics and metabolomics detect impending brain dysfunction, 2) verify that standard hematological and iron parameters are poor indices of brain dysfunction, and 3) establish that iron supplementation in the pre-anemic stage of iron deficiency is essential to mitigate the adverse neurological effects in a nonhuman primate model of iron deficiency anemia.

Role: Principal Investigator (Multi-PIs)

R01 NS099178 Tran (PI)

07/01/2017 - 06/30/2022

NIH/NINDS

'Roles of Iron-Dependent PHD and JARID in Early-Life Iron Deficiency-Induced Adult Neural Gene Dysregulation'

Major Goals: To investigate the roles of iron-dependent cellular mechanisms in the developing brain by which early-life iron deficiency, the most common micronutrient deficiency worldwide, causes persistent cognitive and socio-emotional behavior deficits in adulthood.

Role: Co-Investigator

No Sponsor Award # Rao and Georgieff (PIs)

02/15/2019 - 02/14/2022

Systemex America, Inc.

'Reticulocyte Hemoglobin (RET-He) as a Predictive Biomarker of Early Brain Iron Deficiency'

Major Goals: To discover biomarkers of ID-induced brain dysfunction in the pre-anemic stage of ID and to determine whether Ret-He decreases significantly prior to metabolic evidence of brain ID in a nonhuman primate model of IDA.

Role: Principal Investigator (Multi-PIs)

R21 HD099473 Gale, Georgieff, and Knights (PIs) 09/01/2019 – 08/31/2021

NIH/NICHD

'Gut Microbiomes and Early Human Neurodevelopment'

Major Goals: To test the hypothesis that differences in gut microbial community composition are associated with differences in electrophysiological markers of learning and memory. The results of this study will provide preliminary data for future research proposals to identify mechanisms whereby infant microbiota affect brain function, and to develop microbiota modulation strategies to optimize long-term neurodevelopment.

Role: Principal Investigator (Multi-PIs)

R21 HD099779 Cusick and Musiime (PIs) 09/01/2019 - 08/31/2021

NIH/NICHD

'The Role of Iron Deficiency in the Neurodevelopment of Children Perinatally Exposed to HIV'

Major Goals: To establish the burden of iron deficiency in HIV-infected, HIV-exposed/uninfected, and HIV-unexposed/uninfected children to determine whether there is an association between iron deficiency and neurobehavioral outcomes.

Role: Co-Investigator

R21 HD097575 Gillick (PI) 08/01/2019 - 07/31/2021

NIH/NICHD

'Perinatal Brain Injury: Identifying Cortical Excitability and Circuitry through Multi-Modal Assessment'

Major Goals: To integrate computational modeling with neuroimaging and cortical excitability assessments in infant brain development after perinatal injury.

Role: Co-Investigator

R01 HD086124 Georgieff (PI)/John and Bangirana 01/01/2016 - 12/31/2020

(Prime PIs)

Indiana University (NIH/NICHD Prime)

'Prophylaxis against Malaria to Enhance Child Development'

Major Goals: To determine the effect of malaria prevention in pregnant women and their children on child neurodevelopment, and to identify the major mechanisms through which this malaria prevention affects child neurodevelopment.

Role: Subaward Principal Investigator

No Sponsor Award # Georgieff and Nakagawa (PIs) 01/01/2019 - 12/31/2020

UMN Pediatrics Masonic Cross-Departmental Grant

'Cellular and Molecular Dissection of the Impact of Developmental Vitamin A Deficiency on Brain Disorders'

Major Goals: To use genetic mouse models to understand the role of Vitamin A during early life in the development of the cerebral cortex.

Role: Principal Investigator (Multi-PIs)