



NIH Strategic Workshop

Preconceptional Origins of Child Health Outcomes Workshop

June 17–18, 2021

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Aided by a planning group from multiple NIH Institutes, Centers, and Offices, the NIH ECHO Program is hosting this Preconceptional Origins of Child Health Outcomes Workshop on June 17–18, 2021. This multi-disciplinary workshop brings together speakers and discussants with expertise in the developmental origins of health and disease, human embryology, immunology, environmental, social, and reproductive epidemiology, biostatistics, psychology, obstetrics, pediatrics, maternal-fetal medicine, family medicine, obesity, nutrition, sleep, preconception health, and health disparities. The workshop purposes are:

1. To assess the state of the science, research gaps, and opportunities related to how preconception exposures may influence child health outcomes.
2. To discuss how to overcome operational challenges in conducting preconception cohort studies.

In 2016 NIH launched the nationwide [ECHO Program](#), whose mission is to enhance the health of children for generations to come. ECHO’s observational research rests on combined data from multiple diverse pre-existing and ongoing maternal-child cohort studies, driven by the ECHO-wide Cohort data collection [protocol](#). To date the ECHO-wide Cohort data platform contains data on a total of close to 100,000 children and their family members. ECHO focuses on five key pediatric outcomes: pre-, peri- and postnatal, upper and lower airways, obesity, neurodevelopment, and positive health (well-being). The ECHO Program is interested in effects of a broad range of early environmental exposures on child health outcomes and as such is seeking to better understand the preconceptional origins of children’s health.

AGENDA (DAY 1)

June 17, 2021

DAY 1: 10:00–4:15	TOPIC	SPEAKERS/DISCUSSANTS
10:00–10:10	Introductions/setting the stage	Matthew W. Gillman / S. Sonia Arteaga, ECHO
10:10–10:25	Welcome	Francis S. Collins, NIH Director
THEME 1: LIFESTYLE FACTORS/OBESITY		
Moderator: Drew Bremer (NICHD)		
Speakers: 12 minutes for each presentation, 8 minutes for Q&A		
Questions for speakers to address:		
<ol style="list-style-type: none"> 1. From the evidence from your and others' studies, to what extent do modifiable lifestyle factors, or obesity, in women or men before pregnancy cause adverse health outcomes—or lead to positive health—in their offspring? 2. In your studies, how did you recruit mothers and/or fathers during the preconception period? What lessons have you learned about recruitment or retention in cohort studies from preconception to childhood? 3. What are three key research gaps in this theme for large epidemiological studies with diverse populations? 		
10:25–10:30	Brief Introduction to theme	Drew Bremer, NICHD
10:30–10:50	Preconception sleep and physical activity—possible links with child health outcomes?	Elizabeth E. Hatch, Boston University
10:50–11:10	Impact of preconception weight loss on child health outcomes	Erin LeBlanc, Kaiser Permanente Center for Health Research
11:10–11:30	Preconception nutrition to optimize offspring life chances	Keith Godfrey, University of Southampton
11:30–11:50	Embryonic development	Tom Fleming, University of Southampton
11:50–12:40	Theme 1 discussion (3-minute intro per discussant)	Discussants: Lucilla Poston, King's College London; Pat Catalano, Tufts Medical Center; Chandra Jackson, NIEHS
12:40–1:10	LUNCH	
THEME 2: RECRUITMENT/STUDY DESIGN		
Moderator: Christina Park (ECHO)		
Speakers: 5-minute flash talks		
Questions for speakers to address:		
<ol style="list-style-type: none"> 1. In your studies, why did you choose your research design over others? 2. How did you recruit mothers and/or fathers preconception? What lessons have you learned about recruitment or retention? 3. What are three key suggestions to enhance recruitment among diverse populations? 		
1:10–1:15	Brief Introduction to theme	Christina Park, ECHO
1:15–1:20	Recruitment, planning, fecundity	Joseph B. Stanford, University of Utah
1:20–1:25	Recruiting in the interpregnancy period	Roland Devlieger, KU Leuven

June 17, 2021

DAY 1: 10:00–4:15		
TOPIC	SPEAKERS/DISCUSSANTS	
1:25–1:30	Recruiting Black and African American women for preconception care research: The Gabby Preconception Care System	Brian W. Jack, Boston University
1:30–1:35	Generation R <i>Next</i> Study recruitment <i>Preconception and Embryonic Origins of Health and Disease</i>	Vincent Jaddoe, Harvard University
1:35–2:25	Theme 2 discussion (3-minute intro per discussant)	Discussants: Germaine Buck-Louis, George Mason University; Enrique Schisterman, University of Pennsylvania, Shane Norris, University of the Witwatersrand
2:25–2:35	BREAK	
THEME 3: FATHERS		
Moderator: S. Sonia Arteaga (ECHO)		
Speakers: 12 minutes for presentation, 8 minutes for Q&A		
Questions for speakers to address:		
<ol style="list-style-type: none"> 1. From the evidence from your and others' studies, to what extent do modifiable paternal factors before pregnancy cause adverse health outcomes—or lead to positive health—in their offspring? 2. In your studies, how did you recruit fathers during the preconception period? What lessons have you learned about recruitment or retention in cohort studies that follow participants from preconception to childhood? 3. What are three key research gaps in this theme for large epidemiological studies with diverse populations? 		
2:35–2:40	Introduction to theme	S. Sonia Arteaga, ECHO
2:40–3:00	The social role of fathers during the preconception period and impacts on children	Kirsten Davison, Boston College
3:00–3:20	Preconception epigenetic vulnerability of sperm to cannabis	Susan K. Murphy, Duke University
3:20–4:00	Theme 3 discussion (3-minute intro per discussant)	Discussants: Shanna Swan, Icahn School of Medicine, Mt. Sinai; Michael Golding, Texas A&M University
4:00–4:15	Day 1 Wrap-up	S. Sonia Arteaga

AGENDA (DAY 2)

June 18, 2021

DAY 2: 10:00–3:30	TOPIC	SPEAKERS/DISCUSSANTS
10:00–10:10	Introductions/setting the stage	S. Sonia Arteaga
THEME 4: PHYSICAL AND CHEMICAL EXPOSURES		
Moderator: Kim Gray (NIEHS)		
Speakers: 12 minutes for presentation, 8 minutes for Q&A		
Questions for speakers to address:		
<ol style="list-style-type: none"> 1. From the evidence from your and others' studies, to what extent do modifiable physical or chemical exposures to which women or men are exposed before pregnancy cause adverse health outcomes—or lead to positive health—in their offspring? 2. In your studies, how did you recruit mothers and/or fathers preconception? What lessons have you learned about recruitment or retention in cohort studies that follow participants from preconception to childhood? 3. What are three key research gaps in this theme for large epidemiological studies with diverse populations? 		
10:10–10:15	Introduction to theme	Kim Gray, NIEHS
10:15–10:35	Preconception endocrine disrupting chemical exposures and children's health	Joseph Braun, Brown University
10:35–10:55	Short- and long-term health effects of preconception air pollution exposure	Zhanghua Chen, University of Southern California
10:55–11:15	Reproductive immunology	Gil G. Mor, Wayne State University
11:15–12:05	Theme 4 discussion (3-minute intro per discussant)	Discussants: Lynn Goldman, George Washington University; Leo Trasande, New York University
12:05–12:35	LUNCH	

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DAY 2: 10:00–3:30		
TOPIC	SPEAKERS/DISCUSSANTS	
THEME 5: PSYCHOSOCIAL AND SOCIETAL INFLUENCES		
Moderator: Erica Spotts (OBSSR)		
Speakers: 12 minutes for presentation, 8 minutes for Q&A		
Questions for speakers to address:		
<ol style="list-style-type: none"> 1. From the evidence from your and others' studies, to what extent do modifiable psychosocial, mental health, substance use, or societal factors before pregnancy cause adverse health outcomes—or lead to positive health—in their offspring? 2. In your studies, how did you recruit mothers and/or fathers preconception? What lessons did you learn about recruitment or retention? 3. What are three key research gaps in this theme for large epidemiological studies with diverse populations? 		
12:35–12:40	Introduction to theme	Erica Spotts, OBSSR
12:40–1:00	Preconception influences on child neurodevelopment: Focusing on parental childhood adversity to break the cycle of disadvantage	Christiane S. Duarte, Columbia University
1:00–1:20	Psychosocial/societal influences: Maternal stress and resilience	Christine Dunkel Schetter, UCLA
1:20–1:40	Preconception stress, mental health and substance use: Implications for child health	Alison E. Hipwell, University of Pittsburgh
1:40–2:00	Early childhood adversity	Renee Boynton-Jarrett, Boston University
2:00–2:50	Theme 5 discussion (3-minute intro per discussant)	Discussants: Kecia N. Carroll, Vanderbilt University Medical Center; Sarah Verbiest, University of North Carolina
THEME 6: FUTURE RESEARCH DIRECTIONS & WRAP-UP		
2:50–3:30		Matthew W. Gillman

SPEAKER TALKING POINTS AND RESEARCH GAPS

Preconception sleep and physical activity—
possible links with child health outcomes?

Elizabeth E. Hatch, PhD

Boston University School of Public Health

Speaker — Lifestyle Factors/Obesity Theme

Talking Points

- a) **Study population:** Difficulty enrolling and retaining diverse populations is common among most general population preconception cohorts. Others have been conducted within infertile populations where results may not be generalizable. While strict representativeness of the general population is not necessary (and is virtually impossible to attain in prospective cohort studies of volunteers), having large enough subgroups to study associations (and possible effect measure modification) in diverse populations is critical. For example, disadvantaged couples may have poor sleep quality due to neighborhood factors (noise/light at night), neighborhood crime and violence, household crowding, greater stress due to discrimination, job and food insecurity, and longer working hours or shift/night work. Similarly, economic disadvantage may limit opportunities for leisure time physical activity, while increasing exposure to repetitive work-related physical activity such as heavy lifting. Intervening on lifestyle exposures to improve preconception, pregnancy, and child health outcomes may be more difficult in disadvantaged populations, and the nature of successful interventions may vary across subgroups.
- b) **Measurement and timing of exposure:** Exposure assessment is often based on self-report and ascertained retrospectively even in prospective cohort settings, leading to non-differential misclassification and bias to the null. Data collection via prospective diaries, text messages, or apps; more objective methods to capture exposures (e.g., actigraphy); and measurement of biomarkers would likely result in more valid effect estimates. Non-differential misclassification may also occur when the critical time period for the exposure is not captured.
- c) **Mechanisms of action for preconception risk factors:** Are preconceptional lifestyle factors relevant to child health due to direct exposure of gametes (male and/or female), or is the pathway indirect due to their association with pregnancy exposures or the family environment post-partum (e.g., poor parental sleep leading to higher stress and inadequate parenting)?

Research Gaps

- a) Sleep is foundational to overall health, so it is unclear whether more research in relation to reproductive/child health outcomes is needed. Poor sleep is related to increased stress, preeclampsia, and gestational diabetes. However, studies of shift work/night work (often used as a marker for disrupted sleep) and preterm delivery and other outcomes have mixed findings.
- b) Physical activity: Is there a sweet spot for vigorous/moderate PA in preconception/pregnancy?
- c) How do we translate research findings to improve health especially in the context of disparities?

Key References

- 1) Wise LA, Rothman KJ, Mikkelsen EM, Stanford JB, Wesselink AK, McKinnon C, Gruschow SM, Horgan CE, Wiley AS, Hahn KA, Sørensen HT, Hatch EE. Design and Conduct of an Internet-Based Preconception Cohort Study in North America: Pregnancy Study Online. *Paediatr Perinat Epidemiol.* 2015 Jul;29(4):360-71. doi: 10.1111/ppe.12201. PMID: 26111445; PMCID: PMC4662659.
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- 5) Walker, Matthew, *Why We Sleep.* Penguin Books, 2018

Impact of preconception weight loss on child health outcomes

Erin LeBlanc, MD, MPH

Kaiser Permanente Center for Health Research

Speaker – Lifestyle Factors/Obesity Theme

Talking Points

- a) Childhood obesity prevention efforts may be most effective if they start *before* birth. The first trimester intrauterine environment, determined primarily by pre-pregnancy weight, may be a key risk factor for adverse pregnancy outcomes and transmission of obesity to offspring. Women who enter pregnancy with obesity and/or metabolic dysfunction are at increased risk of maternal morbidity (preeclampsia, cesarean delivery, postpartum hemorrhage). Further, their newborns, exposed *in utero* to this adverse maternal metabolic environment, are at increased risk of neonatal morbidity, including excess fetal adiposity, birth trauma, and neonatal hypoglycemia. In the long-term, these children are at increased risk of obesity and impaired glucose tolerance.
- b) Based on existing data, the National Academy of Medicine (NAM) and American College of Obstetrics and Gynecology (ACOG) currently recommend that women with elevated BMIs who are planning pregnancy lose weight before pregnancy. However, as highlighted by a recent systematic evidence review commissioned by the USPSTF, data are lacking on effectiveness of pre-pregnancy interventions. In particular, we do not know which approaches for preconception weight loss are safe and effective for mothers and their children. Preconception and observational studies have found mixed results regarding associations between preconception weight loss and birthweight, including small for gestational age (SGA). In studies of preconception bariatric surgery, the resulting large and rapid weight loss is associated with increased risk of SGA and a decreased risk of LGA. There are scant data on the impact of weight loss prior to pregnancy on long-term childhood outcomes.
- c) The Prepare study was the first randomized clinical trial to test the impact of a preconception behavioral weight loss intervention. Intervention participants (n=89) lost more weight before pregnancy than controls (n=80; -0.25 ± 0.51 vs -0.03 ± 0.21 kg/week, $P < 0.001$). However, intervention participants gained more weight than controls in the second trimester (0.42 ± 0.26 vs 0.33 ± 0.28 kg/week; $P = 0.04$) and third trimester of pregnancy (0.56 ± 0.37 vs 0.43 ± 0.33 kg/week; $P = 0.02$) and overall (13.2 ± 8.20 vs 10.3 ± 7.41 kg; $P = 0.03$). Spontaneous pregnancy loss was less common in the intervention arm than the control arm (8 [4.9%] vs 19 [11.8%]; OR 0.39 [0.16, 0.92]) but there were no other differences in secondary or exploratory outcomes, including no differences in birthweight or risk of SGA or LGA. Our results are consistent with an observational study that found that among women with BMIs over 25 kg/m² at conception, those with weight loss in the year before pregnancy experienced 2.8 kg more gestational weight gain than women with stable weight before pregnancy.
- d) Preconception studies are needed to fill these research gaps. However, recruiting women prior to pregnancy and then following them through pregnancy can be challenging because of the uncertainty about the number of participants that will experience pregnancy and the timing of those pregnancies. For the Prepare study, we actively reached out to reproductive-aged women in our health system (Kaiser Permanente Northwest) by letter, email, and text, inviting them to join our study. To be eligible, women had to answer “yes” to the following question: *Would you like to become pregnant in the next two years?* By the end of the 51 month study, approximately 55% of the participants had experienced a pregnancy lasting at least 14 weeks. We are now recruiting mother-child dyads who participated in Prepare into our follow-up cohort study, PrepareD. We believe there were several reasons for our successful recruitment including access to large pool of reproductive-aged women and a pragmatic study design, which leveraged the EMR to collect outcomes (thereby reducing study visit burden) and allowed for variable pregnancy onset, consistent with what would occur in clinical settings. Our experience with the Prepare study indicates that recruitment of women planning pregnancy into studies of weight loss is feasible.

Research Gaps

- a) Does elevated BMI and associated metabolic dysfunction during early pregnancy have long-term negative impacts on children's metabolic health?
- b) What are the long-term risks and benefits of preconception weight loss for offspring?
- c) Do the risks and benefits of preconception weight loss vary by maternal BMI, amount of weight loss, and/or timing of weight loss in relation to pregnancy onset?

Key References

- 1) US Preventive Services Task Force; Davidson KW, Barry MJ, Mangione CM, Cabana M, Caughey AB, Davis EM, Donahue KE, Doubeni CA, Krist AH, Kubik M, Li L, Ogedegbe G, Pbert L, Silverstein M, Simon M, Stevermer J, Tseng CW, Wong JB. Behavioral Counseling Interventions for Healthy Weight and Weight Gain in Pregnancy US Preventive Services Task Force Recommendation Statement. *JAMA*. 2021 May 25;325(20):2087-2093. doi: 10.1001/jama.2021.6949.
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- 4) American College of Obstetricians and Gynecologists. ACOG Committee opinion no. 549: obesity in pregnancy. *Obstet Gynecol*. 2013;121(1):213-217.

Preconception nutrition to optimize offspring life chances

Keith Godfrey, FRCP, PhD

University of Southampton, UK

Speaker – Lifestyle Factors/Obesity Theme

Talking Points

- a) Preconception diet, body composition/metabolism and lifestyle are implicated in offspring body composition, cardiometabolic, neurobehavioural and allergic outcomes.
- b) Preconception nutritional and complex randomized clinical trials (RCTs) are massive undertakings, but are needed to advance public health objectives.
- c) Educational interventions during adolescence and interpregnancy interventions have potential for population-scale impact.

Research Gaps

- a) Nutrition/lifestyle influences on sperm epigenomics and transcriptomics, and their consequences for the development and life chances of the offspring.
- b) How to optimise preconception nutrition and lifestyle at scale in young people.
- c) How to utilise the inter-conception period as an opportunity to optimise nutrition and lifestyle for the benefit of the offspring.

Key References

- 1) Godfrey KM, Barton SJ, El-Heis S, et al. Myo-inositol, Probiotics and Micronutrient Supplementation from Preconception for Glycemia in Pregnancy: NiPPeR International Multi-center Double-blind Randomized Controlled Trial. *Diabetes Care* – epub 29 March 2021.
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- 3) Schoenaker DAJM, Stephenson J, Connolly A, et al, UK Preconception Partnership. Characterising and monitoring preconception health in England: a review of national population-level indicators and core data sources. *J Developmental Origins Health and Disease* – in press.
- 4) Taylor EJ, Wilding S, Ziauddeen N, et al. Change in modifiable maternal characteristics and behaviours between consecutive pregnancies and offspring adiposity: A systematic review. *Obes Rev.* 2020;21(11):e13048. doi:10.1111/obr.13048
- 5) Stephenson J, Vogel C, Hall J, et al, for the Preconception Partnership. Preconception health in England: a proposal for annual reporting with core metrics. *Lancet* 2019; 393: 2262–71.
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- 8) El-Heis S, Crozier SR, Healy E,. Maternal stress and psychological distress preconception: association with offspring atopic eczema at age 12 months. *Clin Exp Allergy.* 2017;47(6):760-769.
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Embryonic development

Tom Fleming, PhD

University of Southampton, UK

Speaker – Lifestyle Factors/Obesity Theme

Talking Points

- a) *Origin of Developmental Origins of Health and Disease (DOHaD) is Peri-Conception (PC)*
 - Gametes and early embryos are receptive and vulnerable to the environment, the critical origin of DOHaD
 - Diverse environmental conditions affect the PC period, from nutrition to assisted reproductive technology (ART), with lifetime consequences
 - Found across human and animal models
 - Affects both parents (gametes) and their early embryos
 - This early origin of DOHaD makes a compelling case for preconception health of parents to promote child health
- b) *DOHaD is a stepwise 'timeline' of altered development from PC to adult*
Human 'PC' nutrition models (e.g., DHW; The Gambia):
 - Identify epigenetic changes in offspring, biomarkers of adverse programming, and candidates for investigating causes
 - Confounders may limit search for detailed mechanisms, from PC to adult
 - ART models, treatment more focused on PC period, but confounders
- c) *Animal PC models:*
 - Permit controlled, direct analyses treatment focused on PC period reveal a stepwise progression of adverse programming from PC to adult
 - Comprise epigenetic, signaling cellular, metabolic and physiological mechanisms
 - Responses may be similar or vary dependent upon environmental exposure
- d) *PC DOHaD comprises environmental perturbation of development but also conserved mechanisms of plasticity to promote survival – embryos actively engaged in sensing their environment and making "decisions" on how to develop*
 - Example from mouse maternal undernutrition (LPD) model
 - From maternal diet to compensatory histotrophic nutrition
 - From embryo response to fetal and postnatal growth regulation

Research Gaps

- a) **Gap 1**
 - Need more systematic studies on effects of diverse environments on donated *human* embryos (where possible)
 - Can employ hES cell models too, with embryo validation
 - Dietary, ART, toxicants....
 - RNA-Seq / Single-cell or embryo / Epigenomics / Metabolomics
 - Will generate unbiased candidates, multiple induction mechanisms

b) **Gap 2**

- PC animal models show maternal diet *independent* of maternal condition (obesity; BMI etc) can induce adverse developmental programming affecting offspring health
- Need clinical epidemiological studies to separate effects of maternal diet from metabolic status.
Will poor diet in normal healthy women impose long-term effects on pregnancy and child health?

c) **Gap 3**

- Need better understanding of *sex differences* in response to peri-conceptional environment
- The influence of sex on embryo phenotype and DOHaD programming at systematic level and in response to diverse environmental factors (Hansen et al, 2016 Cell Tissue Res 363: 237–247)
 - Male embryos grow faster to the blastocyst stage than female embryos
 - Male embryos show altered profile of gene expression compared with female embryos
 - Embryos exhibit sexual dimorphism in responsiveness to cytokine and hormone signaling
- Need epidemiological comparisons between male and female child health risks, and assessment of causes

References

- 1) Fleming TP, Watkins AJ, Velazquez MA, et al. Origins of lifetime health around the time of conception: causes and consequences. *Lancet*. 2018;391(10132):1842-1852. doi:10.1016/S0140-6736(18)30312-X
- 2) Roseboom TJ. Epidemiological evidence for the developmental origins of health and disease: effects of prenatal undernutrition in humans. *J Endocrinol*. 2019;242(1):T135-T144. doi:10.1530/JOE-18-0683
- 3) Chen M, Heilbronn LK. The health outcomes of human offspring conceived by assisted reproductive technologies (ART). *J Dev Orig Health Dis*. 2017;8(4):388-402. doi:10.1017/S2040174417000228
- 4) Kermack AJ, Finn-Sell S, Cheong YC, et al. Amino acid composition of human uterine fluid: association with age, lifestyle and gynaecological pathology. *Hum Reprod*. 2015;30(4):917-924. doi:10.1093/humrep/dev008
- 5) Hansen PJ, Dobbs KB, Denicol AC, Siqueira LGB. Sex and the preimplantation embryo: implications of sexual dimorphism in the preimplantation period for maternal programming of embryonic development. *Cell Tissue Res*. 2016;363(1):237-247. doi:10.1007/s00441-015-2287-4

Recruitment, planning, fecundity

Joseph B. Stanford, MD, MSPH, CFMC

University of Utah School of Medicine

Speaker — Recruitment/Study Design Theme

Talking Points

- a) Rapid efficient screening and enrollment is essential to capture high fecundity planners in the preconceptional time frame. We and other researchers have done this by automating online screening followed by rapid contacting or immediate online enrollment, and additionally by offering value to women for the goal of conceiving (i.e., ways to identify the fertile window, pregnancy tests).^{1,2}
- b) To capture unplanned pregnancies, innovative approaches are needed. A tiered approach that enrolled women not planning pregnancy who were at relatively high probability of pregnancy resulted in data capture much earlier in the first trimester (part of the preconceptional window), as compared to first trimester enrollment in pregnancy. In the National Children's Study, this tiered approach was used with a direct household recruiting strategy, but it could also be used with other recruiting strategies.³
- c) Time to pregnancy, and fertility treatments, including any use of donor gametes, are correlated with perinatal and developmental outcomes, and should be considered essential data elements of the preconceptional exposome. These data elements can be assessed retrospectively as well as prospectively, with appropriate attention to the potential biases of retrospective assessment.^{4,5}

Research Gaps

- a) What are effective approaches to engage women and partners who are not planning pregnancy to have the opportunity for capturing periconception and early pregnancy, within diverse populations and sociocultural contexts?
- b) What are ways to improve retrospective assessment of time to pregnancy and fertility treatments?
- c) Of fertility-related treatments for subfecund couples that lead to live birth, which ones also improve perinatal and child developmental outcomes?

References

- 1) Porucznik CA, Cox KJ, Schliep KC, Wilkins DG, Stanford JB. The Home Observation of Periconceptional Exposures (HOPE) study, a prospective cohort: aims, design, recruitment and compliance. *Environ Health* 2016;15:67.
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Recruiting in the interpregnancy period

Roland Devlieger, MD, PhD

KU Leuven

Speaker – Recruitment/Study Design Theme

Talking Points

- a) The interpregnancy as a neglected window of opportunity.
- b) Problems with recruitment and retention in the interpregnancy period.
 - Long term weight management is not prioritized during a short (2 nights) maternity stay (recruitment).
 - Apprehension to the confrontation with own body and weight after delivery (recruitment-retention).
 - Very busy period for new parents in a country with relative short maternity leave (15 weeks) (retention).
- c) Actions to improve recruitment and retention in the interpregnancy period. Three suggestions for future recruitment/retention:
 - Recruit at the maternity ward (D1-2).
 - Combine e-health with face-to-face visits.
 - Offer home-visits, especially for vulnerable families.

Research Gaps

- a) Relation between interpregnancy weight change and metabolic outcome in subsequent children.
- b) Impact of interpregnancy lifestyle interventions on children's health.
- c) Optimal way to approach and retain postpartum women in clinical trials.

Key References

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Recruiting Black and African American women for preconception care research: The Gabby Preconception Care System

**Brian W. Jack, MD, MA, Clevanne Julce, MPH, PhD(c),
Nireesha Sidduri, MPH, Timothy Bickmore, PhD**

Boston University

Speaker – Recruitment/Study Design Theme

Talking Points

The Study. Preconception care (PC) provides an important opportunity to impact not only the health of a mother and her infant, but also the adult health of the next generation. How to effectively deliver such care is unknown. Creating tools to assist busy clinicians to deliver this care is a priority. Gabby conversational agent technology delivers a PC risk assessment that screens for more than 100 health risks and provides tailored advice about how to take action on the risks over 12 months through subsequent interactions. We conducted an RCT to examine the impact of the Gabby on PC risks in a sample of 528 African American (AA) and Black women. Gabby resulted in a 16% increase in the reported rate of PC risks, reaching the action or maintenance stages of the transtheoretical model compared with a control group. These changes were maintained at 12 months. Gabby has the potential to improve women's PC. Gabby's scalability has implications for improving the delivery of PC as an adjunct to clinical practice or as a population-level health tool.

- a) **Recruitment.** We recruited women via recruitment advertisements from the websites ResearchMatch.org, ClinicalTrials.gov, NewsExpo, Bulletin Board, and Craigslist; referrals from enrolled participants; Boston Medical Center clinical data warehouse; **Healthy Start Association** meetings; and via fliers sent to universities and community organizations, such as neighborhood action networks, churches, local health centers, libraries, and hair salons. Recruitment materials targeted AA/Black women, highlighted eligibility, and provided an overview of the intervention.
- b) **Enrollment.** Potential participants were asked to contact the research staff by email to schedule an enrollment telephone call, during which participants were assessed for eligibility criteria: self-reported to be African American or Black, or both; aged 18–34 years; currently not pregnant; have computer and internet access; and able to understand written and spoken English. Research staff explained the study purpose, risks, and benefits. Each potential participant was asked three questions to confirm their understanding of the consent form. Verbal consent was then collected.
- c) **Outcome of this Recruitment Strategy.** Over 40 months, 528 women were recruited from 35 states and 242 cities. The participants were a mean age of 27 years, 407 (77%) of 528 were a student or worked full time or part time, 465 (88%) of 528 attended some post-secondary school, 141 (42%) of 333 reported having been pregnant at least once, 503 (95%) of 527 used the internet to learn about health, and most had high health literacy, social support, and self-efficacy.

Recruitment Lessons Learned

- a) **Recruitment strategies facilitating enrollment.** (a) Intervention informed by focus groups of AA/Black women, (b) Intervention culturally tailored for AA/Black women, (c) Targeting communities with high population AA/Black women, (d) Online recruitment platforms (i.e., Craigslist and Research Match); and (e) Adding a text option as a way to contact research staff.
- b) **Factors resulting in recruitment of a study population with higher education, health literacy, and income.** (a) Required computer access, (b) Online recruitment, (c) Online intervention
- c) **Frequency of preconception outcomes.** (a) At recruitment, pregnancy intent was low (70 of 528), (b) At 12 months, pregnancy rate was low (23 of 528), (c) nine reporting their pregnancy was planned.

Key Recommendations

- a) Create culturally tailored interventions or platforms
- b) Online outreach especially social media
- c) Texting to contact staff about enrollment
- d) Research team staff that is reflective of the population recruited

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Generation R Next Study recruitment *Preconception and Embryonic Origins of Health and Disease*

Vincent Jaddoe, MD, PhD

Harvard T.H. Chan School of Public Health

Speaker — Recruitment/Study Design Theme

Main Talking Points

- a) Major recruitment challenges for preconception cohort studies
 - No routine contact moment for women who may become pregnant
 - Preconception counseling has been implemented, but low and selective response
 - Tendency for selection towards Dutch, higher educated (non-risk groups)
 - Discussion points when the study is designed
 - Homogenous vs heterogeneous population
 - Balance in response at baseline and follow up
 - Balance in budget for recruitment vs measurements
- b) Successful and unsuccessful recruitment strategies
 - Mailings to 250,000 addresses in Rotterdam
 - Advertising at bus stops, local TV and radio
 - Use the brand name Generation R (well known)
 - Advertise with ultrasounds
 - Collaboration with city partners
 - Social media
- c) Social media use
 - Mailings to 250,000 addresses in Rotterdam
 - Advertising at bus stops, local TV and radio
 - Use the brand name Generation R (well known)
 - Advertise with ultrasounds
 - Collaboration with city partners
 - Social media

Research Gaps

- a) Evidence for preconception vs very early-pregnancy as critical period
 - Identification of critical period for preventive strategies is needed, early pregnancy is much easier for recruitment than preconception
- b) Role of fathers
 - Fathers are often neglected, important to include them and collect data
- c) Early embryonic development
 - Embryonic development might be critical for establishing developmental trajectories of risk factors. Novel technologies enable detailed studies.

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The social role of fathers during the preconception period and impacts on children

Kirsten Davison, PhD, MS

Boston College School of Social Work

Speaker — Fathers Theme

Talking Points

- a) There is very little research on the effect of fathers' behaviors during the preconception period on children. Areas where there is some strength include — alcohol and tobacco use, men's mental health.
- b) Fathers' behaviors during the preconception period may influence child outcomes through the *social milieu*.
- c) There are a number of frameworks to guide research on fathers.
- d) GUTS Fathers & Families — one example of utilizing an existing cohort to look at the role of fathers during the preconception period.

Research Gaps

- a) Few studies on fathers and virtually no studies on fathers from priority populations.
- b) There are measurement gaps that need to be filled.
- c) Be ready to convince skeptical reviewers. The lack of measurement tailored to fathers makes the task of convincing reviewers even more difficult.

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Preconception epigenetic vulnerability of sperm to cannabis

Susan K. Murphy, PhD

Duke University Medical Center

Speaker – Fathers Theme

Talking Points

- a) Cannabis use is associated with sperm DNA methylation changes involving many genes implicated in autism and other neurodevelopmental disorders.^{1,2}
- b) The use of cannabis³ and tobacco products⁴ are associated with altered DNA methylation in sperm. Cannabis (THC) and tobacco (nicotine) are commonly co-used, but effects of co-use on sperm DNA methylation are unclear.
- c) Can drug-associated sperm DNA methylation alterations be mitigated by abstaining from use to allow for replenishing the altered sperm with unaffected sperm?

Research Gaps

- a) **Which methylation changes observed in sperm are transmitted intergenerationally?**
Postfertilization epigenetic reprogramming resets the majority of the epigenomic information derived from the sperm and egg, aside from imprinted loci and some repetitive elements. Yet there are other regions that resist this reprogramming, which offer the potential for transmission. What is the scope and identity of these regions? Does this differ between individuals? What provides their protection?
- b) **How stable are sperm DNA methylation profiles over time?**
The spermatogonia progenitor cells undergo asymmetric division to produce spermatocytes that become mature spermatozoa. While methylation patterns in the spermatogonia are passed on to the spermatocytes during cell division, there may be additional modifications that occur during the maturation process and there is a need to appropriately maintain the established patterns. What is the variability in intra-individual methylation profiles across the sperm population, and does this stay consistent over weeks? Months? Years? When does preconception start (Puberty? Months or days prior to conception?), and does this vary by exposure? Related to this question, are the spermatogonia vulnerable or is it the post-spermatogonial cell population that is most vulnerable?
- c) **Can we assess risk of transmission of epimutations from studies of the sperm population?**
Once heritability is established, it will be important to determine how epimutations are distributed across the sperm population within an individual. Epimutations might be universally present at the same locations in all sperm, but this is unlikely. It is more likely that subsets of sperm carry particular epimutations and that there will be different combinations of epimutations in each individual sperm cell. These distributions will be important to understand to better determine the potential transmission of risk to offspring.

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Preconception endocrine disrupting chemical exposures and children's health

Joseph Braun, PhD

Brown University School of Public Health

Speaker — *Physical and Chemical Exposures Theme*

Talking Points

- a) We need studies to examine “low hanging fruit” with potential “sledgehammer” effects to determine if preconception is a critical period of development.
- b) Studies of chemical exposures with modest or unknown effect sizes will need to have large samples to identify potential effects at the individual or population level and conduct serial sampling to identify periods of heightened susceptibility.
- c) Cohorts of couples seeking artificial reproductive therapy are one promising avenue to study preconception exposures and child health.

Research Gaps

- a) We lack compelling evidence that preconception chemical exposures impact children's health.
- b) The impact of father's chemical exposures on their child's health is largely unknown.
- c) It is unclear which periods of life before conception are most susceptible to chemical exposures in both mothers and fathers.

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Short- and long-term health effects of preconception air pollution exposure

Zhanghua Chen, PhD

University of Southern California Keck School of Medicine

Speaker — *Physical and Chemical Exposures Theme*

Talking Points

- a) Literature review about health effects of preconception air pollution
 - 1) PM_{2.5} exposure has been mostly studied
 - 2) Pregnancy loss and pregnancy complications
 - 3) Low birth weight and fetal growth restriction
- b) Study limitations
 - 1) Retrospective cohort study design
 - 2) Exposure assessment based on residential address of mother
 - 3) Statistical methods and covariates
- c) “Growth Trajectories and Air Pollution in infants and children” (GAAP) Study investigating the effect of preconception air pollution

Research Gaps

- a) Paternal preconception air pollution exposure effect
- b) Long-term health effect of preconception air pollution exposure
- c) Health disparities across sex, race/ethnicity, and SES subgroups.

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Reproductive immunology

Gil G. Mor, MD, PhD

Wayne State University School of Medicine

Speaker – Physical and Chemical Exposures Theme

Talking Points

- a) Basic concepts of immunology or pregnancy
- b) Misconceptions about the immunology of pregnancy
- c) The role of immune cells and inflammation in normal pregnancies
- d) Impact of Maternal immune activation on fetal development—insights from viral infections

Research Gaps

- a) Environmental factors inducing maternal inflammation
- b) Role of maternal inflammation on the development of the fetal immune system
- c) Implications of maternal inflammation on neonatal and adult health

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Preconception influences on child neurodevelopment: Focusing on parental childhood adversity to break the cycle of disadvantage

Christiane S. Duarte, PhD, MPH

Ruane Professor

Columbia University - New York State Psychiatric Institute

Speaker — *Psychosocial and Societal Influences Theme*

Talking Points

- a) Importance of focusing on *parental exposure to childhood adversities*, including those resulting from structural racism. The cycle of intergenerational transmission of adversity is particularly relevant for minoritized, marginalized populations.
- b) Mechanisms of transmission and protection related to parental exposure to childhood adversities can lead to solutions and have implications for interventions
- c) The experience of the Boricua Youth Study and the Avon Longitudinal Study of Parents and Children (ALSPAC). Could the next stage of ECHO include an intergenerational cohort capable of informing solutions to curtail the effects of parental childhood exposure to adversities?

Research Gaps

- a) Influence of childhood exposures that are prospectively assessed
- b) Focus on populations highly exposed to adversities
- c) Identification of solution-oriented protective factors and mechanisms: going beyond association studies of risk

Five Key References

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Psychosocial/societal influences: Maternal stress and resilience

Christine Dunkel Schetter, PhD

University of California Los Angeles

Speaker — *Psychosocial and Societal Influences Theme*

Talking Points

- a) Stressors, stress appraisals, and mental health conditions or symptoms (depression, anxiety) are not the same, and must be distinguished in studying psychosocial processes during preconception.
- b) Stress exposures are hard to modify. A focus on preconception resilience may be optimal, e.g., adaptive coping, family and community support.
- c) Maternal mental health conditions before, between, and during pregnancy have similar adverse effects to stress, and are a modifiable target.

Research Gaps

- a) **Resilience (or protective) factors** at multiple levels of analyses are missing in most research and need attention.
- b) Study of behavioral and biological mechanisms involved in effects of **preconception interventions** (or absence of effects) will help to understand what can be done earlier in the life cycle.
- c) **Strong psychological science** engagement in preconception and interconception studies is needed, not only at individual level or on mental health but with respect to social and cultural context.

Key References

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Preconception stress, mental health and substance use: Implications for child health

Alison E. Hipwell, PhD, MA, ClinPsyD

University of Pittsburgh

Speaker — Psychosocial and Societal Influences Theme

Talking Points

- a) Experimental animal studies provide compelling evidence for parental preconception effects of stress and substance abuse on offspring biology and behavior. Findings indicate that stress exposure leads to alterations in offspring stress physiology and brain development, increases in anxious and depressed-like behaviors, and reductions in social interactions. The specific risk and protective effects of preconception substance abuse on the next generation are less clear.
- b) Retrospective reports of psychosocial stress and mental health symptoms are problematic due to mood-congruent recall biases that also lack clinical and temporal specificity and are only moderately associated with prospective collected measures.
- c) Well-designed longitudinal human studies are few but growing in number. They generally provide convergent evidence for adverse effects of preconception psychosocial stress on birth and neonatal outcomes, and preliminary indications of negative effects of preconception stress and depression on regulatory systems in infancy. However, studies of the effects on child outcomes assessed beyond one year of age are more mixed and further research is warranted.

Research Gaps

- a) **Lifespan perspective:** We know that developmental history is important for an individual's health. However, we know little about the relevance for offspring health of proximal and distal influences in the preconception period or the accumulation of stress, mental health or substance use problems across the lifespan. By elucidating developmental progression and periods of vulnerability, adaptation and resilience, we could improve the timeliness and effectiveness of interventions designed to prevent future problems and optimize child health.
- b) **Stress phenotypes:** Research is needed that considers the timing, severity and duration of well-defined stressors together with biobehavioral indices of stress response (e.g., perceptions of stress/coping, physiological response and recovery, adaptation) that will advance our understanding of preconception stress phenotypes and inform targets for intervention.
- c) **Buffers, protective factors:** Given that many stressors are chronic, unpredictable or intractable, increasing knowledge of modifiable protective factors (e.g., psychosocial resources, building community, health screening and education) has especially high relevance for clinical translation and for improving the health of future generations.

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Early childhood adversity

Renée Boynton-Jarrett, MD, ScD

Boston University School of Medicine

Speaker — Psychosocial and Societal Influences Theme

Talking Points

- a) Early childhood adversities are associated with pubertal development, reproductive health conditions, fertility, birth outcomes and health risk behaviors that contribute to intergenerational child health.
- b) Exploring the severity, chronicity, developmental timing, type and accumulation of adversity is important to understanding mechanisms of risk, just as an investigation of resilience factors and positive childhood experiences informs understanding of risk mitigation.
- c) Research on early life adversities incompletely considers the broader social ecology—structural racism, structural inequities and social forces—that influences patterns of risk. Additionally, a limited group of early life adversities are commonly measured and race-based trauma is often inconsistently considered.

Research Gaps

- a) Although the prevalence of early life adversity is high across all demographic groups in the US, members of populations that are socially marginalized due to race/ethnicity, socioeconomic status, sexuality, immigration status experience a disproportionate burden of risk. There is limited research on structural factors and social forces that contribute to these inequities.
- b) There is an opportunity to broaden our understanding and measurement of structural racism. Existing measures of structural racism are limited and few have been conceptualized with the perspectives of those who experience a disproportionate impact.
- c) Community members most significantly impacted by health inequities, such as women of color, are rarely involved in establishing research priorities, designing study methods, or conceptualization of measures. Participatory research methods, citizen science, solutions-focused and strengths-oriented research and leadership development pathways for diverse researchers in training can be expanded.

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SPEAKER AND DISCUSSANT BIOS



Renée Boynton-Jarrett, MD, ScD

Boston University School of Medicine

Speaker — Psychosocial and Societal Influences Theme

Renée Boynton-Jarrett, a pediatrician and social epidemiologist, is an associate professor at Boston Medical Center and Boston University School of Medicine. She is the founding director of the Vital Village Networks. Vital Village uses a trauma-informed lens to improve community capacity to promote child wellbeing and advance equity through dedicated collaborative partnerships, research, data-sharing, and community leadership development in Boston and nationally through the NOW Forum and CRADLE Lab. Her scholarship has focused on early-life adversities as life course social determinants of health. She has a specific concentration on psychosocial stress and neuroendocrine and reproductive health outcomes, including obesity, puberty, and fertility. Community attributes that impact health and resilience and structural factors that influence these patterns is a focus of her work. She received her AB from Princeton University, her MD from Yale School of Medicine, and ScD in Social Epidemiology from Harvard School of Public Health, and completed residency in Pediatrics at Johns Hopkins Hospital.



Joseph Braun, PhD

Brown University School of Public Health

Speaker — Physical and Chemical Exposures Theme

Dr. Braun is an Associate Professor in the Department of Epidemiology at the Brown University School of Public Health. For 15 years, he has been committed to identifying modifiable risk factors of pediatric diseases in order to improve public health. Working with an interdisciplinary team, he studies the health effects of environmental pollutant exposures before conception and during gestation, infancy, childhood, and adolescence. Dr. Braun's research foci include endocrine disrupting chemicals, toxic metals, obesity, cardiometabolic health, and pediatric neurodevelopmental disorders. His research group applies advanced biostatistical techniques to longitudinal cohort studies (HOME, MIREC, and PEACE) in order to quantify the health effects of chemical mixtures and identify periods of heightened susceptibility to chemical exposures. Dr. Braun was formerly a school nurse in Milwaukee, Wis., before receiving his master's and doctoral degrees in Epidemiology from the University of North Carolina at Chapel Hill. He completed postdoctoral training in environmental health at the Harvard School of Public Health.



Kecia N. Carroll, MD, MPH

Vanderbilt University Medical Center

Discussant — Psychosocial and Societal Influences Theme

Dr. Carroll is an Associate Professor of Pediatrics in the Division of General Pediatrics at the Vanderbilt University Medical Center. As an epidemiologist, she centers her research around prenatal and early life exposures on childhood asthma and respiratory disease. Dr. Carroll investigates how maternal dietary exposures during pregnancy influence the development of early childhood respiratory and atopic diseases by using administrative databases and cohort studies. She attended medical school at the Vanderbilt University School of Medicine, completed a residency at the University of California, San Francisco, and a General Academic Pediatrics Research Fellowship at the Vanderbilt University Medical Center.



Patrick Catalano, MD

Tufts University School of Medicine, Tufts Medical Center

Discussant — Lifestyle Factors/Obesity Theme

Dr. Catalano is Professor of Obstetrics and Gynecology at the Mother Infant and Research Institute of Tufts University School of Medicine. He is also Chair Emeritus of the Department of Reproductive Biology at Case Western Reserve University/MetroHealth Medical Center. His research includes the longitudinal evaluation of women before, during, and after pregnancy to determine the short- and long-term effects of maternal obesity and diabetes on both the mother and her offspring. He is a member of several professional organizations including the American College of Obstetrics and Gynecology, Society of Maternal-Fetal Medicine, Society for Reproductive Investigation, American Diabetes Association, and the Perinatal Research Society. He was also the previous Chair of the American Diabetes Association Council on Pregnancy and Women's Health. His awards include the Norbert Freinkel Award from the American Diabetes Association, the Jorgen Pedersen Award from the Diabetes in Pregnancy Study Group of the European Association for the Study of Diabetes, and the Agnes Higgins Award for contributions to maternal-fetal nutrition from the March of Dimes. He earned his MD from the College of Medicine at the University of Vermont.



Zhanghua Chen, PhD

University of Southern California Keck School of Medicine

Speaker — Physical and Chemical Exposures Theme

Dr. Chen is Assistant Professor of Preventive Medicine at the Keck School of Medicine at the University of Southern California. She is an environmental epidemiologist and biostatistician with multidisciplinary expertise in environmental health, biostatistics, epidemiology, clinical medicine, obesity and diabetes pathophysiology, genomics, metabolomics, and data science. She has a strong track record in environmental health research with particular interests in the health effects of early-life environmental exposures in children and adults, the epidemiology of diabetes and obesity, and methods of multi-omics studies. Dr. Chen is establishing a novel research area in environmental epidemiology by leveraging the advanced metabolomics and multi-omics approaches. She is the principal investigator on the NIEHS-supported K99/R00 Pathway to Independence Award: "Metabolomic Signatures Linking Air Pollution, Obesity and Diabetes." She has also published many papers in well-received medical journals such as *Diabetes Care* and *American Journal of Respiratory and Critical Care Medicine*. Her accomplishments in environmental health research have received wide media attention from national and international news agencies, including Reuters and Xinhua News Agency.



Kirsten Davison, PhD, MS

Boston College School of Social Work

Speaker — Fathers Theme

Dr. Davison is the Donahue and DiFelice Endowed Chair and Associate Dean for Research in the School of Social Work at Boston College. Following the completion of her PhD in Human Development and Families Studies at Penn State University, Dr. Davison held faculty appointments at SUNY Albany (2003–2011) and Harvard T.H. Chan School of Public Health (2011–2019) before joining the faculty at Boston College in July 2019. Dr. Davison leads an extramurally funded research program focused on parenting and child health outcomes, with a particular focus on underserved families in a domestic setting. Funded by the National Institutes of Health, current studies include a randomized controlled trial testing the efficacy of a childhood obesity preventive intervention for low-income families implemented in Head Start, a cohort study examining links between sleep and growth in children from birth to 2 years, and a national study examining the role of fathers in childhood obesity prevention. Beyond her research, Dr. Davison has led transdisciplinary postgraduate training programs including the Public Health Nutrition doctoral program and the Cancer Prevention and Control fellowship program at Harvard.



Roland Devlieger, MD, PhD

KU Leuven

Speaker — Recruitment/Study Design Theme

Roland Devlieger holds an academic position at the KU Leuven as associate professor. He is the head of the division of maternal-fetal medicine within the department of Obstetrics and Gynecology, University Hospitals Leuven, Belgium. His research focus is mainly clinical and translational and focuses on obesity and pregnancy, reproduction after bariatric surgery, and fetal medicine and surgery. He is Senior Clinical Researcher for the Flemish research fund, FWO Flanders, Belgium and member of the board of directors from the International Society for Prenatal Diagnosis (ISPD). He is a founding member of the Fetal Care Academy and board member of BASO (Belgian association for the study of obesity). His current H-factor is 30 with a total of 2672 citations (without self-citations) from 252 peer-reviewed publications.



Christiane S. Duarte, PhD, MPH

Columbia University

Speaker — Psychosocial and Societal Influences Theme

Dr. Duarte is a Professor in the Division of Child and Adolescent Psychiatry, Columbia University - New York State Psychiatric Institute. Dr. Duarte's research is based on innovative population-based studies about the development of mental disorders in children, adolescents and young adults. Through the use of state-of-the-art sampling, recruitment, and culturally appropriate assessment methodologies, she has sought to generate knowledge of relevance to diverse, often underserved and understudied populations. Currently, she is a leader of the Boricua Youth Study, the only multi-national source of information about how mental disorders develop from childhood to young adulthood in a Latino subgroup (Puerto Ricans). Dr. Duarte's work has received support from the Brain and Behavior Research Foundation (formerly NARSAD), the Robert Wood Johnson Foundation (RWJF) and the U.S. National Institute of Health (NIDA, NIMH, NIAAA and NICHD). She is also a key member in several international collaborations in global mental health focused on how to improve child mental health services and implement interventions in low-resource settings. She has published several articles in psychiatric, psychological, public health, and pediatric journals.



Christine Dunkel Schetter, PhD

University of California Los Angeles

Speaker — Psychosocial and Societal Influences Theme

Dr. Dunkel Schetter is a Distinguished Professor of Psychology and Psychiatry at the University of California, Los Angeles. She is Director of the NIMH pre- and postdoctoral training program in Biobehavioral Issues in Mental and Physical Health, and Co-Chair of the Health Psychology PhD program. She received her PhD from Northwestern University and completed postdoctoral training at the University of California, Berkeley. Her broad research expertise is in stress, coping and social support in a variety of health and mental health contexts. She has studied social relationships and adjustment to cancer, coping with stress and social support in middle-aged couples, psychological adjustment to infertility, genetic screening for cystic fibrosis, and adjustment to HIV/AIDS.



Tom Fleming, PhD, BSc

University of Southampton

Speaker — Lifestyle Factors/Obesity Theme

Dr. Fleming is Emeritus Professor of Developmental Biology within Biological Sciences at the University of Southampton. He previously served as Senior Lecturer and Reader in Biology at the university. Prior to joining the University of Southampton, he was Senior Research Associate in the Anatomy Department at the University of Cambridge and Demonstrator at the University of Keele. He earned his PhD in cell biology at the University of London and his BSc in zoology from the University of Wales in Swansea.



Keith Godfrey, FRCP, PhD

University of Southampton

Speaker — Lifestyle Factors/Obesity Theme

Dr. Godfrey is Director of the current National Institute of Health Research (NIHR) Southampton Biomedical Research Centre in nutrition. He is a Professor of Epidemiology and Human Development at the University of Southampton, Director of the Centre for Developmental Origins of Health and Disease, and Honorary Consultant within University Hospital Southampton NHS Foundation Trust. Professor Godfrey also serves as Trustee of the UK-registered charity, the International Society for the Developmental Origins of Health and Disease. His research is defining measures to improve the early growth and development of children, thereby improving their lifelong health.



Michael Golding, PhD

Texas A&M University

Discussant — Fathers Theme

Dr. Golding is tenured Associate Professor in the Department of Veterinary Physiology at Texas A&M University, where he serves as the director of two courses studying human embryology and the physiological events of pregnancy. His research is focused at the interface between pregnancy and epigenetics, trying to understand how environmental exposures before conception or early in development cause disease later in life. Dr. Golding is associate editor for the scientific journal *Environmental Epigenetics* and has served on multiple NIH, NSF, and CIHR study sections examining epigenetics and developmental programming. His research program is focused on defining biochemical mechanisms of epigenetic inheritance, determining how these processes are influenced by exposure to toxicants, and the capacity of these heritable changes to cause birth defects and disease, and contribute to the development of fetal alcohol spectrum disorders (FASDs). Currently, his research is focused on understanding how male drinking, prior to conception, contributes to the development of alcohol-induced birth defects and disease.



Lynn Goldman, MD, MS, MPH

George Washington University Milken Institute of Public Health

Discussant — Physical and Chemical Exposures Theme

Dr. Goldman is the Michael and Lori Milken Dean and Professor of Environmental and Occupational Health at the Milken Institute School of Public Health at the George Washington University. Formerly the Assistant Administrator for Toxic Substances at the U.S. Environmental Protection Agency, she is a renowned expert in pediatric environmental health and chemicals and pesticides policy. She has engaged in translating research to policy through writing policy analyses and via Congressional testimony in service of successful efforts by Congress to achieve passage of reforms both to federal pesticide law (the 1996 Food Quality Protection Act) and federal chemicals law (the 2016 Lautenberg Chemical Safety Act for the 21st Century) as well as legislation to establish California's Childhood Lead Poisoning Prevention Program. She was previously Professor of Environmental Health Sciences at the Johns Hopkins University Bloomberg School of Public Health and Chief of the Division of Environmental and Occupational Disease Control at the California Department of Public Health. Dr. Goldman holds a BS and MS from the University of California at Berkeley, an MD from the University of California at San Francisco; an MPH from Johns Hopkins University; and completed pediatric residency training at the UCSF Benioff Children's Hospital in Oakland. She is a member of the National Academy of Medicine (NAM) and has received several awards including the NAM Walsh McDermott Award for service to the academy, Heinz Award for Global Environmental Change, and the American Public Health Association Environment Section's Homer M. Calver Award.



Elizabeth E. Hatch, PhD

Boston University School of Public Health

Speaker — Lifestyle Factors/Obesity Theme

Dr. Hatch is a Professor of Epidemiology at the Boston University School of Public Health. She is also a member of the Boston Nutrition Obesity Research Center at Boston University. Dr. Hatch's areas of research include fertility and pregnancy outcomes, reproductive health, childhood obesity, and women's cancer research. Currently, Dr. Hatch is leading a research study to evaluate factors related to fertility, miscarriage, and adverse pregnancy outcomes in Denmark. She has been the principal investigator for various NIH-funded grants focused on reproductive health, and her research has been published in several scholarly journals.



Alison E. Hipwell, PhD, MA, ClinPsyD

University of Pittsburgh

Speaker — Psychosocial and Societal Influences Theme

Dr. Hipwell is Professor of Psychiatry and Psychology at the University of Pittsburgh. Her research focuses Dr Hipwell's program of research integrates multi-level and multidisciplinary developmental models to understand precursors and biobehavioral mechanisms of maternal peripartum mental health and their relevance for intergenerational transmission. For the past 19 years, Dr Hipwell has been integrally involved in the scientific direction of the longitudinal Pittsburgh Girls Study (PGS, MH056630; DA012237; JF-FX-0058), which has documented the type, timing and chronicity of life stress exposures (e.g., adversity, trauma, experiences of discrimination and racism) among 2,450 girls followed from childhood to young adulthood. She has also led/co-led multiple studies focused on prenatal and postpartum health and infant developmental outcomes (e.g., Preconception stress exposure: Implications for offspring neurodevelopment, OD023244; Preconception and prenatal stress effects on cardiovascular disease risk in Black women, HL157787; Parsing the heterogeneity of neural functioning in postpartum depression, HD067185; Postpartum psychopathology and teenage mothers, MH071790; Improving maternal and child health through prenatal fatty acid supplementation, HD084586; Impact of maternal caregiving on brain-behavior relationships in infants MH115466).



Brian W. Jack, MD, MA

Boston University School of Medicine, Boston Medical Center

Speaker — Recruitment/Study Design Theme

Dr. Jack is a Professor at the Department of Family Medicine and the Director of the Center for Health System Design & Implementation at the Boston University School of Medicine and Boston Medical Center. He is also the Director of the Lesotho Boston Health Alliance, and is a founder of the AAFP's Center for International Initiatives. Dr. Jack's research interests include preconception health, family medicine, and patient safety. He has been published in over 130 medical journals, peer reviewed articles, papers, and book chapters. Dr. Jack is also the principal investigator for several grant projects funded by PCORI, the HRSA, MIMHD, AHRQ, and NHLBI.



Chandra Jackson, PhD, MS

National Institute of Environmental Health Sciences (NIEHS), National Institute on Minority Health and health Disparities (NIMHD)

Discussant — Lifestyle Factors/Obesity Theme

Dr. Jackson is an Earl Stadtman Investigator who leads the Social and Environmental Determinants of Health Equity Research group in the Epidemiology Branch of the National Institute of Environmental Health Sciences (NIEHS), with an appointment in the National Institute on Minority Health and Health Disparities (NIMHD). She investigates physical and social environmental factors that impact disparities in sleep health and subsequent cardiometabolic dysfunction. Dr. Jackson researches the social and biological factors of sleep and cardiovascular health by race, ethnicity, and socioeconomic status. Her research has been presented at national and international scientific conferences, and has been published in several academic journals and major media outlets.



Vincent Jaddoe, MD, PhD

Harvard T.H. Chan School of Public Health

Speaker — Recruitment/Study Design Theme

Dr. Jaddoe is a pediatrician and Professor of Pediatric Epidemiology at the Harvard T.H. Chan School of Public Health. He is Principal Investigator of the Generation R Study, a population-based prospective cohort study among 10,000 pregnant women and their children in Rotterdam, The Netherlands. His research is focused on three main themes: maternal and fetal health, fetal and infant programming of common childhood diseases, and genetics and epigenetics of common childhood diseases. The general aim of his research is to explore how genetic variants and environmental exposures lead to maternal gestational complications, fetal and childhood developmental adaptation mechanisms, and risk factors for common diseases. Specific interest is in the identification of early critical periods and mechanisms leading to risk factors for diseases in later life. Main diseases of interest include cardiovascular disease, type 2 diabetes, obesity and respiratory diseases. Genetic association studies are embedded in the Early Growth Genetics (EGG) Consortium and Early Growth & Longitudinal Epidemiology (EAGLE) Consortium, in which various birth cohorts (>30,000 subjects) combine

their genome-wide association studies efforts.



Erin LeBlanc, MD, MPH

Kaiser Permanente Center for Health Research

Speaker — Lifestyle Factors/Obesity Theme

Dr. LeBlanc is an epidemiologist and board-certified adult endocrinologist at the Kaiser Permanente Center for Health Research. Her research focuses on conditions that affect women, including menopause, obesity, osteoporosis, diabetes, and vitamin D deficiency. Currently she leads the Prepare study, which is examining the effects of a pre-pregnancy weight loss program. She led the D2d study, a multicenter study examining the effects of vitamin D on diabetes risk, as well as a study examining risk factors associated with fractures among people taking bisphosphonates. She was a co-investigator on De Por Vida, which is examining the effects of a weight loss intervention in Hispanics with diabetes or prediabetes. In 2011, Dr. LeBlanc led two systematic evidence reviews on obesity to support the U.S. Preventive Services Task Force. She also served as the Principal Investigator for the Women's Health Initiative study, which examined heart disease, cancer, and osteoporosis in postmenopausal women. Dr. LeBlanc came to CHR in 2009 from Oregon Health & Science University. She graduated cum laude from the Yale University School of Medicine. Following her internal medicine residency at Stanford University and before joining OHSU, she completed fellowships in women's health and endocrinology at the Portland VA Medical Center and OHSU, where she remains an affiliate assistant professor of endocrinology.



Germaine Buck Louis, PhD, MS

George Mason University

Discussant — Recruitment/Study Design Theme

Dr. Louis is the Dean of the College of Health and Human Services at George Mason University. She was previously the Director for the Division of Intramural Population Health Research at the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD), National Institutes of Health. This position was preceded by her role as a tenured professor in the Department of Social and Preventive Medicine, University of Buffalo, School of Medicine and Biomedical Sciences, where she taught in both the graduate and medical schools. She is an internationally recognized reproductive and perinatal epidemiologist whose expertise focuses on environmental influences on human fecundity and fertility. Her research has focused on a mixture of environmental exposures, including endocrine disrupting chemicals, stress and lifestyle in relation to a spectrum of reproductive outcomes in both men and women. During her career, she served as Principal Investigator for original extramural and intramural research totaling more than \$53 million. She has served as the President of the Society for Pediatric and Perinatal Epidemiologic Research, President of the Society for Epidemiologic Research, and Councilor for the International Society for Environmental Epidemiology.



Gil G. Mor, MD, PhD

Wayne State University School of Medicine

Speaker — Physical and Chemical Exposures Theme

Dr. Mor is the Scientific Director and Vice Chair of Research for the C.S. Mott Center for Human Growth and Development at the Wayne State University School of Medicine, where he is a Professor of Obstetrics and Gynecology. He is a member of the American Association for Cancer Research, the Society for Gynecologic Investigation, and the American Society of Reproductive Immunology. Dr. Mor's research examines the immunology of pregnancy, and the role of inflammation in cancer formation and progression. His research has been published over 300 times, and he is an editor of several educational books focused on pregnancy and immunology.



Susan K. Murphy, PhD

Duke University

Speaker — Fathers Theme

Dr. Murphy is Associate Professor in Obstetrics and Gynecology at the Duke University School of Medicine. Her research interests are largely centered around epigenetics and the role of epigenetic modifications in health and disease. Her research projects include studies of gynecologic malignancies, including working on approaches to target ovarian cancer cells that survive chemotherapy and later give rise to recurrent disease. Her projects investigate the nature of the Developmental Origins of Health and Disease (DOHaD) hypothesis, which reflects the idea that early environment plays an important part in shaping risks of developing neurodevelopmental disorders or other chronic health problems. She is currently focused on preconception exposures in males with studies of the impact of cannabis use on the sperm epigenome and heritability of these effects. Her lab is also working on the effects of in utero exposures, with their primary work revolving around the Newborn Epigenetics Study (NEST), a mother-infant dyad cohort recruited from central North Carolina between 2005 and 2011 and whom they have followed since early pregnancy.



Shane Norris, PhD

University of the Witwatersrand

Discussant — Recruitment/Study Design Theme

Shane Norris is a Research Professor within the Department of Paediatrics at the University of the Witwatersrand, Johannesburg, South Africa. Shane is the Director of the South African Medical Research Council's Developmental Pathways for Health Research Unit (DPHRU), and Director of the South African Department of Science and Technology and National Research Council's Centre of Excellence in Human Development (CoE-HUMAN). He is an elected Fellow of the Academy of Science of South Africa, and President of the Africa Chapter of the International Society of Developmental Origins of Health and Disease. Shane's research expertise is in lifecourse nutrition and epidemiology.



Lucilla Poston, CBE, PhD

King's College London

Discussant — Lifestyle Factors/Obesity Theme

Professor Poston is Tommy's Charity Professor of Maternal & Fetal Health at King's College London and Director of the Tommy's Maternal & Fetal Research Unit based at St. Thomas' Hospital. She is the Research Lead for King's Health Partners' Institute of Women and Children's Health and leads a large multidisciplinary research team which investigates disorders of pregnancy including premature birth, pre-eclampsia and the complications arising from maternal obesity. Her own research focuses on maternal nutrition, obesity and gestational diabetes, with a focus on the early life origins of health and disease. Professor Poston is President of the International Society for Developmental Origins of Health and Disease, an Honorary Fellow of the Royal College of Obstetricians and Gynaecologists (FRCOG), and was elected Fellow of the Academy of Medical Sciences in 2009. She was appointed NIHR Senior Investigator, Emeritus in 2017, having succeeded twice in open competition. In the same year, she was awarded a Commander of the Order of the British Empire (CBE) for services to Women's Health.



Enrique Schisterman, PhD, MS

University of Pennsylvania Perelman School of Medicine

Discussant — Recruitment/Study Design Theme

Dr. Schisterman is Chair of the Department of Biostatistics, Epidemiology and Informatics at the Perelman School of Medicine at the University of Pennsylvania. Dr. Schisterman, whose expertise bridges biostatistics and epidemiology, is a national leader in epidemiological methods and reproductive epidemiology. He previously served as senior investigator and Epidemiology Branch Chief in the Division of Intramural Population Health Research in the Eunice Kennedy Shriver National Institute of Child Health & Human Development at the National Institutes of Health. At the NIH, he completed the BioCycle Study, a prospective observational study to assess the relationships between endogenous hormones and biomarkers of oxidative stress and other biomarkers across the menstrual cycle. He also designed and completed important randomized trials for low-cost interventions to improve fertility in couples, including the Effects of Aspirin on Gestation and Reproduction Trial and the Folic Acid and Zinc Supplementation Trial. He is Editor in Chief of the American Journal of Epidemiology, and has served as editor for multiple journals. He earned his BA in statistics at Haifa University and both his master's degree in statistics and his PhD in epidemiology from the State University of New York, Buffalo. He completed his postdoctoral training in the Department of Epidemiology at the Harvard School of Public Health in 2000.



Joseph B. Stanford, MD, MSPH, CFCMC

University of Utah

Speaker — Recruitment/Study Design Theme

Dr. Stanford of the University of Utah focuses his practice on restorative reproductive medicine (natural procreative technology) for infertility, miscarriage, and treating women's health conditions without using artificial hormones. He also has a particular interest in polycystic ovarian syndrome, endometriosis, premenstrual syndrome, natural family planning and menopause. He is a certified FertilityCare Medical Consultant through the American Academy of FertilityCare Professionals. He received his medical degree from the University of Minnesota Medical School and completed residency training in family medicine and a master's degree in public health at the University of Missouri-Columbia. He is board certified in family medicine, and a Fellow of the American Academy of Family Physicians.



Shanna Swan, PhD

Icahn School of Medicine at Mount Sinai

Discussant — Fathers Theme

Dr. Swan has worked for over twenty-five years to understand the threats posed by chemicals to our environment and our health, and, when necessary, to develop new paradigms to assess their risks. Of most concern to Dr. Swan are the chemicals that our bodies can confuse with its own hormones (the "endocrine disrupting" chemicals). At the Icahn School of Medicine at Mount Sinai, Department of Environmental Medicine and Public Health, Dr. Swan is working with a wide range of collaborators, including epidemiologists, biostatisticians, toxicologists, geneticists and systems biologists, to conduct studies and develop methods to evaluate the risks from such chemicals—methods that are sensitive enough to tease out the often subtle health effects of complex mixtures.



Leonardo Trasande, MD, MPP

New York University College of Global Public Health

Discussant — Physical and Chemical Exposures Theme

Dr. Trasande, Professor of Pediatrics at NYU Langone Health, is an internationally renowned leader in children's environmental health. His research focuses on identifying the role of environmental exposures in childhood obesity and cardiovascular risks, and documenting the economic costs for policymakers of failing to prevent diseases of environmental origin in children proactively. He also holds appointments in the Wagner School of Public Service and NYU's College of Global Public Health. He is perhaps best known for a series of studies published in *Lancet Diabetes and Endocrinology* and the *Journal of Clinical Endocrinology and Metabolism* that document disease costs due to endocrine disrupting chemicals in the U.S. and Europe. Dr. Trasande leads one of 35 centers across the country as part of the National Institute of Health's Environmental Influences on Child Health Outcomes (ECHO) Program. He is leveraging the NYU Children's Health and Environment Study, as well as another birth cohort, to examine phthalates, bisphenols, organophosphate pesticides and polycyclic aromatic hydrocarbons and their effects on fetal and postnatal growth and early cardiovascular and renal risks. He has served as a member of numerous scientific committees and expert panels, including the American Academy of Pediatrics' Executive Committee of the Council for Environmental Health; the Science and Technical Advisory Committee for the World Trade Center Health Program; and the National Children's Study Methodological Review Panel of the National Academy of Sciences. After receiving his bachelor, medical, and public policy degrees from Harvard, he completed the Boston Combined Residency in Pediatrics and a legislative fellowship in the Office of Senator Hillary Rodham Clinton.



Sarah Verbiest, PhD, MSW, MPH

University of North Carolina at Chapel Hill School of Social Work, School of Medicine

Discussant — Psychosocial and Societal Influences Theme

Dr. Verbiest is the Director of the Jordan Institute for Families at the University of North Carolina at Chapel Hill School of Social Work, and is the Executive Director of the Collaborative for Maternal and Infant Health at the UNC School of Medicine. She also leads the national NC Preconception Health and Health Care Initiative, is a steering committee member for the HRSA MCHB Lifecourse Intervention Research Network, and is a Principal Investigator of the Maternal Health Learning and Innovation Center. Dr. Verbiest's research focuses on preconception health, maternal and child health, preterm birth prevention, and family care. She has led many successful research efforts, including being a co-investigator of the Re-engineering Postnatal Unit Care project, Transition Home to Reduce Perinatal Morbidity, and Mortality MIECHV Early Home Visiting Needs Assessment projects. Dr. Verbiest's research has been published in several maternal, child health, and behavioral journals.

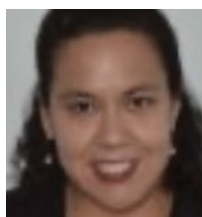
NIH BIOS



Matthew W. Gillman, MD, SM

Office of the Director, National Institutes of Health (NIH)

Dr. Gillman, MD, SM joined the National Institutes of Health on July 5, 2016 as the director of the ECHO Program. Dr. Gillman joined NIH from Harvard Medical School where he was a professor of population medicine and a professor of nutrition at Harvard School of Public Health. His background is in the fields of epidemiology, pediatrics, and internal medicine. He has extensive experience with cohort studies, having served as an investigator on several large, high-profile studies such as Project Viva, the Growing Up Today Study, PROBIT, the Framingham Heart Study and the National Children's Study.



S. Sonia Arteaga, PhD

Office of the Director, National Institutes of Health (NIH)

Dr. S. Sonia Arteaga, is a Supervisory Health Scientist Administrator in the Environmental influences on Child Health Outcomes (ECHO) Program at the National Institutes of Health. She joined the ECHO Program in 2019 and leads a team of Program Officers that oversees the ECHO Program, is the Program lead for ECHO's Opportunity Infrastructure Fund, and manages a diverse portfolio of grants focusing on obesity and environmental influences on children's health. Prior to joining ECHO, Dr. Arteaga was at the National Heart, Lung, and Blood Institute where she led several research initiatives, including the Healthy Communities Study, a large observational study in 130 diverse communities and over 5000 children and their families to assess the characteristics of programs and policies and their associations with BMI, diet, and physical activity in children. She was also the NHLBI lead for the Lifestyle Interventions for Expectant Moms (LIFE-Moms) consortium which targeted appropriate gestational weight gain among women with overweight and obesity. Dr. Arteaga is a member of the Senior Leadership Group of the NIH Obesity Research Task Force and provides leadership on the development and coordination of obesity research efforts across the NIH. Dr. Arteaga is also a member of the National Collaborative on Childhood Obesity Research and works with other federal agencies to further childhood obesity research. Dr. Arteaga received her Ph.D. in psychology from the University of Maryland Baltimore County.



Drew Bremer, MD, PhD

Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD)

Dr. Andrew A. Bremer joined the National Institutes of Health (NIH) as a Medical Officer in November 2013 within the National Institute of Diabetes and Digestive and Kidney Diseases' Division of Diabetes, Endocrinology, and Metabolic Diseases, and was appointed in May 2018 to be the Chief of the Pediatric Growth and Nutrition Branch within the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD). His areas of research include pediatric and adult endocrine disorders, maternal diet and gestational obesity, the impact of the intrauterine environment on long-term maternal and child health outcomes, and childhood obesity. He is also the Acting Chief of the Pregnancy and Perinatology Branch at NICHD and the Program Official for NICHD's Neonatal Research Network, Maternal-Fetal Medicine Units Network, and Global Network for Women's and Children's Health Research. Dr. Bremer is a Co-Chair on the National Collaborative on Childhood Obesity Research Steering Committee, and the NIH Liaison to the American Academy of Pediatrics' Committee on Nutrition and Section on Obesity.



Kimberly Gray, PhD

National Institute of Environmental Health Science (NIEHS)

Dr. Gray is an epidemiologist with training in maternal child health, neuroscience and environmental health. As a Program Director within the Population Health Branch, Extramural Research and Training at NIEHS, she oversees research related to pediatric epidemiology including early life exposures that influence children's neurological health and well-being. Kimberly directs the former NIEHS and EPA Children's Environmental Health Centers, NIEHS Environmental Epidemiology Cohort Maintenance and Resource, and the new NIEHS Collaborative Centers in Children's Environmental Health Research and Translation. She is a scientific member of the NIEHS WHO Collaborative Centre among the Children's Environmental Health focus area, the NIH Pediatric Research Consortium led by NICHD and the NIEHS liaison to the ECHO trans-NIH working group.



Christina Park, PhD

Office of the Director, National Institutes of Health (NIH)

Dr. Park is an epidemiologist trained in environmental epidemiology at the Johns Hopkins School of Public Health. She serves as Program Officer for the Environmental influence on Child Health Outcomes (ECHO) program. In addition to overseeing a number of cohort grants, she serves as a data lead within the ECHO program office and contribute to a number of program areas including protocol development, implementation and evaluation, data collection and management, and promotion of team science practices. Dr. Park's research interests include maternal and child health outcomes, and health services research related to health disparity issues. She has contributed to the development and implementation of the National Children's Study (NCS) Vanguard Study at NICHD.



Erica L. Spotts, PhD

Office of Behavioral and Social Sciences Research (OBSSR)

Dr. Erica L. Spotts is a Health Scientist Administrator for the Office of Behavioral and Social Sciences Research (OBSSR) at the National Institutes of Health. In that role, she supports the OBSSR mission to enhance the impact of health-related behavioral and social sciences research, coordinate and integrate these sciences within the larger NIH research enterprise, and communicate health-related behavioral and social sciences research findings. Dr. Spotts previously served in the Division of Behavioral and Social Research at the National Institute on Aging (NIA). Dr. Spotts' research interests focus on the interplay of interpersonal relationships, mental health, and genetic factors in adolescence and adulthood. At the NIH, she has focused on promoting research that integrates behavioral, social and genetic sciences. More recently, Dr. Spotts has been organizing OBSSR's Training Committee, which has the mission of identifying and addressing training needs in the behavioral and social science community both within and outside of the NIH.

NIH PLANNING GROUP

Matthew W. Gillman, MD, SM (ECHO/OD), Workshop Chair

S. Sonia Arteaga, PhD (ECHO/OD), Workshop Co-Chair

Carol Blaisdell, MD, Med (ECHO/OD)

Andrew Bremer, MD, PhD (NICHD)

Kimberly Gray, PhD (NIEHS)

Manjit Hanspal, PhD (ECHO/OD)

Susan Laessig, PhD (ECHO/OD)

Erin Luetkemeier, PhD (ECHO/OD)

Somdat Mahabir, PhD, MPH (NCI)

Christina Park, PhD (ECHO/OD)

Erica L. Spotts, PhD (OBSSR)

Leslie Thompson, PhD (ECHO/OD)

Alkis Togias, MD (NIAID)