Online Proceedings

POSTER SESSION 1

Commons West, Easel 38

11:00 AM to 1:00 PM

Diarrheal Illness during Pregnancy and its Effects on Birth Outcomes in Nepalese Mothers

Katie Jean (Katie) Gustafson, Senior, Biology (Physiology)
Mary Gates Scholar
Mentor: Helen Chu, Allergy & Infectious Diseases
Mentor: Kira Newman

Globally, poor and underserved countries tend to have an elevated incidence of infectious disease, often contributing to increased mortality rates. One health issue resulting from this is diarrhea, the 6th leading cause of mortality in developing countries. Because pregnant women are already vulnerable to infections due to an immune system that is rapidly adapting to a developing fetus, they may be more susceptible to diarrhea and the complications that come with it. We sought to identify whether diarrhea during pregnancy was associated with adverse birth outcomes, such as preterm birth and being small for gestational age. We used data from a prospective longitudinal study of maternal influenza immunization of pregnant women and their infants conducted in rural Nepal from 2011-2014. Diarrhea episodes were defined as three or more watery bowel movements per day for one or more days. The chi-square test, two-sample t-test, and log-binomial regression were performed to evaluate baseline characteristics and the association between diarrhea during pregnancy and adverse birth outcomes. From our study, we found that average weight and BMI at enrollment for women with diarrhea was significantly lower than those without diarrhea during pregnancy (47.6kg vs. 48.5kg, p=0.01, 20.72 BMI vs 21.06 BMI, p=0.01) and women with diarrhea during pregnancy were significantly more likely to have small for gestational age infants (42.6% vs. 36.8%, p=0.03). We also found that the incidence of non-live birth, preterm, and low birth weight did not significantly differ between mothers with and without diarrhea. By understanding the risks diarrhea during pregnancy poses for both mothers and infants, we can assess the severity of this problem, and whether or not a possible means of prevention should be prioritized. Further research should examine whether methods to improve weight and BMI during pregnancy prevents diarrheal illness and thus negative birth outcomes.

POSTER SESSION 1

MGH 258, Easel 181

11:00 AM to 1:00 PM

Gut Bacterial Bile Acid Metabolism Modulates Homeostatic Enteric Nervous System Signaling

Sean Timothy Koester, Senior, Biology (Physiology)
Mentor: Neelendu Dey, Medicine

We previously observed that turmeric could be used to manipulate gut motility in a microbiome-dependent-bile acid-mediated manner via the enteric nervous system (ENS). Bile acids comprise a class of metabolites synthesized by the host and modified by gut microbes. Bacterial bile salt hydrolases (BSH) are responsible for deconjugation, the first step in bile acid metabolism for generation of secondary bile acids. We hypothesized that homeostatic ENS signaling is dependent upon gut bacterial bile acid metabolism. To test this hypothesis, we colonized wild-type gnotobiotic mice with different defined consortia varying in BSH activity and subjected them to a two-week low-fat diet $\pm$ turmeric. As a control, one treatment group remained germ-free. mRNA isolated from small intestine and colon was subjected to gene expression profiling returning counts of 68 target genes, including ENS-specific genes, and 7 housekeeping controls. A machine learning algorithm was deployed to identify genes whose expressions were most impactful in discriminating between treatment groups. Glp2r and VIP were highly discriminatory with respect to BSH activity. Enteric neurons express Glp2r, activate the mTORC1 pathway in response to GLP-2, and modulate intestinal epithelial cell growth. We found that Glp2r expression was significantly greater in mice harboring consortia with BSH activity than in germ-free mice. GLP-2 induces VIP neurotransmission from enteric neurons. Indeed, VIP expression is correlated with Glp2r expression. These data suggest that gut bacterial bile acid metabolism regulates homeostatic ENS signaling, with implications for gut motility and colorectal carcinogenesis.

POSTER SESSION 1

Commons West, Easel 43

11:00 AM to 1:00 PM

Reliability of Goniometer Measurements to Determine Ankle Dorsiflexion: Implications for Assessment of Gastrocnemius Equinus

Cristina Gildee, Senior, Anthropology: Medical Anth & Global Hlth, Anthropology: Human Evolutionary Biology, Anthropology: Archaeological Sciences
Mentor: Patricia Kramer, Anthropology
Mentor: Elen Feuerriegel, Anthropology

Ankle range of motion (ROM) is frequently measured in clinical settings for the purpose of diagnosing and treating foot and ankle pathologies. Gastrocnemius equinus (GE), a condition in which isolated gastrocnemius contracture inhibits ankle ROM, contributing to foot pain in otherwise neurologically healthy individuals. Controversy surrounds the definition of GE, however, and the reliability of goniometer-based measurements of dorsiflexion—and consequently identification of gastrocnemius contracture—is untested. This study examines the reliability of using a goniometer to measure ankle dorsiflexion. Two observers (KR and CG) measured ankle dorsiflexion in 14 neurologically healthy individuals (6M/8F; ages 20-56 years; 6 participants measured by both observers) with the knee in fully-extended and flexed positions. Three measurements were taken for each position with the goniometer fulcrum on the lateral malleolus; stationary and moving arms aligned with the fibular head and fifth metatarsal, respectively. Inter- and intra-observer reliability was assessed using Cronbach's alpha. Intra-observer Cronbach's alpha was 0.230 (CG) and 0.533 (KR) for dorsiflexion with the knee extended, and 0.805 (CG) and -0.350 (KR) for dorsiflexion with the knee flexed. Inter-observer Cronbach's alpha was 0.656 for extension and -0.245 for flexion. Little correlation exists within or between observers for goniometer-based ankle dorsiflexion measurements in either a flexed-knee or extended-knee position. The clinically-accepted practice of using a goniometer to determine ankle ROM, and consequently to diagnose and treat GE, may be unreliable and needs further evaluation.

POSTER SESSION 4

Commons East, Easel 1

4:00 PM to 6:00 PM

A 3D Geometric Morphometric Analysis of *Homo naledi* Distal Humeri

Ashlee Breedlove, Junior, Anthropology: Archaeological Sciences
Mentor: Ben Marwick, Anthropology
Mentor: Elen Feuerriegel, Anthropology

Homo naledi is a species of hominin that lived in South Africa at between 335-236 ka, around the same time that anatomically modern humans were evolving in Africa. While the lower limb of *Homo naledi* shares many characteristics indicative of obligate bipedality with modern humans, the upper limb shows a more primitive morphology related to climbing. The distal humerus is one of the more common bony elements found in the fossil record and its morphology directly reflects the functional requirements of the limb, making it a good place to study upper limb function and adaptation. Using 3D geometric morphometrics, we compared seven distal humeri attributed to *Homo naledi* with distal humeri from great apes, modern humans, Neandertals, and other extinct hominins to place *H. naledi* in a functional context. We conducted a principal components analysis and partial least squares analysis on anatomical landmark data to investigate variation in distal humeral shape. Preliminary results indicate that *H. naledi* had a distal humeral morphology broadly similar to gorillas and unlike modern humans. Our results provide new insights into the upper limb mechanics and the role of climbing in the locomotion of *Homo naledi*, as well as clarify their phylogenetic relationship with other hominins.

POSTER SESSION 4

Balcony, Easel 113

4:00 PM to 6:00 PM

Using Small Molecule Stimulators to Enhance Proteasome Activity and Delay Progression of Cellular Symptoms of Alzheimer's in a Model Organism

Arash Nikjoo, Senior, Biology (Molecular, Cellular & Developmental), English
Mentor: Matt Kaeberlein, Pathology
Mentor: Elena Vayndorf

Alzheimer's is a progressive, age-associated, neurodegenerative disease characterized by memory loss, deterioration in thinking and reasoning skills and gradual loss of executive function. Two well-documented biochemical hallmarks associated with disease progression are the accumulation of extracellular beta-amyloid (Aβ) plaques and intracellular neurofibrillary tangles found in the brains of Alzheimer's patients. One theory of the disease holds that aggregated proteins found in these two deposits inhibit protein degradation by the 26S proteasome, a large protein that is one of the central components of the ubiquitin-proteasome clearance system. This system, of which the proteasome is a key component, executes most of the controlled protein degradation in the cell. Importantly, impairments in proteasome function are associated with multiple neurodegenerative diseases. The overall goal of this project is to determine whether proteasome stimulators can delay toxicity associated with Aβ aggregation in a C. elegans Alzheimer's disease model. C. elegans is a powerful model organism in biomedical research due to its ease of culturing, well-described genetics, gene homology and availability of transgenic tools. My project utilizes a C. elegans strain that expresses the full-length human amyloid beta peptide (A$\beta_1 - 42$) in body wall muscle cells.

These animals become paralyzed when up-shifted to a restricted temperature due to aggregation of Aβ proteins in the muscle. To test the hypothesis that proteasome stimulators delay the progression of Alzheimer's symptoms, I will treat animals with four drugs and measure the time of paralysis. Using a high-throughput drug screening system recently developed in our lab, I will treat animals with four proteasome stimulators or vehicle controls, in triplicate, and determine the onset of paralysis for each drug. These results will help shed light on the involvement of protein aggregation clearance in treating symptoms of Alzheimer's in this model organism, and help inform future treatments for this and other neurodegenerative disorders.