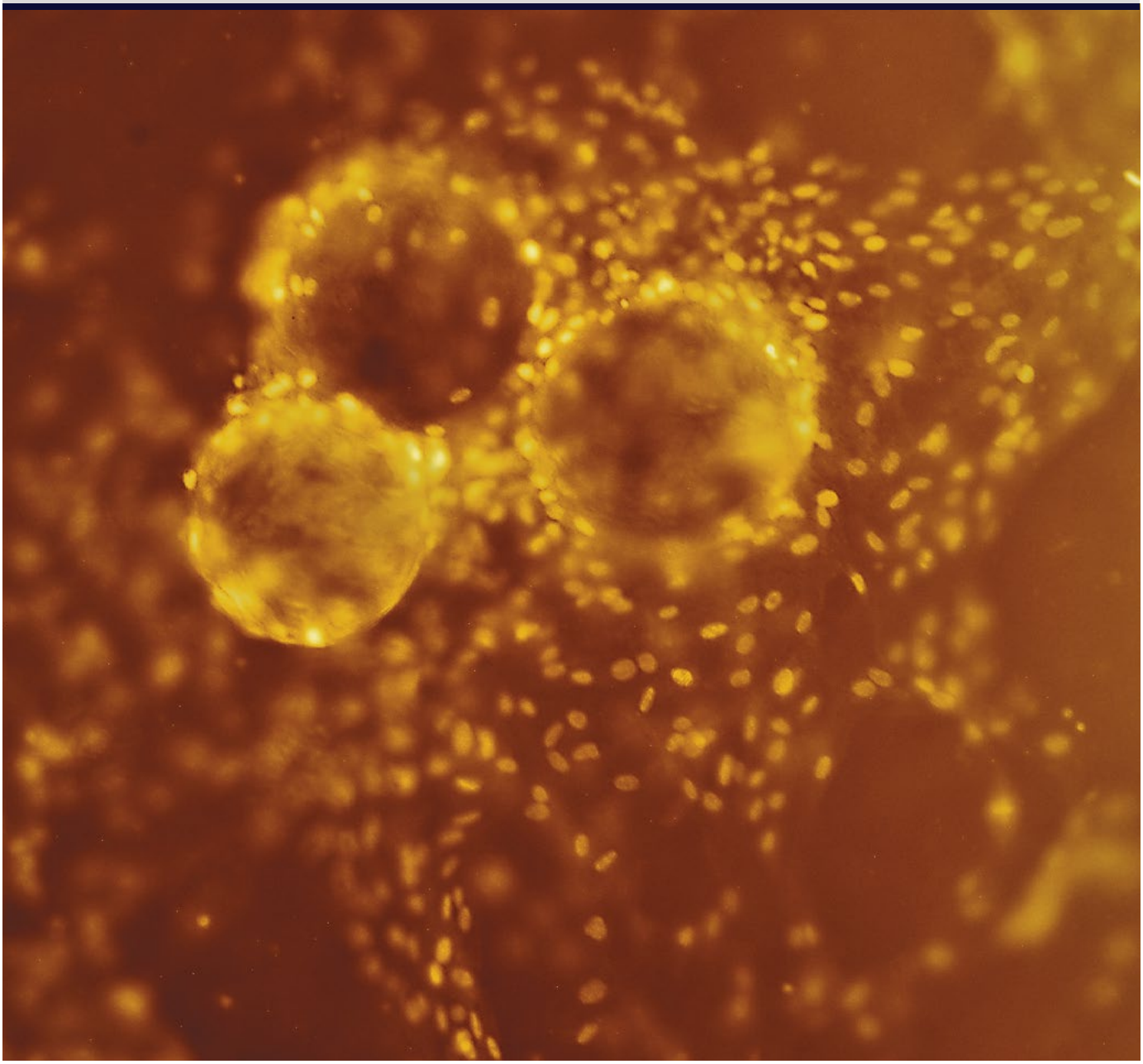
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN | DIVISION OF NUTRITIONAL SCIENCES

2019 Nutrition Symposium

N·S·G·S·A Nutritional Sciences Graduate Student Association



ILLINOIS
Nutritional Sciences
COLLEGE OF AGRICULTURAL, CONSUMER
& ENVIRONMENTAL SCIENCES

APRIL 17, 2019

Welcome

On behalf of the Nutritional Sciences Graduate Student Association (NSGSA), the Division of Nutritional Sciences (DNS), and all participating presenters, we would like to welcome you to the 2019 Nutrition Symposium at the University of Illinois! The Nutrition Symposium is an important event for sharing ideas across disciplines and with the community.

Started in 1994 by NSGSA, the symposium offers students within DNS and related disciplines on campus an opportunity to present their nutrition research prior to the national meetings held annually in the spring. This symposium offers a first glance at exciting research in the areas of metabolic regulation, cancer, gastrointestinal physiology, immunology, physical activity, public health, and bioactive plant compounds. Students will be traveling and presenting at a variety of conferences, including the American Society for Nutrition Annual Meeting, American Society of Animal Sciences Joint Annual Meeting, and Experimental Biology.

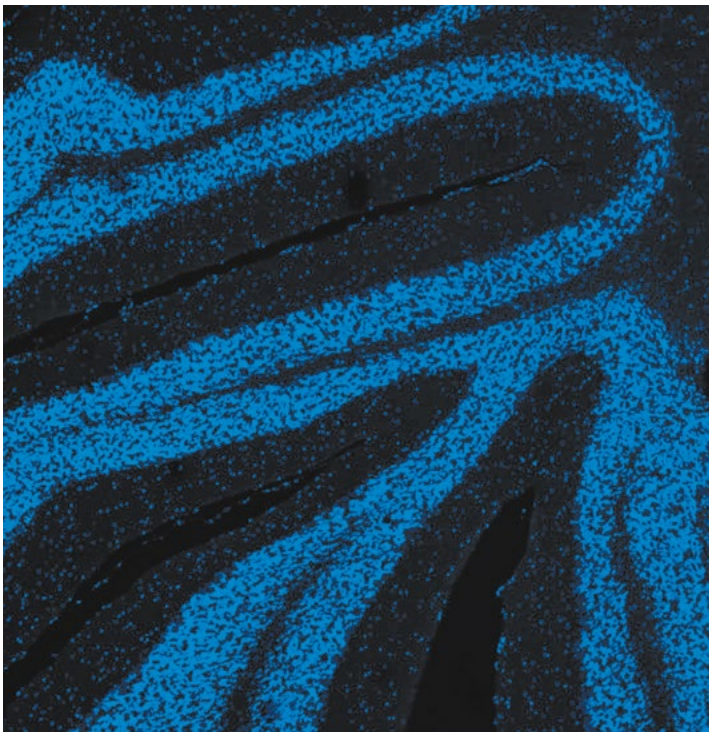
This year, NSGSA is honored to have Dr. Corby K. Martin deliver the keynote address, "Challenges in measuring food intake, energy balance, and dietary adherence: The quest for clinically relevant solutions." Dr. Martin will discuss the novel technologies that have been developed and implemented in his laboratory to accurately quantify energy intake and measure dietary adherence to clinical trials.

Additionally, NSGSA is proud to highlight the work of world-class faculty members through a mini-symposium. This year's presentations highlight the field of nutritional neuroscience, and will feature Drs. Naiman Khan, Nu-Chu Liang, and Ryan Dilger.

We are grateful to the many people involved with this meeting and program. We would like to first thank our keynote speaker, Dr. Corky K. Martin. Thank you to our sponsors – their support is essential to the success and quality of the program. The NSGSA executive board and the symposium program committee have worked long and hard to organize an excellent program. Most of all, we would like to thank our session chairs, judges, presenters and attendees for participating in this year's events and making them a success.

The Nutritional Sciences Graduate Student Association Steering Committee

http://www.nutritionalsciences.illinois.edu



(Cover image) Collaboration across disciplines has allowed us to investigate the how the tumor microenvironment influences malignant behavior of glioblastoma, the most common and deadly primary brain tumor in adults. Working with Dr. Brendan Harley and Emily Chen in the Department of Chemical and Biomolecular Engineering, we have observed how glioblastoma cells invade through three dimensional cell culture platforms in hypoxic conditions. By seeding cells on collagen-coated dextran beads, we can investigate how aspects of the tumor microenvironment, as well as targeted genetic alterations, influence invasive behavior. Submitted by Jan Lumibao.

(Left) Mouse brain tissue slice stained with DAPI and imaged using LSM 700 confocal fluorescence-enabled microscope. Submitted by Jan Lumibao

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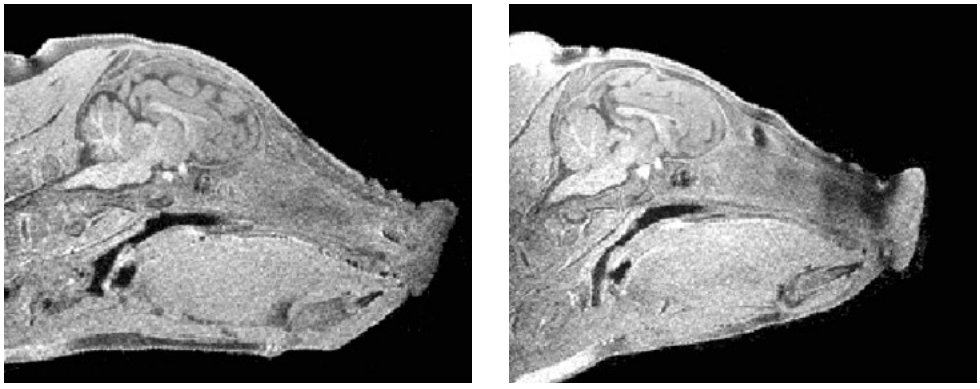

Neonatal Pig, Magnetization Prepared Rapid Acquisition Gradient Echo (MPRAGE), Piglet Nutrition and Cognition Laboratory, submitted by Joanne Fil

April 17, 2019

Schedule of Events

8:15 a.m. – 9:00 a.m. — **Breakfast**

Sims Executive Conference Room, ACES Library
Sponsors, presenters, DNS students, faculty, and staff are invited

***9:15 a.m. – 10:15 a.m.** — **Graduate Student Oral Presentations 1**

Monsanto Room, ACES Library
9:15 a.m. Katie Ranard
9:30 a.m. Hannah Bailey
9:45 a.m. Celeste Alexander
10:00 a.m. Sharon Thompson

10:15 a.m. – 10:30 a.m. — **Break**

***10:30 a.m. – 11:30 a.m.** — **Graduate Student Oral Presentations 2**

Monsanto Room, ACES Library
10:30 a.m. Bridget Hannon
10:45 a.m. Erin Davis
11:00 a.m. Caitlyn Edwards
11:15 a.m. Ashley Adams

11:35 a.m. – 11:55 p.m. — **Data Blitz Session**

Monsanto Room, ACES Library

12:00 a.m. – 1:00 p.m. — **Lunch**

Heritage Room, ACES Library
DNS students, presenters, and sponsors are invited, RSVP required

***1:00 p.m. – 2:30 p.m.** — **Faculty Mini-Symposium**

"Nutritional neuroscience: The brain-plate connection"
Monsanto Room, ACES Library
1:00 p.m. Naiman Khan, PhD, RD
1:30 p.m. Nu-Chu Liang, PhD
2:00 p.m. Ryan Dilger, PhD

2:30 p.m. – 2:45 p.m. — **Outstanding Faculty Award Presentation**

3:00 p.m. – 3:45 p.m. — **Industry Panel & Discussion**

Bevier Commons
Sponsors, presenters, DNS students, faculty, and staff are invited

***4:00 p.m. – 5:00 p.m.** — **Keynote Address by Dr. Corby K. Martin, Pennington Center for Biomedical Research**

180 Bevier Hall
"Challenges in measuring food intake, energy balance, and dietary adherence: The quest for clinically relevant solutions"

5:00 p.m. – 5:15 p.m. — **Break**

***5:15 p.m. – 6:40 p.m.** — **Graduate Student Poster Session**

Heritage Room, ACES Library
Evening Reception, Award Announcements
Sponsors, presenters, DNS students, faculty, and staff are invited

** Open to the general public*

Nutritional Sciences Graduate Student Association

The Nutritional Sciences Graduate Student Association (NSGSA) was founded in the spring of 1973 by students in the program. The purpose of the organization is to provide a means of communication among graduate students, faculty, and alumni of the Division of Nutritional Sciences (DNS) which spans multiple colleges and departments.

NSGSA serves as a forum for student opinion and input and gives students the opportunity to expand their experiences as graduate students. Our activities reflect our desire to enrich our experiences as graduate students and to promote the importance of the nutritional sciences discipline both within the university and among the surrounding communities of Champaign and Urbana.

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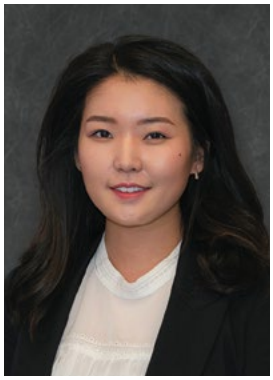
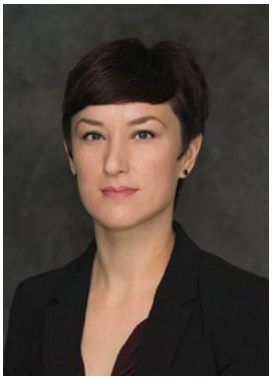


Mindy Lee
Media Chair



Sharon Thompson
Secretary

NSGSA Board photographs by Justin Kim

2019 Nutrition Symposium Committee

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Planning Committee

Planning Committee:
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Jan Lumibao
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Lindsey Ly
Colleen McKenna
Katherine Ranard
Sharon Thompson

Session Judges

Oral Session 1

Dr. Sayee Anaak
Dr. Naiman Khan
Dr. Michael Miller

Oral Session 2

Dr. Corby Martin
Dr. Melissa Prescott
Dr. Kelly Swanson

Poster Session

Dr. Jaume Amengual
Dr. Anna Arthur
Dr. John Erdman
Dr. Maria de Godoy
Dr. Juan Loor
Dr. Elvira de Mejia
Dr. Erik Nelson
Dr. Yuan-Xiang Pan
Dr. Hans Stein
Dr. Andrew Steelman
Dr. Marcia Siegel
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Nutritional Sciences Graduate Student Association

https://nutrsci.illinois.edu/students/gsa

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Graduate Student Oral Presentations Session 1

9:15 a.m. - 10:15 a.m.
Monsanto Room, ACES Library

Graduate Student Oral Presentations Session 2

10:30 a.m. – 11:30 a.m.
Monsanto Room, ACES Library

Data Blitz Session

11:35 p.m. – 11:55 p.m.
Monsanto Room, ACES Library

Faculty Mini-Symposium: *"Nutritional Neuroscience: The Brain-Plate Connection"*

1:00 p.m. – 2:30 p.m.
Monsanto Room, ACES Library

Graduate Student Poster Session

5:15 p.m. – 6:40 p.m.
Heritage Room, ACES Library

See poster session floor plan map on page 38.

Graduate Student Poster Session

Continued

Presenting Author Index

Winners of the 2018 University of Illinois Nutrition Symposium poster and oral competitions with keynote speaker, Dr. Thomas Seyfried. Photo by L. Brian Stauffer.

Symposium Contributers

The University of Illinois Division of Nutritional Sciences and the Nutritional Sciences Graduate Student Association would like to acknowledge the generosity of the sponsors and friends of our 2019 Nutrition Symposium.

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Department of Animal Sciences

Illinois Health Sciences Institute

University of Illinois
Department of Food Science
and Human Nutrition

Keynote Speaker

Dr. Corby K. Martin, PhD, FTOS

Dr. Martin is a Professor and Director of the Ingestive Behavior, Weight Management, & Health Promotion Laboratory at Pennington Biomedical Research Center, which is part of the Louisiana State University System. Dr. Martin also Directs the Human Phenotyping Core of the Center's National Institutes of Health funded Nutrition Obesity Research Center (NORC). Dr. Martin completed his undergraduate degree and a Master's degree in psychology at Eastern Washington University and his doctorate in Clinical Psychology at Louisiana State University. Dr. Martin then completed his Predoctoral Internship as well as a Post-doctoral fellowship at the Medical University of South Carolina. Since the completion of his fellowship in 2002, Dr. Martin has been a faculty member at Pennington Biomedical Research Center. Dr. Martin has received various awards during his training and he was the recipient of the Lilly Scientific Achievement Award in 2013 and became a Fellow of The Obesity Society in 2015.

Dr. Martin's research program includes studying the effects of energy perturbation by under- and overeating, as well as via exercise, on physiological, behavioral, and psychological endpoints. He has extensive experience conducting interventions to modify food intake, exercise, and body weight, and his research includes the application of technology to monitor and modify participants' behavior through mobile health (mHealth) interventions. He was part of a team that developed and validated mathematical models that predict body mass change over time in response to dieting and overfeeding, and these models were used to quantify adherence to energy intake prescriptions. The team incorporated this approach into clinic-based and mHealth weight management interventions, including SmartLoss®, a weight loss intervention that is remotely delivered via internet-connected devices (e.g., smartphones, tablets, computers), and SmartMoms®, a weight management program to promote recommended levels of gestational weight gain among pregnant women. His laboratory also assesses food intake in cafeteria settings via images of food selection and plate waste, and he and his team developed and validated the Remote Food Photography Method© and SmartIntake® smartphone app to capture food intake data in near real-time in participants' natural environment. More recently, Dr. Martin and his colleagues developed a smartphone app called FoodImage that measures the food waste of individuals and households, and that app is currently being evaluated in a United States Department of Agriculture-funded project. Finally, with his colleagues, he is developing an app to automatically provide feedback to people about their portion size, food intake, and dietary adherence in real time

FOODIMAGE

"Challenges in measuring food intake, energy balance, and dietary adherence: The quest for clinically relevant solutions"

It is exceeding challenging to obtain reliable and valid measurements of human food intake in free-living conditions. Self-report methods rely on the ability of the participant to accurately recall the types and portion sizes of foods consumed, and the accuracy of these methods have been questioned. Importantly, ~50% of the error in self-report methods is due to participants' inability to accurately estimate portion size, and we found that participants' estimates remain inaccurate even after extensive training. These and other data indicate that methods that rely on a participant to estimate portion size, at least without visual aids, are extremely unlikely to achieve the level of accuracy necessary to conduct nutrition research and to inform dietary change. Further, these methods are not suitable for use over the long term as user burden is high and participants fail to consistently track intake over the long term. Recent advances have helped address these limitation, however, including food photography and mathematical modeling of energy balance.

When using the Remote Food Photography Method® (RFPM) and SmartIntake® smartphone app, participants capture images of their food selection and plate waste with the SmartIntake app. The user identifies foods that are not easily identified by containers by typing a food description into a text box. The food images and associated data are automatically sent in real time to Pennington Biomedical Research Center's server, where they are analyzed to estimate energy and nutrient intake. To facilitate data quality and completeness, the SmartIntake® app includes Ecological Momentary Assessment (EMA) methodology to remind participants to capture food images. Additionally, when participants cannot capture images of their foods, a back-up method is used and participants enter these data into the app. The food images are analyzed by the PBRC team using validated visual comparison procedures and the method results in accurate estimates of the food selection, plate waste, and food intake of adults. For infants, the method accurately quantifies powdered formula intake and intake of liquids via baby bottles. Finally, the method provides accurate meal level data for young children, though error is higher and significant when the intake of children is assessed over one week.

The RFPM and SmartIntake methods have since been adapted to develop an app called FoodImage™, which quantifies the food waste of individuals and households and is being evaluated in a USDA-funded project. Finally, a new app, PortionSize™, will be discussed that offers the ability to provide users with immediate feedback about their food intake and dietary adherence, while also providing the accuracy of the RFPM.

Food photography provides a novel solution to measure food intake and provides researchers and clinicians with near real time data. This greatly facilitates the delivery of dietary interventions, as objective real time food intake data are obtained, which provides a framework for nearly instantaneous participant feedback. Nonetheless, the methods are not suitable to utilize continuously for the length of time (months or years) needed to obtain accurate measures of dietary adherence during dietary interventions. To solve this problem, we partnered with collaborators to develop and validate energy balance models that predict body weight change over time based on the size of an energy surplus (for weight gain) or energy deficit (for weight loss). The models can be used to quantify dietary adherence using weight change nomograms, and can also be used to determine average energy intake over long periods of time based on observed body weight. This work culminated in the development of unique and effective mobile health weight management interventions that can be delivered via smartphone, including SmartLoss®, as well as SmartMoms®, which is a weight management program to promote recommended levels of gestational weight gain among pregnant women. Through our clinical research, we have found that pairing the complementary methods of food photography and energy balance modeling significantly enhances our clinical research by: 1) allowing us to accurately measure energy and nutrient intake at given points in time with food photography, 2) allowing us to objectively quantify dietary adherence over the long term with energy balance models, and 3) leveraging the objective and real time food photography data to drive dietary adherence.

Dr. Martin's's Keynote Address
4:00 – 5:00 p.m.
180 Bevier Hall

Faculty Mini-Symposium:
"Nutritional Neuroscience: The Brain-Plate Connection"

Abstracts and Biographies

Retinal carotenoids: A nutritional window into brain and cognition

Naiman Khan, PhD, RD

Department of Kinesiology and Community Health, Division of Nutritional Sciences, University of Illinois at Urbana-Champaign, Urbana, IL

ABSTRACT: Identification of foods and nutrients that promote human cognitive function and brain health has the potential to have a lasting impact on quality of life for all populations. However, a perpetual challenge in the field of nutritional neuroscience has been the limited knowledge of specific dietary components with the sensitivity to both dietary consumption and cognitive function. Given that the human retina is formed embryonically from neural tissue and is integrated into the neural system via the optic nerve, structural aspects of brain tissue may also be reflected in the retina. Recent findings from our laboratory and others have demonstrated that retinal nerve fiber layer thickness is predictive of intellectual abilities and cognitive function and is subject to the deleterious effects of aging and metabolic risk. Additionally, the macular of the retina preferentially accumulates dietary carotenoids. Specifically, lutein not only contributes to retinal carotenoids, but also disproportionately accumulates in the human brain across all cortices. Macular Pigment Optical Density (MPOD), a non-invasive measure of retinal carotenoids and proxy of brain lutein, has been associated with neuroprotective effects on cognition in older adults. Recent findings from our laboratory have extended the importance of retinal carotenoids to cognitive function among persons with Multiple Sclerosis. Further, we have demonstrated, using both cross-sectional and intervention approaches, that lutein intake promotes attentional abilities, neuroelectric function, and memory among preadolescent children. On-going work in our laboratory is examining the links between retinal morphometric measures and pigmentation to determine the nature of the relationship between diet, retinal health, and cognitive function across the lifespan and among clinical populations.

BIOGRAPHY: Dr. Khan's research has taken a multidisciplinary approach to integrate knowledge in the disciplines of nutrition and cognitive neuroscience to understand the influence of foods and nutrients on specific aspects of attention, memory, and achievement. He has appointments in the units of Kinesiology and Community Health, Nutritional Sciences, Neuroscience, and the Family Resiliency Center at the University of Illinois at Urbana-Champaign. He has extensive training and research experience in nutritional science, body composition, and cognitive neuroscience. His work has focused on the relation of health behaviors of nutrition and physical activity and their physiological correlates of adiposity and aerobic fitness on measures of brain function and cognitive health. On-going research trials in his laboratory include randomized-controlled trials testing the efficacy of acute and long-term physical activity and nutrition interventions for improving cognitive control and relational memory. Specifically, Dr. Khan is interested in elucidating the influence of dietary lutein, retinal pigments, and neuropsychological function. The overarching objective of his research program is to generate foundational knowledge in nutritional neuroscience by translating the impact of health behaviors to cognitive function and brain health.

Dietary choice and exercise in rats: a pathway to understand mechanisms underlying sex differences in the development of obesity

Nu-Chu Liang, PhD

Department of Psychology, Division of Nutritional Sciences, University of Illinois at Urbana-Champaign, Urbana, IL

ABSTRACT: The difference between energy intake and expenditure dictates how body weight changes: prolonged caloric intake exceeding energy expenditure can lead to obesity whereas the reverse is associated with life-threatening emaciation. Habitual moderate to high levels of exercise can not only facilitate maintenance of healthy body weight, but also decrease over-consumption of highly palatable, energy dense foods. Voluntary wheel running in rats provides a good model to investigate neurobiological mechanisms underlying how exercise affects dietary choice and body weight. To this end, our laboratory have established a model of wheel running with simultaneous ad libitum access to a high carbohydrate chow verse a high fat (HF) diet. We have demonstrated that wheel running can significantly reduce the intake of the HF diet to the extent of complete avoidance. More than 60% of male rats maintain this running-induced HF diet avoidance for longer than 2 weeks of the two-diet choice feeding regimen whereas only less than 30% of females show such persistent HF diet avoidance. Gonadectomy in male rats does not change the persistency of running-induced HF diet avoidance. By contrast, both estrogen and progesterone are involved in the increase of HF diet intake and subsequent development of HF diet preference during running. When the simultaneous running and two-diet choice schedule continues for more than 5 weeks, male, but not female, running rats weigh less than their sedentary controls. Thus, the lack of persistent reduction in HF diet intake and preference likely contributes to the resistance to the weight reduction effect of exercise that is observed in both women and female rodents. Future research will utilize the two-diet choice paradigm to investigate how exercise and differences in HF diet preference contribute to sex differences in diet-induced obesity and subsequent development of type 2 diabetes.

BIOGRAPHY: Dr. Liang received her bachelor degree in Psychology and master degree in Physiology in Taiwan. She studied neural pathways of taste and its hedonic effects during her graduate study at the Pennsylvania State University. After receiving a PhD in Neuroscience, she performed postdoctoral research on using rodent models to understand mechanisms by which exercise contributes to anorexia nervosa and obesity at the Johns Hopkins Medical Institute. In addition to the dietary choice and exercise project, the Liang laboratory at UIUC has developed rat models of alcohol and cannabis co-exposure and received funding from NIDA to study how co-use of the two drugs impact the brain and behaviors. The future research focus is to understand how inappropriate ingestive behaviors, e.g., aberrant eating and drug use, impact metabolic and cognitive function.

Perinatal nutrition and the gut-brain axis

Ryan Dilger, PhD

Department of Animal Sciences, Division of Nutritional Sciences, University of Illinois at Urbana-Champaign, Urbana, IL

ABSTRACT: There exists a need to better understand complex interrelationships between dietary intake and cognitive function, and animal models are critically important in this endeavor. The field of nutritional neuroscience has, as a primary goal, the application of findings to the human clinical setting, and therefore, models that closely mimic the human condition are highly valued. Thus, based on similarities in patterns of brain development and structure, the pig has emerged as a biomedical and preclinical model for studying human brain development and cognitive function. Building upon the storied history of using the neonatal pig as a research model for studying pediatric nutrition and metabolism, recent emphasis has been placed on understanding how signaling mechanisms in the gut, being largely synonymous with microbial interactions, influence neurodevelopment and brain function. As a precocial species, the young pig can be artificially-reared with relative ease, thus providing strict control over dietary intake. Moreover, validated methods to assess learning and memory using behavioral assays now exist, and these outcomes provide a powerful and integrated view of how nutrition influences brain development. Sensitive neuroimaging sequences are also available, and along with cellular and molecular techniques optimized for the pig, there exists a fruitful area to generate new knowledge of how early-life nutrition influences neurodevelopmental processes. As such, nutritional strategies to alter the delivery of specific components to the brain, or influence the microbial composition or production of bioactive compounds in the gastrointestinal tract, are currently being tested. There are many advantages to extending the field of pediatric nutrition research by integrating outcomes related to the microbiome, routes of information transfer between the gut and brain, and processes associated with cognitive function and brain development, and the young pig will play a pivotal role in these investigations.

BIOGRAPHY: Dr. Ryan Dilger is an Associate Professor in Animal Sciences and his lab studies the interaction of nutrition, health, and neuroscience using pig and chicken models. He received his B.S and M.S degrees at Purdue University, and completed his Ph.D. and post-doctoral training here at the University of Illinois. Overall, his research projects can be broadly categorized into two areas: 1) practical nutrition and health issues facing production animal agriculture, and 2) fundamental nutrition and developmental questions studied using the pig as a translational model to improve human health and well-being. Dr. Dilger has published 81 peer-reviewed articles and generated over $14 million in research funding since starting on faculty in 2010.

Graduate Student Oral Session Abstracts

Oral Session 1

Judges: Michael Miller, Naiman Khan, Sayee Anaak

α-Tocopherol restriction dysregulates neurogenesis-related gene expression in brains of weanling α-tocopherol transfer protein knockout mice

Katherine M. Ranard[1], Matthew J. Kuchan[2], John W. Erdman, Jr[1,3]

[1]Division of Nutritional Sciences, University of Illinois at Urbana-Champaign, Urbana, IL; [2]Abbott Nutrition, Columbus, OH, [3]Department of Food Science and Human Nutrition, University of Illinois at Urbana-Champaign, Urbana, IL

INTRODUCTION: Humans with vitamin E (α-tocopherol, αT) deficiency develop neurological disorders. Similarly, α-tocopherol transfer protein knockout ($Ttpa^{-/-}$) mice have low vitamin E status and exhibit neurodegeneration with age. Shifts in the transcriptome may precede behavioral manifestations of vitamin E deficiency, but it is unknown how early abnormalities occur. Aberrations during brain development could have lifelong implications. The objective of this study was to determine how αT restriction during early-life affects the expression of pre-selected neurogenesis-related genes in the cerebellum (CB) and cerebral cortex (CC) of $Ttpa^{-/-}$ weanlings.

METHODS: Female $Ttpa^{+/+}$ (n=9) and $Ttpa^{-/-}$ (n=10) mice were nursed by $Ttpa^{+/-}$ dams until postnatal day 21. Dams were fed AIN-93G diet (75 mg αT/kg diet) during days 1-9 of gestation, and αT-stripped diet for the rest of the study. Homogenized brain tissues from 21 day old weanlings were used to measure αT concentrations via HPLC-PDA. The expression of genes critical for brain development (Rora, Shh), myelination (Plp1, Cntnap1, Mbp, Mobp, Nr1h3), synaptic function (Cplx1, Cplx2, Vamp2, Necab1, Prkcg), and αT cellular uptake (Scarb1) were measured in the CB and CC via real-time qPCR.

RESULTS: αT levels were significantly decreased in brains of $Ttpa^{-/-}$ mice (0.1 ± 0.1 nmol/g) compared to $Ttpa^{+/+}$ mice (9.8 ± 1.4 nmol/g) ($P<0.001$), confirming their low αT status. Rora, Shh, Cntnap1, and Mbp were significantly upregulated ($P<0.05$) in both the CB and CC of $Ttpa^{-/-}$ mice, while several genes were only upregulated in one brain region (Plp1 in the CB, Mobp in the CC). Necab1 and Scarb1 were significantly downregulated in the CB of $Ttpa^{-/-}$ mice ($P<0.05$).

CONCLUSIONS: αT restriction during the fetal and postnatal periods alters the expression of neurogenesis-related genes. These findings support a role for αT in brain development.

Protein quality of animal products evaluated by the digestible indispensable amino acid score methodology

Hannah M. Bailey[1], E.P. Berg[2], H.H. Stein[1]

[1]Department of Animal Sciences, University of Illinois at Urbana-Champaign, [2]Department of Animal Sciences, North Dakota State University

INTRODUCTION: Two experiments were conducted to test the hypothesis that meat products have digestible indispensable amino acid scores (DIAAS) greater than 100.

METHODS: In experiment 1, DIAAS values were determined for 9 pork products (i.e., raw belly, smoked bacon, smoked-cooked bacon, non-cured ham, alternatively cured ham, conventionally cured ham, 63°C loin, 68°C loin, and 72°C loin). Ten pigs (BW: 26.63 ± 1.62 kg) were surgically fitted with a T-cannula in the distal ileum and randomly allotted to a 10 × 10 Latin square design with 10 diets and ten 7-d periods. Nine diets contained a single pork product as the sole source of crude protein (CP) and amino acids (AA), and a N-free diet was formulated to determine basal endogenous losses of CP and AA. In experiment 2, DIAAS values were determined for 8 meat products (i.e., salami, bologna, beef jerky, raw ground beef, cooked ground beef, 56°C ribeye roast,

64°C ribeye roast, and 72°C ribeye roast). Nine ileal-cannulated pigs (BW: 35.50 ± 3.77 kg) were randomly allotted to a 9 × 8 Youden square design with 9 diets and eight 7-d periods. Each of the 8 meat products were included in one diet as the sole source of CP and AA, and a N-free diet was also used. The DIAAS values were calculated using the determined concentration of digestible indispensable AA in each meat product and 2 reference protein patterns established by the Food and Agriculture Organization of the United Nations (FAO); 1) children 6 mo to 3 yr and 2) children >3 yr, adolescents, and adults.

RESULTS: In experiment 1, all pork products had a DIAAS value greater than 100, regardless of the reference protein pattern. Loin heated to 63°C had the greatest ($P < 0.05$) DIAAS value (129) for children 6 mo to 3 yr, and smoked-cooked bacon had the greatest ($P < 0.05$) DIAAS value (142) for older children, adolescents, and adults. For both reference patterns, Val was the first limiting AA in all pork products, except for smoked-cooked bacon, which was limiting in Trp for children 6 mo to 3 yr. In experiment 2, for children 6 mo to 3 yr, 72°C ribeye roast and cooked ground beef had DIAAS values less than 100, but all other meat products had values greater than 100 with the greatest ($P < 0.05$) DIAAS values determined for ribeye roast heated to 64°C (121) and bologna (118). For older children, adolescents and adults, all meat products had DIAAS values greater than 100, except cooked ground beef with a DIAAS of 99. The two products with the greatest ($P < 0.05$) DIAAS values were ribeye roast heated to 64°C (130) and bologna (128). The AA that were limiting in the meat products for children 6 mo to 3 yr were sulfur AA in salami and beef jerky, Leu in bologna, cooked ground beef, and 72°C ribeye roast, Trp in raw ground beef, and Val was limiting in 56°C and 64°C ribeye roasts. Whereas for older children, adolescents and adults, sulfur AA were limiting in beef jerky, Leu was limiting in bologna, raw ground beef, and cooked ground beef, and Val was limiting in salami and the 3 ribeye roasts.

CONCLUSIONS: In conclusion, the protein quality of meat products is generally excellent, but overcooking may reduce the DIAAS of meat products.

Cholecystectomy alters gastrointestinal health indices and exacerbates post-menopausal metabolic dysfunction in a mouse model consuming a high fat diet

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INTRODUCTION: Cholecystectomy (XGB), the removal of the gallbladder, is the most common abdominal surgery performed in the United States. Individuals can survive without a gallbladder, but have an increased prevalence of metabolic syndrome, hepatic steatosis, and small intestinal bacterial overgrowth. However, little is known about the underlying mechanisms leading to the systemic changes that occur post-XGB. Because bile acids (BA) act as hormones, it is hypothesized that the constant flow of bile into the gastrointestinal (GI) tract following XGB may play a role. We previously developed a novel model of XGB in ovariectomized (OVX, model of menopause) mice as the two main risk factors for XGB, age (40-50 years) and sex (female), correspond with the average onset of menopause in women. Additionally, the dietary fiber psyllium husk (PH) possesses strong bile acid-binding capacity. Thus, the objectives of this study were to assess (1) the impact of XGB on metabolic health, GI health, and small intestinal bacterial overgrowth, and (2) the ability of post-prandial PH intervention to ameliorate these effects in XGB/OVX mice.

METHODS: Twelve-wk-old female C57BL/6J mice (N=48) were fed a high-fat (45% kcal), low-sucrose diet for the entire study (16 wk). *Ad libitum* access to food was allowed between 17:00 and 8:00. A 2x2 (surgery x diet) factorial design was utilized, resulting in four groups of mice. XGB and sham (SHM) operations were performed at wk 0 and all mice were OVX at wk 4. SHM/FS and XGB/FS mice were fasted (FS) between 8:00 and 17:00 while SHM/PH and XGB/PH mice had *ad libitum* access to pelleted PH. BW and food intake were measured weekly. At sacrifice, plasma was collected for lipid profiling, and liver and GI tissues and contents were collected for bacterial culturing, hepatic triglyceride (TG), flow cytometry, histology, and gene expression analysis.

RESULTS: A significant ($p<0.01$) surgery*wk interaction was observed for BW, with XGB mice having higher BW at wk 15-16 compared to SHM, and significant ($p<0.05$) diet*wk and surgery*diet inter-

actions for food intake. XGB mice had higher ($p<0.01$) plasma TG and LDL and total cholesterol compared to SHM mice. Additionally, PH intervention lowered ($p<0.05$) plasma LDL concentrations, independent of surgery. XGB mice tended ($p=0.06$) to have greater hepatic TG content compared to SHM, independent of diet. In the duodenum, SHM mice had more ($p<0.05$) anaerobic CFU compared to XGB. In the ileum, PH resulted in fewer ($p<0.05$) anaerobic CFU. Preliminary flow cytometry analysis revealed that XGB mice tended ($p=0.10$) to have a lower proportion of ileal $CD4^+CD8^-$ T cells compared to SHM. XGB/PH mice had a lower ($p<0.01$) proportion of cecal $CD4^-CD8^+$ T cells compared to XGB/FS.

Effects of avocado consumption on gastrointestinal microbial metabolite concentrations and taxa abundances: a randomized, controlled trial

Sharon V. Thompson[1], Caitlyn G. Edwards[1], Ginger E. Reeser[2], Naiman A. Khan[1,2,3], Hannah D. Holscher[1,2,4]

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INTRODUCTION: Avocados are rich in dietary fiber and monounsaturated fatty acids, nutrients that have been independently connected with metabolic health benefits and changes to the gastrointestinal (GI) microbiota. However, little is known regarding the impact of avocado consumption on GI microbial community composition and microbially-derived metabolites, particularly among adults with overweight or obesity.

METHODS: Adults (n=160) between 25-45 years of age with BMI ≥ 25.0 kg/m^2 were enrolled in an investigator-blinded, parallel arm, randomized, controlled trial. Participants consumed isocaloric meals with or without fresh Hass avocado once daily for 12-weeks. Compliance was evaluated with daily self-report records. Fecal microbially-derived metabolites, including acetate, propionate, butyrate, isovalerate, valerate, and isobutyrate were quantified using gas chromatography mass spectroscopy on a dry matter basis. Following fecal DNA extraction, microbial analyses were conducted by sequencing the V4 region of the 16S rRNA gene. Sequence data were analyzed using DADA2 and QIIME version 2. Per protocol (PP; > 80% meal consumption) and intent-to-treat (ITT) approaches were applied and generalized linear mixed models were assessed for treatment, time, and treatment by time interactions in SAS version 9.4.

RESULTS: The intervention was completed by 88% (n=140) of participants, average meal compliance among both groups was 90%, and 83% (n=132) of participants met PP criteria. Microbiota analyses were completed for 156 ITT and 109 PP participants, respectively. ITT time by treatment analyses indicated that compared to control, avocado consumption increased acetate ($p<0.01$) and total short-chain fatty acid (SCFA; $p=0.02$) concentrations and increased the relative abundances of *Faecalibacterium* ($p=0.01$). PP time by treatment analyses revealed that avocado consumption increased acetate concentrations ($p<0.01$), increased the relative abundances of *Lachnospira* ($p=0.04$), and trended to increase *Faecalibacterium* ($p=0.08$).

CONCLUSIONS: Fresh Hass avocado intake increased the relative abundances of microbes capable of fiber fermentation and SCFA production among adults with overweight or obesity, providing valuable evidence for the impact of this nutrient dense food on the GI microbiota.

Graduate Student Oral Session Abstracts

Oral Session 2

Judges: Melissa Prescott, Kelly Swanson, Corby Martin

Genetic variants in lipid metabolism pathways interact with diet to influence blood lipid concentrations in adults with overweight and obesity

Bridget A. Hannon[1], Caitlyn G. Edwards[1], Sharon V. Thompson[1], Nicholas A. Burd[1,2], Hannah D. Holscher[1,3], Margarita Teran-Garcia[1,4], Naiman A. Khan[1,2]

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INTRODUCTION: There is substantial controversy regarding the role of saturated (SFA) and unsaturated fat intake for optimal cardiometabolic health due to the heterogeneity of blood lipid changes in clinical trials. This variance may be due to genetic differences. Studying physiologically relevant variants can elucidate the mechanisms by which genotype affects metabolism. The objective of this study was to determine relationships between genetic variation, dietary fat intake, and blood lipid concentrations in adults.

METHODS: Genomic DNA, blood lipid concentrations (total cholesterol, high-density lipoprotein cholesterol [HDL], triglycerides [TG], and low-density lipoprotein cholesterol), and seven-day diet records were obtained from 87 adults (25-45 years) with overweight or obesity. Resting energy expenditure (REE) was measured using indirect calorimetry and used to determine implausible intakes using a modified Goldberg method (kilocalories/REE). Genetic variants included 22 single nucleotide polymorphisms (SNPs) from genes in lipid metabolism pathways. Variants were analyzed with dietary fat intake (total fat, SFA, monounsaturated fat [MUFA], and polyunsaturated fat [PUFA]) via regression analyses. All models were adjusted for age, sex, and ancestry.

RESULTS: Nine SNPs (*ANGPTL3* rs10889337, *ANGPTL4* rs7255436, *APOE* rs1044250, *CETP* rs5882, *FADS1* rs174548 and rs174550, *LPL* rs13702 and rs328, *PPARG* rs12639162) were associated with one or more blood lipid concentration traits. Two significant diet-gene interactions were detected: the interaction of total fat intake and *LPL* rs13702 was associated with HDL concentrations (P=0.01), and the interaction of MUFA intake and *CETP* rs5882 was associated with TG concentrations (P=0.01). Carriers of the minor allele that reported higher total fat intake exhibited higher HDL concentrations, while minor allele carriers with higher MUFA intake exhibited lower TG concentrations.

CONCLUSIONS: In summary, interactions between diet and genes in lipid metabolism pathways were predictors of blood lipid concentrations in adults with overweight and obesity. Fatty acid intake may not modulate blood lipid concentrations uniformly across all individuals. Therefore, personalized dietary recommendations for chronic disease prevention may be warranted.

Early life nutrient intake is associated with weight-for-length Z-scores at 3 and 12 months

Erin C. Davis[1], Salma Musaad[2], Marcia Monaco[3], Sharon M. Donovan[1,3]

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INTRODUCTION: Rapid weight gain over the first 12 months of life is a risk factor for childhood obesity. While macronutrient concentrations in human milk (HM) or infant formula (IF) have been associated with rapid weight gain or weight-for-length Z-scores later in infancy, few studies evaluate milk intake. Therefore, the objective was to assess how nutrient intake at 6 weeks of age,

across multiple feeding modes, influences growth over the first year of life.

METHODS: Data were collected from 222 healthy mother-infant pairs enrolled in the STRONG Kids 2 Cohort. Twenty-four hour test weighing was conducted to measure milk intake volume and a human milk sample was collected at 6 weeks postpartum. Milk samples were analyzed for total protein (Bradford assay), fat (total lipid extraction), and carbohydrate (Orcinol assay). Mode of feeding at 6 weeks, servings per day of HM and/or IF, and formula type were reported by mothers. For exclusively breastfeeding infants, HM macronutrient concentrations and total intake were used to calculate nutrient intake. For those receiving IF, the numbers of feedings from HM and/or from IF and formula nutrition information were also used to calculate nutrient intake. Infant length and weight collected at study visits were used to calculate weight-for-length Z-scores (WFL-Z). Mixed linear models were used to measure associations between macronutrient intake, total calories, total milk intake and WFL-Z at 3 months and 12 months of age. Models were controlled for 6-week feeding mode, breastfeeding duration, and timing of solid food introduction.

RESULTS: At 3 months, WFL-Z was associated with total milk ($p=0.03$) and caloric intake ($p=0.03$) as well as intake of fat ($p=0.02$), carbohydrate ($p=0.05$), and protein ($p=0.03$). WFL-Z at 12 months was associated with protein ($p=0.02$) and fat ($p=0.04$) intakes at 6 weeks but no longer associated with other measures of nutrient intake.

CONCLUSIONS: Our results support previous findings suggesting that high protein intake in infancy contributes to obesity risk. While milk intake was only quantified once, data show that nutrient intake at 6 weeks-of-age influences future growth. More research is needed to understand other lifestyle and nutritional factors between 3 and 12 months that contribute to growth trajectories and weight during infancy.

Effects of a 12-week avocado randomized-controlled trial on cognitive function and lutein status among adults with overweight and obesity

Caitlyn G. Edwards[1], Anne M. Walk[2], Sharon V. Thompson[1], Ginger E. Reeser[2], John Erdman,[1,3], Nicholas A. Burd[1,2], Hannah D. Holscher[1,2,3], Naiman A. Khan[1,2]

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INTRODUCTION: Overweight and obesity affect over two-thirds of the US population. This is concerning, as excess adiposity increases risk for dementia in later adulthood. Thus, it is important to elucidate dietary approaches that benefit cognition among individuals with overweight or obesity. Lutein is a xanthophyll carotenoid thought to impact cognitive function. Daily consumption of an avocado, a bioavailable source of lutein, has been shown to improve cognitive function and lutein status but it is not clear whether these benefits extend to populations with overweight and obesity. Thus, we evaluated the influence of daily avocado consumption on changes in cognitive function, serum lutein concentrations, and retinal xanthophyll status among adults with overweight and obesity using a randomized-controlled study.

METHODS: Adults (N=72, 25-45 years, 31 males) with overweight or obesity (BMI ≥ 25 kg/m^2) were randomized to either an intervention group (N=38) that received a daily meal with one avocado or a control group (N=34) that received an isocaloric meal without avocado for 12 weeks. Fasting serum lutein concentrations were evaluated through high-performance liquid chromatography. Macular pigment optical density (MPOD) was assessed through heterochromatic flicker photometry. Selective attention was assessed by a modified Eriksen flanker task.

RESULTS: Group by time interactions were observed for serum lutein concentrations ($p=0.002$) and flanker task accuracy ($p=0.006$) whereby the intervention group exhibited a more substantial increase in serum lutein concentrations (0.04ug/ml; 95% CI, 0.02 to 0.06) and improvements in overall task accuracy (2.4%; 95% CI, 0.4 to 4.5). However, there was no statistically significant relationship between task performance and changes in serum lutein concentration ($p=0.23$), nor changes in MPOD.

CONCLUSIONS: Daily consumption of a meal containing avocado improved selective attention and serum lutein concentrations among adults with overweight and obesity over a 12-week period. Interestingly, the cognitive benefits of avocado consumption were apparent even prior to changes in retinal lutein status. Given that avocados are comprised of a variety of nutrients and phyto-

chemicals, additional work is necessary to determine non-carotenoid dependent mechanisms by which avocados may impact cognitive function.

County-level associations between food retail outlet availability and violent crime rate

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INTRODUCTION: Violent crime is a major public health issue. Currently, information on the relationship between food retail outlet availability and violent crime occurrence is limited. This research aimed to evaluate U.S. county-level associations between the availability of healthy (grocery stores, supercenters, and farmers' markets) and unhealthy (convenience stores and fast food restaurants) and violent crime rate after adjusting for socio-demographic factors. We hypothesized that counties with fewer healthy food retailers would have a higher violent crime rate.

METHODS: Data collected in 2014 on 3,126 counties were obtained from two sources: The United States Department of Agriculture Food Environment Atlas and the United States Department of Justice Uniform Crime Reporting Program. Measures on resident socio-demographics (% under 18, % Non-Hispanic black, % Hispanic, poverty rate, and metro county status), per capita food retail outlets, and per capita violent crimes were analyzed. Violent crime rate reflects the total number of murders, robberies, forcible rapes, and aggravated assaults per 10,000 county residents. The CDC's Modified Retail Food Environment Index (mRFEI) was applied to assess the overall healthfulness of each county's retail food environment; a higher score indicates that more healthy food retailers are availability. Multivariable-adjusted linear regression models were used to examine associations between food retail outlet availability and violent crime rate.

RESULTS: After adjusting for socio-demographic factors, increased availability of grocery stores ($p = 0.01$) and farmers' markets ($p < 0.0001$) was significantly associated with a lower violent crime rate. Furthermore, a higher mRFEI score ($p = 0.0002$) was associated with a lower violent crime rate. Increased availability of supercenters ($p < 0.0001$) and fast food restaurants ($p < 0.0001$) was associated with a higher violent crime rate. There was no association between the availability of convenience stores and violent crime rate.

CONCLUSIONS: U.S. counties with fewer healthy food retailers had a higher violent crime rate after adjusting for socio-demographic factors. These findings highlight the need for additional research on the role of the retail food environment in community violence.

Graduate Student Poster Session Abstracts

Effects of omega-3 fatty acid derived lipid metabolites on the inflammation and insulin sensitivity of adipose tissue

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INTRODUCTION: Insulin resistance (IR) is a pathological condition characterized by reduction in the response to insulin by insulin-responsive tissues including liver, skeletal muscles and adipose tissue (AT). IR is causally related to metabolic syndrome and strongly correlated with several chronic metabolic diseases like type II diabetes mellitus (T2DM) which is estimated to affect 30% of the USA adults by 2050. The fact that insulin resistance is a prerequisite to T2DM and 60-90% of T2DM cases are related to obesity, makes obesity-induced insulin resistance a major risk factor in T2DM pathogenesis. The correlation between obesity and IR is attributed mainly to impairment of the storage and endocrine functions of AT. Excessive expansion of AT in obesity leads to the infiltration of macrophages (MΘs) into AT and a chronic state of inflammation. This obesity-induced chronic inflammation is characterized by imbalance between pro-inflammatory (M1) and anti-inflammatory (M2) MΘs and strongly correlated with IR. Therefore, switching M1/M2 polarization toward M2 might resolve the chronic inflammation in obese AT and protect against IR.

METHODS: Recently, our group showed that 19, 20- epoxydocosapentaenoic acid-ethanolamine (19,20-EDP-EA), an omega-3 endocannabinoid epoxide derived from docosahexaenoic acid (DHA), increases IL-10 while decreases IL-6 cytokines expression, and 13, 14-EDP-EA induces the polarization of MΘs toward M2 in microglial cells. Based on these findings and along with our recent preliminary data that confirmed the presence of 19,20 EDP-EA in mice epididymal AT, we hypothesize that 19, 20-EDP-EA has anti-inflammatory effect in AT and enhances the polarization of MΘs toward M2 phenotype. Aims and methodology: Aim1. To determine the effect of 19,20-EDP-EA on: a. M1/M2 MΘs polarization by co-culturing adipocytes with MΘs and examining the gene expression of MΘs polarization markers; b. on the differentiation of preadipocytes using ORO staining, flow cytometry and image J; c. on hypoxia; and d. on insulin sensitivity and glucose uptake. Aim2. To determine the molecular mechanism by which 19,20-EDP-EA exerts their effect on AT. Luciferase and fluorescence polarization assays will be applied to examine the transactivation and the binding affinity of CB1, CB2, and PPAR-γ receptors.

EXPECTED RESULTS: We expect that 19,20-EDP-EA will protect against inflammation-induced insulin resistance in AT by enhancing the polarization of MΘs toward M2 and resolving inflammation and subsequent improvement in the storage and endocrine functions of AT.

Dietary tomato and prostate carcinogenesis and progression in overweight/obese TRAMP mice

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INTRODUCTION: Despite decreasing trends of diagnosis, prostate cancer (PCa) is the most commonly diagnosed male cancer in the United States. The 2018 revision to the 2014 Prostate Cancer Continuous Update Project (WCRF/AICR) maintained that there was strong evidence to support that being overweight or obese increases the risk for advanced, high-grade, and fatal PCa. Abundant epidemiological and pre-clinical evidence exists to show that physiologically relevant levels of dietary tomato intake reduce the risk for PCa, with some evidence suggesting that tomato intake is beneficial for reducing the risk for advanced PCa. Our lab has previously shown that

freeze-dried tomato powder (TP) added to diets of lean, transgenic mice prone to PCa (TRAMP mice) inhibits prostate carcinogenesis, and other labs have shown more accelerated and aggressive growth of PCa in overweight/obese TRAMP mice.

METHODS: Our experimental design consists of two studies, each involving four-week-old TRAMP mice randomly assigned to consume one of four diets. The diets are either normal fat (AIN-93G with 17.2% kcal from fat) or higher fat/sugar (to mimic a human, "Western" diet with 44.6% kcal from fat), both with and without 10% TP. Tumor development will be monitored via ultrasound imaging. Study 1 will measure tumor incidence and progression in mice (n=30/group), with mice (n=15/group) terminated one or four weeks following tumor detection to assess early and later molecular changes in the tumors. Study 2 will involve identical procedures as Study 1 with mice (n=6/group) additionally monitored for tumor angiogenesis (PET-CT using a novel 64Cu-labeled $\alpha_V\beta_3$ integrin probe), tumor blood perfusion, and tumor metabolism (18F-FDG injection).

RESULTS: We hypothesize that TP will reduce the following: (a) prostate carcinogenesis; (b) inflammation; (c) androgen signaling and metabolism; (d) angiogenesis; and (e) tumor metabolic rate in the prostates and tumors of both lean and overweight/obese TRAMP mice at early and later stages of PCa progression, with TP attenuating the potentiating effects observed with increased adiposity in overweight/obese mice.

CONCLUSION: The results will inform men about both the risks of body fatness and the value of increasing tomato food consumption as well as inform the design of future clinical trials.

Uric acid: An overlooked, inexpensive biomarker of metabolic syndrome

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INTRODUCTION: Elevated serum uric acid (HUA) levels have been shown to have a positive correlation with metabolic syndrome (MetS) risk factors. Previous studies have identified uric acid (UA) to be an inexpensive predictive marker of cardiovascular disease. In countries where rates of MetS continue to increase, such as Mexico, it is important to identify reliable and inexpensive markers that will aid in predicting the development of MetS components. The objective of this study is to evaluate the association between serum uric acid (UA) and MetS risk factors in young Mexican adults, factors that include glucose (GLU), systolic blood pressure (SBP), diastolic blood pressure (DBP), waist circumference (WC), triglycerides (TG), high-density lipoprotein (HDL), and body mass index (BMI).

METHODS: Mexican college applicants involved in the Universities of San Luis Potosí and Illinois: Multidisciplinary Investigation on Obesity, Genetics and Socio-environment (UP AMIGOS) cohort (ages 18-25, n=747, 56% female) underwent a health screening following an overnight fast. Fasting blood samples, anthropometric measurements, and blood pressure were collected. According to the literature, HUA levels are defined as ≥7 and ≥6 mg/dL for males and females, respectively. T-tests were conducted to compare mean differences of MetS risk components between individuals with and without HUA levels. Analyses were conducted separately by sex.

RESULTS: The mean ± SD of UA was 5.73 ± 1.32 mg/dL and 4.39 ± 1.19 mg/dL for males and females, respectively. Males and females with HUA had a significant increase in TG, and WC, with a decrease in HDL (all P<0.001). HUA was positively correlated with WC (R^2=0.331, P<0.001), SBP (R^2=0.151, P<0.0001), DBP (R^2=0.176, P<0.0001), GLU (R^2=0.863, P=0.0263), TG (R^2=0.424, P<0.0001) and BMI (R^2=0.363, P<0.0001). In contrast, HDL was negatively correlated with HUA (R^2=-0.277, P<0.0001). All correlations were adjusted for age and sex.

CONCLUSION: Serum UA has a strong correlation with MetS risk factors in young Mexican adults. Routine monitoring of serum UA could be utilized as an inexpensive early predictor of MetS, which would allow for early interventions.

Interplay between systemic inflammation, visceral fat, and cognitive control in people with excess fat mass

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INTRODUCTION: Excess fat mass has been associated with poorer cognitive function. Elevated visceral adiposity (VAT) has also been associated with cardiometabolic risk factors including chronic systemic low-grade inflammation. Whereas the cognitive implications of inflammation have been extensively studied in preclinical models, the influence of inflammatory cytokines on cognitive function in humans is unclear. Thus, this study aimed to investigate the relations among VAT, inflammatory cytokines, and cognitive control. We hypothesized that elevated VAT and inflammatory markers would be related to poorer performance during a cognitive control task.

METHODS: Participants between 25-45 years (N=77, 48 females) with overweight and obesity (BMI ≥ 25 kg/m2) underwent a DXA scan to quantify VAT. An Eriksen Flanker Task was used to assess cognitive control while Event-Related Potentials were recorded. Following an overnight fast, blood was collected to quantify plasma C-reactive protein (CRP) and Interleukin-6 (IL-6) concentrations using ELISAs. Spearman's correlations were used to analyze relations using a one-tailed approach.

RESULTS: Greater VAT was related to lower congruent (r=-0.19, p=0.05) and incongruent trial accuracy (r=-0.26 p=0.01). Greater VAT was related to lower congruent P3 peak amplitude (r=-0.23, p=0.02) and slower latency (r=0.37, p<0.001). Similarly, higher plasma CRP and IL-6 concentrations were associated with poorer congruent (rCRP=-0.22 pCRP=0.03; rIL6=-0.20 pIL6=0.03), and incongruent (rCRP=-0.33 pCRP=0.002; rIL6=-0.32 pIL6=0.002) accuracy. Additionally, CRP concentrations were related to slower incongruent P3 peak latency (r=0.22, p=0.02). Partial correlations controlling for plasma CRP and IL-6 concentrations showed that VAT was no longer associated with cognitive performance (all p's > 0.07); however, the association between VAT and P3 peak amplitude (r=-0.26, p=0.01) and latency (r=0.35, p=0.001) persisted even following adjustment for CRP and IL-6 concentrations.

CONCLUSIONS: This work replicates previous research indicating that VAT is related to poorer attentional abilities; however, we extend the literature by elucidating the role of low-grade inflammation as a contributing factor in this relationship in adults with excess fat mass.

DATA BLITZ SESSION PRESENTATION

Macular carotenoids, retinal morphometry, and cognitive function in multiple sclerosis

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INTRODUCTION: Individuals with multiple sclerosis (MS) often suffer a progressive loss in visual and cognitive function. While the exact reason for the cognitive decline in MS is unknown, generalized neurodegeneration of the central nervous system has been associated with lower carotenoid levels. Carotenoids have antioxidant effects that could support nerve health and be protective against cognitive decline. Thus, their role in the brain may be related to their role in the eye and vision health. We investigated the correlation among macular carotenoids, retinal and optic nerve thickness, and cognitive function in persons with MS.

METHODS: Participants included persons diagnosed with MS between 45-64 years (N=29) living in Illinois. Carotenoid accumulation, defined as macular pigment optical density (MPOD), was measured using heterochromatic flicker photometry. Optical coherence tomography (Heidelberg

Engineering) was used to assess total macular volume (TMV), central foveal (CF), and nerve fiber layer thickness (RNFL). Cognitive function was assessed using an Eriksen flanker task for attentional control with event-related brain potentials.

RESULTS: While MPOD was not correlated with TMV (Rho=0.23, p=0.14), CF (Rho<-0.01, p=0.50), or RNFL (Rho=0.19, p=0.19), MPOD was correlated with faster congruent (Rho=-0.34, p=0.04) and incongruent reaction time (Rho=-0.33, p=0.04) and faster congruent (Rho=-0.52, p<0.01) and incongruent (Rho=-0.37, p=0.04) P2 latency. RNFL was positively correlated with incongruent accuracy (Rho=0.41, p=0.02) and inversely related to incongruent P2 latency (Rho=-0.41, p=0.05), N2 congruent (Rho=-0.46, p=0.03), and incongruent (Rho=-0.47, p=0.03) amplitude. Additionally, RNFL was inversely related to congruent (Rho=-0.51, p=0.02) and incongruent (Rho=-0.54, p=0.01) P3 amplitude. Larger TMV was related to faster congruent (Rho=-0.43, p=0.04) and incongruent P2 latency (Rho=-0.48, p=0.02). CF was not correlated with any of the cognitive task outcomes.

CONCLUSIONS: Macular pigmentation and markers of retinal and optic nerve health may positively influence cognitive function in MS. However, MPOD and OCT measures were not correlated, suggesting that macular carotenoids, and retinal and optic nerve thickness may exert independent benefits for cognitive function.

Genetic variations in β,β-carotene-15,15'oxygenase 1 are associated with lipid profiles in young Mexican adults

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INTRODUCTION: Retinoids are important mediators of many physiological processes in the body, including lipid metabolism. The major dietary precursors of retinoids are pro-vitamin A carotenoids, especially beta-carotene. Beta-carotene, which is cleaved by β,β-carotene-15,15'oxygenase 1 (BCO1) and render two molecules of retinoids, can be the principal source of retinoic acid in the body. However, the availability of retinoids body processes is somewhat dependent on the activity of BCO1 enzyme. Some studies not only have shown that single nucleotide polymorphisms (SNPs) could affect the efficiency of carotene to retinol conversion, and have shown associations with plasma lipid profile.

METHODS: This report investigates the associations of BCO1 SNPs (rs6564851 and rs6420424) and plasma lipid profile in a cohort of young Mexican adults (n=692). DNA was extracted from whole blood and was genotyped for the SNPs of interest.

RESULTS: Under the dominant model of heritance, homozygote individuals for the G-allele at BCO1-rs6420424 had lower TC and LDL compared with carriers of the A-allele ($P < 0.05$). However, under the dominant model of heritance, homozygote individuals for the G-allele at BCO- rs6564851 had higher TC, LDL, and non-HDL compared with carriers of the A-allele ($P < 0.05$).

CONCLUSIONS: These preliminary results suggest that individual genetic variations in the BCMO1 gene could confer changes in enzyme activity. In turn, plasma lipid profile is affected and might increase the risk for dyslipidemia. In the future, haplotype construction of the risk-alleles will be investigated for the impact on plasma lipid profiles.

DATA BLITZ SESSION PRESENTATION

Associations between serum lutein and human gut microbiota

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INTRODUCTION: Lutein is a carotenoid found in green leafy vegetables, avocados, and eggs, and is purported to have protective effects against age-related macular degeneration (AMD) as well as benefits for visual and cognitive health. Recent studies have indicated significant variation in serum lutein among individuals and that gastrointestinal (GI) microbial profile may potentially contribute to lutein status. However, the extent to which the GI microbiota contribute to lutein is unclear. The current study aimed to determine GI microbial predictors of serum lutein in a healthy young adult population.

METHODS: Among adults ages 25-45 years (N=105), venous blood was collected following a 10-hour fast. Serum lutein was determined using HPLC. Fecal DNA was extracted and the V4 region of the 16S rRNA gene was amplified. Amplicon sequence variants were assigned using the GreenGenes 13-8 database and DADA2, followed by analysis in QIIME2 and LDA Effect Size (LEfSe). Participants underwent DXA scan for whole body percent fat (%Fat) and completed a 7-day food record to assess lutein consumption. Demographic information on participant's age and sex was also assessed and included in the statistical models.

RESULTS: Four genera (*Dialister, Ruminococcus, Gemmiger,* and *Phascolarctobacterium*) and two species (*Bacteroides eggerthii, Ruminococcus torques*) were different between individuals in the highest and lowest quartiles of serum lutein. The genera *Ruminococcus* (Rho=-0.24, p=0.02) and *Phascolarctobacterium* (Rho=-0.21, p=0.03) and species *R. torques* (Rho=-0.35, p<0.001) were inversely related to serum lutein. Linear regression modelling, adjusted for age, sex, %Fat, and dietary lutein, revealed that *R. torques* was the only significant predictor of serum lutein concentrations, accounting for 8.4% of the variance.

CONCLUSIONS: Our results reveal that individuals with lower serum lutein concentrations have a higher relative abundance of *R. torques* than those with higher lutein concentrations. As R. torques has been shown to be elevated in those with AMD, it is possible the relationship between this microbe and lutein is evident earlier in adulthood. However, further dietary intervention trials are warranted to clarify the relations among R. torques and serum lutein concentrations.

Examining the link between fermentation and recognition memory

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INTRODUCTION: There is growing interest in the link involving the microbiota-gut-brain-axis. Both prebiotics and probiotics have been shown capable of improving indices of cognition and affective behavior in both human and animal models, yet the causal factor remains largely unknown. Here we perform a retrospective analysis to determine if a stable relationship exists between recognition memory and colonic volatile fatty acids using a translational piglet model.

METHODS: Five studies assessing the supplementation of prebiotics or iron deficiency were examined for relationships between colonic volatile fatty acids and recognition memory. Correlation and linear regression analyses were performed to assess the direction and strength of relationships between recognition memory and colonic concentrations of acetate, propionate, butyrate, isovalerate, valerate, and isobutyrate.

RESULTS: Between five studies, 12 different experimental groups were assessed. Of the short chain fatty acids, acetate was found to be related to recognition memory among three experimental groups, propionate among two groups, and butyrate among one (all $P < 0.05$). Of the branched chain fatty acids, isovalerate was related with recognition memory in four groups, valerate among none, and isobutyrate among three groups. Overall, there was high multi-collinearity between short chain fatty acids and the direction and strength of relationships were highly variable (all $P < 0.05$).

CONCLUSIONS: While there are multiple links between colonic short chain fatty acids and recognition memory, they are highly variable and diet-dependent. Despite their relatively low concentrations, we found numerous links between branched chain fatty acids and cognition. These relationships offer another perspective to help unravel the link within the microbiota-gut-brain-axis.

Impact of arachidonic acid and docosahexaenoic acid supplementation on tissue fatty acid incorporation in the young pig

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INTRODUCTION: Docosahexaenoic acid (DHA) and arachidonic acid (ARA) are conditionally essential fatty acids (FA) commonly supplemented in human infant formulas due to insufficient endogenous synthesis. Supplementation of these FA has been shown to yield FA profiles closer to those of a breastfed infant. The need for DHA supplementation in infant formula has been well-establish due to its positive influence on retinal and cognitive health. However, ARA supplementation recommendations have come under some scrutiny. This study aimed to use the neonatal piglet model to examine the impact of single and dual supplementation of ARA and DHA on tissue FA incorporation.

METHODS: Forty-eight male pigs were provided one of four dietary treatments ad libitum (n = 12 per treatment) from postnatal day 2 to 30. Dietary treatments included the following target ARA and DHA levels expressed as a percentage of total fatty acids: Diet 1 – Control (devoid of ARA and DHA), Diet 2 – 0.8% ARA, Diet 3 – 0.8% DHA, Diet 4 – 0.8% ARA + 0.8% DHA. Growth and food intake were measured daily. Plasma, red blood cells (RBC), and prefrontal cortex (PFC) were collected at study conclusion for FA analysis.

RESULTS: There were no significant differences ($P > 0.05$) between diet groups in food intake and overall growth. Pigs on diet 1 had lower ($P < 0.001$) ARA than those on diet 2 in the PFC, plasma, and RBC. Pigs on diet 3 had lower incorporation of ARA than those on diet 1 in the PFC ($P < 0.001$) and RBC ($P = 0.03$). Pigs on diet 4 had lower incorporation of ARA than those on diet 2 in the PFC ($P < 0.001$), plasma ($P < 0.01$), and RBC ($P = 0.01$). Pigs on diet 1 had lower ($P < 0.001$) DHA levels than those on diet 3 in the PFC, plasma, and RBC. There were no significant differences in DHA levels ($P > 0.05$) between diet 1 and diet 2 in PFC, plasma, or RBC. Pigs on diet 4 had lower incorporation ($P < 0.01$) of DHA than those on diet 3 in the PFC and plasma.

CONCLUSIONS: These results show that PFC, RBC, and plasma ARA and DHA levels are sensitive to dietary intake when compared to diets devoid of these fatty acids. Results also indicate that endogenous ARA levels in the PFC and RBC are reduced when only DHA supplementation is provided in the absence of dietary ARA, hence the supplementation of ARA when DHA is provided may be warranted for maintenance of ARA concentrations in these tissues.

Interrelationships between household chaos, children's ADHD tendencies, and diet quality

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INTRODUCTION: Household environment, diet, and inattention/hyperactivity tendencies have been shown to influence children's physical and cognitive development. However, these factors are often studied independently. Therefore, there is little knowledge on the interrelationships between household environment, diet, and children's ADHD tendencies. This study aimed to investigate relationships between ADHD tendencies, household chaos, and diet quality among 4 and 5-year olds.

METHODS: Four and five-year-old children (n=55, 22 females) were recruited from the East-Central Illinois area. Participants' parents completed two surveys and a seven-day food record. The ADHD Rating Scale-IV Home Version questionnaire and the Confusion, Hubbub, and Order Scale (CHAOS) questionnaire were used to assess inattention/hyperactivity tendencies and household chaos, respectively. Diet records were analyzed using the Nutrition Data Systems for Research (NDSR) 2015 to estimate Healthy Eating Index 2015 scores (HEI-2015). All measures were self-reported by the child's caregiver.

RESULTS: Using Spearman's bivariate correlations, total HEI score was negatively and significantly

related to hyperactivity tendencies (r= -.24, p=.04) and total raw scores (r=-.24, p=.04). CHAOS was positively and significantly related to inattention tendencies (r=.24, p=.04), hyperactivity tendencies (r=.31, p=.01), and total raw scores (r=.31, p=.01). CHAOS indicated no significant relationship with total HEI score. Using partial correlations while controlling for age, sex, income, and gender, household chaos was positively and significantly related to hyperactivity tendencies (r=.28, p=.03) and total raw scores (r=.28 p=.03). Additionally, total HEI score was no longer significantly related to inattention or hyperactivity tendencies.

CONCLUSIONS: These findings suggest that children's tendencies of hyperactivity and inattention are associated with commotion in the household environment. Additional research is necessary to determine the potential of dietary factors in this relationship.

H1N1 influenza virus triggers changes in myelin lipid composition

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INTRODUCTION: The seasonal flu (influenza virus) is a common viral infection affecting millions of people every year. Systemic inflammation brought on by infection accelerates the progression of many neurodegenerative diseases including Parkinson's disease, Alzheimer's disease, and Multiple Sclerosis. Interestingly, systemic inflammation in healthy individuals also lead to behavioral changes, cognitive impairment, anxiety, and depression similar to that of neurodegenerative diseases. The mechanisms underlying these changes are attributed to the secretion of proinflammatory cytokines by reactive glia, influencing oligodendrocyte homeostasis. Oligodendrocytes are glial cells responsible for generating the myelin sheath, an insulating lipid covering that helps to increase neuronal conduction. Importantly, myelin has been demonstrated to be essential for normal behavior, and cognitive and motor function. We have found that the influenza infection significantly decreases oligodendrocyte-specific gene expression, likely affecting myelin plasticity. Therefore, we investigated how systemic inflammation brought on by the influenza virus alters myelin composition of the brain.

METHODS: We infected C57BL/6 mice (N=20) with 1 Hemagglutination Unit of mouse-adapted influenza virus. Using analytical methods, we investigated the major and sub- classes of lipids from isolated myelin.

RESULTS: We found major changes in major and sub-lipid classes including phosphatidyl lipids, diacylglycerols and ceramides.

CONCLUSIONS: These novel findings may help to explain how the myelin is involved in both neurodegenerative diseases and peripheral virus infection, ultimately manifesting in the alteration of our behavior and cognition.

The effect of prebiotic consumption on the gastrointestinal microbiota of healthy adults: A randomized, controlled, crossover trial

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INTRODUCTION: Chronic stress is recognized as a contributing factor in health conditions such as depression, anxiety, and sleep disturbances. Prebiotic consumption, which changes the gastrointestinal microbiota in a way that benefits host health, is one potential treatment being explored to alleviate these conditions. Accordingly, we aimed to determine the effects of fructooligosaccharide (FOS) and galactooligosaccharide (GOS) consumption on changes in the gastrointestinal (GI)

microbiota and biological and behavioral markers of stress among adults.

METHODS: A randomized, controlled, double-blind, crossover trial was conducted in healthy adults (n=24) between 25 and 45 years of age. Participants consumed two study beverages in a counter balanced order: 1) 8 oz per day 1% Lactaid (control) and 2) 8 oz of 1% Lactaid with 5 g FOS and 5 g GOS (prebiotic). Each study beverage was consumed daily for 4-weeks with a 2 to 4-week washout between study periods. Fecal samples were collected at the beginning and end of each period. Following fecal DNA extraction, the V4 region of the 16S rRNA gene was amplified. Sequencing was performed on an Illumina HiSeq. Sequence data were analyzed with DADA2 and QIIME 2. Taxonomy was assigned with the GreenGenes 13_8 99% OTU reference database. Statistical analyses were conducted in SAS 9.4 using linear mixed modeling with time, treatment, and the time by treatment interaction as fixed effects and participant and period as random effects.

RESULTS: Prebiotic consumption increased the relative abundance of *Bifidobacterium* (p=0.01) compared to the control group. In addition, there was an increase observed in the relative abundance of Erysipelotrichaceae *Clostridium* (p=0.04) in the prebiotic group and a decrease in the control group. In contrast, there was a decrease observed in the relative abundance of *Prevotella* (p=0.004) in the prebiotic group and an increase in the control group.

CONCLUSIONS: These results demonstrate that FOS and GOS induce changes in the GI microbiota of healthy adults. Ongoing analyses include an examination of the relationships between 24-hour urinary free cortisol concentrations, a potential biological marker of stress, and relative abundance of microbes examined in the current study.

The effect of an unrestrictive diet program (iDip) on weight management with primary focus on protein and fiber intake and calorie reduction

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INTRODUCTION: Obesity and weight management are possibly the most prevalent issues in public health. Obesity has been known to increase the risk of diseases including hypertension, diabetes, heart diseases, cancers, sleep apnea, and arthritis. Various scientific studies on weight loss and management plans have been presented to combat the epidemic issue. However, bariatric surgery continues to be the most credible source since not a lot of effective dietary weight management programs are widely available. This study is to develop a cost-effective program for safe weight loss and sustainable maintenance for overweight adults with associated comorbidities through dietary modifications.

METHODS: The approach of Individualized Diet Improvement Program (iDip) was to build knowledge of participants to enable personalized selection of food items for weight loss and maintenance with an emphasis on increasing protein and fiber intake and reducing calories. Fourteen adults with BMI ≥ 27kg/m2 and associated comorbidities were recruited. The study comprised of 22 diet improvement education sessions over 12 months with follow-up for 6 months. Daily self-weighing was required via Wi-Fi scale. Food Frequency Questionnaire (FFQ) data was collected at baseline and at 12 months. Feedback was provided for 24-hour records in the form of a protein-fiber (PF) plot, in which a target weight loss (protein: 7-11g/100kcal, fiber: 1.8-3.2g/100kcal) and maintenance (protein: 4-8g/100kcal, fiber: 1.4-2.8g/100kcal) box were plotted for easy target visualization.

RESULTS: Out of 14 participants, 12 (86%) completed all 22 diet improvement sessions and most of them weighed daily. All completers found the program beneficial. Mean weight loss at 6 months and 12 months was -6.1kg ± 1.2 and -4.8kg ± 1.4, respectively. Four participants did not lose weight but no significant weight gain from baseline was observed. Of these 4, 1 participant showed rebound weight gain (-14.5kg at 6 months and +0.7kg at 12 months). Eight participants achieved weight loss with maintenance: mean weight loss at 6 months and at 12 months was -6.6kg ± 1.1 and -7.8kg ± 0.8, respectively. Although mean fiber intake showed no change from baseline (maintained at 1.3g/100kcal), overall PF plot dietary pattern moved toward the target weight loss box as the program continued. Mean protein intake at 6 months increased to 5.4g/100kcal ± 0.3 from 4.1g/100kcal ± 0.3 at baseline.

CONCLUSIONS: The majority (67%) of participants successfully lost weight and maintained losses for

12 months without strict diet instructions, showing the feasibility of the informed decision-making approach. Further studies will be required to improve weight loss rates and develop an approach to non-responders.

Effects of yeast on gut integrity and fecal characteristics of dogs undergoing abrupt diet transition

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INTRODUCTION: When pet owners decide to change diets, rapid diet transition may cause gastrointestinal distress. Yeast products may help with digestive upset during diet transition due to their nutraceutical properties. The objective of this study was to determine the effects of a yeast product on the gut integrity and fecal characteristics of adult dogs undergoing an abrupt diet transition. All animal care and experimental procedures were approved by the University of Illinois Institutional Animal Care and Use committee prior to experimentation.

METHODS: Twelve adult female beagles (age: 5.16 ± 0.87 yr, BW: 13.37 ± 0.68 kg) were used in a replicated 4 x 4 Latin square design with four 28-d experimental periods. During d1-14, dogs were fed a kibble diet and supplemented with placebo or yeast product. During d15-28, dogs remained on their placebo or yeast treatments, but were fed a canned diet or high-fiber diet. Fresh fecal samples were collected on d13, 16, 20, 24 and 27 for measurements of pH, dry matter, calprotectin, IgA, *E. coli* and *C. perfringens*. All data were analyzed using Mixed Models procedure of SAS 9.4. Fecal pH, dry matter, calprotectin, IgA and *E. coli* were not affected ($P>0.05$) by treatment before diet transition.

RESULTS: Dogs supplemented with yeast product tended to have higher ($P<0.10$) fecal *C. perfringens* than the controls. After diet transition, most parameters were not altered by treatment except that yeast-supplemented dogs tended to have higher ($P<0.10$) fecal IgA than controls.

CONCLUSION: Results suggest that the yeast product modestly improved intestinal health after abrupt diet transition in adult dogs.

Single nucleotide polymorphisms in BCO1 and CD36 are related to macular pigment among children

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INTRODUCTION: Xanthophyll carotenoids in the retina – assessed as macular pigment optical density (MPOD) – have been linked to visual and cognitive health. While genetic variations in genes related to carotenoid cleavage (e.g., beta-carotene-15,15'-monooxygenase [*BCO1/BCMO1*]) and xanthophyll transport (e.g., Cluster Determinant 36 [*CD36*]) proteins have been shown to influence MPOD in adults, it is unknown whether these relationships are evident in childhood. We examined the influence of genetic variation (single nucleotide polymorphisms [SNPs]) in *BCO1* and *CD36* on MPOD in 7-10 year-olds (*N*=134).

METHODS: MPOD was assessed using heterochromatic flicker photometry. DNA was extracted from saliva samples and genotyped for six tag-selected SNPs, identified by previous work among adults. Ancestry informative markers (AIMs) were genotyped to account for ethnic heterogeneity. Dietary lutein and zeaxanthin (L + Z) was assessed using 7d food records among a subsample (N=82).
RESULTS: Minor allele frequencies (MAF) of T allele at *BCO1*-rs7501331, T allele at *CD36*-rs1527483, C allele at *CD36*-rs3173798 were 0.194, 0.090 and 0.213, respectively. MAF in current study were aligned with MAF (global) in the 1000 Genomes Project. No deviation from Hardy-Weinberg equilibrium was detected. In the partially adjusted (AIMs, age, sex, BMI %tile) models, three of the six SNPs were associated with low MPOD. Carriers of the *BCO1*-rs7501331 T allele had significantly lower (~18%) MPOD than the CC homozygotes (p=0.042). Minor allele (T) carriers of *CD36*-rs1527483 exhibited lower MPOD (~23%) than CC homozygotes (p=0.043). *CD36*-rs3173798 C allele carriers had ~32% lower MPOD than those with the TT genotype (p<0.001). Applying the fully adjusted models (AIMs, age, sex, BMI %tile, L + Z) among the subsample revealed that L + Z was a significant predictor of MPOD (p=0.04); however, *CD36*-rs3173798 was the only SNP associated with MPOD (p=0.009).
CONCLUSIONS: MPOD in children is potentially influenced by individual genetic variation. Specifically, variation in the *CD36* gene, responsible for a protein involved in transport of lipids and carotenoids, was a robust predictor of macular pigment in children. These findings have implications for future recommendations for dietary or supplemental approaches to improving xanthophyll status among children.

DATA BLITZ SESSION PRESENTATION

Training the gut: how exercise impacts the gut microbiota and gut barrier function

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INTRODUCTION: The gastrointestinal tract contains trillions of microbes, collectively called the gut microbiota, that play essential roles in host physiology and health. While diet is well-established to impact the composition of the gut microbiome, increasing evidence suggests that exercise also influences gut physiology.
METHODS: We reviewed all published animal and human studies on exercise and the gut microbiome, gut barrier, and gut immune system.
RESULTS: Exercise independently alters the composition and functionality of the gut microbiota in both animal and human studies. Exercise also influences the integrity of the gut epithelial barrier and modulates the gut immune system.
CONCLUSION: Exercise has a significant impact on gut physiology with potential implications for human health and disease.

DATA BLITZ SESSION PRESENTATION

Effect of beef quantity on daily muscle protein synthesis during resistance training in middle-aged adults

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INTRODUCTION: Higher protein diets (>1.6 g/kg/d) are thought to maximize daily myofibrillar protein synthesis (MPS) rates to resistance exercise training. Current research has focused on isolated protein sources to stimulate MPS without regard to other nutritional factors within a healthy

diet. Therefore, we examined the impact of targeted dietary counseling underlining food-focused healthy eating patterns with equal distribution of protein through high-quality sources at the Recommended Daily Allowance (RDA) or in excess on resistance exercise mediated daily rates of MPS in middle-aged adults.

METHODS: Nineteen healthy middle-aged adults (11M, 8F, 48 ± 7 y, BMI: 28.9 ± 3.7 kg/m2, 7451 ± 4957 steps/d) were randomized to consume protein at the RDA (0.8-1.0 g/kg/d, n=10) or twice the RDA (2×RDA, 1.6-1.8 g/kg/d, n=9) for 2 weeks. Participants were counseled by a registered dietitian on equal distribution of protein between meals and consumed either 15g (RDA) or 30g (2×RDA) protein from lean beef in the immediate post-exercise period and nightly before sleep. Week 0 (days -7 to 0) served as a dietary habituation, and week 1 (days 1-8) included whole body resistance exercise sessions (3/week) with the dietary intervention. On day 0, participants ingested 5 mL/kg over 10.5h of deuterated water (2H2O) for deuterium enrichment of body water, with maintenance daily doses of 0.625 mL/kg/d 2H2O for days 1-8. Repeated saliva and muscle biopsies from the *vastus lateralis* were collected throughout the 1-week intervention to assess daily rates of myofibrillar protein synthesis.

RESULTS: The 2×RDA group (1.6 ± 0.4 g/kg/d) consumed significantly more protein than the RDA group (1.0 ± 0.4 g/kg/d, P=0.01). Steady-state body water enrichment was not different (P=0.94) between the 2×RDA (0.9 ± 0.3%) or RDA (0.9 ± 0.1%) groups. Daily MPS was not different (P=0.43) between RDA (0.91 ± 0.2 %/d) and 2×RDA groups (1.13 ± 0.6 %/d) during the 1-week intervention.

CONCLUSIONS: Daily MPS with resistance exercise training is not altered by a more protein-dense diet when at least the RDA is consumed in middle-aged adults. Our data suggest that multi-component nutritional strategies focusing on protein quality, distribution, and timing may supersede the importance of only considering total quantity to support early hypertrophic protein remodeling with resistance exercise.

Development and initial validation of a theory of planned behavior survey for sodium restriction in hemodialysis

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INTRODUCTION: A low-sodium diet is commonly recommended to prevent excessive fluid intake and sodium retention in patients undergoing hemodialysis (HD). Excessive sodium intake contributes to volume overload in HD, exacerbating hypertension and contributes to poor cardiovascular outcomes. HD patients are routinely counseled to reduce dietary sodium, but the efficacy of educational and behavioral approaches is low, often resulting in poor rates of dietary adherence. The purpose of this study was to develop a dietary questionnaire to evaluate HD patient barriers to eating a low-sodium dietary based on the Theory of Planned Behavior (TPB).

METHODS: The Dietary Sodium Restriction Questionnaire (DSRQ) was selected for modification, with permission, to transition from use in heart failure to HD. The original DSRQ had three TPB constructs: attitude behavior (AB), subjective norm (SN), and perceived behavior control (PBC). Four renal dietitians and survey analysts were consulted for feedback on survey design. Each TPB construct was expanded to 12 questions increase survey reliability in HD. The survey was then piloted for test-rested validity and reliability in 12 HD subjects before and after one-month of a usual diet.

RESULTS: Initial Cronbach's alpha was 0.89, 0.76, and 0.73, while one-month follow-up Cronbach's alpha was 0.96, 0.88, and 0.68, for AB, SN, and PBC respectively. Mean baseline construct scores were 4.3, 4.6, and 3.5 (AB, SN, and PBC respectively), which were not significantly different upon one-month follow-up (all p>0.05). Patients rated frequency of following a low-sodium diet an average of 3.8, while ease of following a low-sodium diet was 4.0 (1-5 scale).

CONCLUSIONS: The modified DSRQ appears to have good initial and follow-up reliability for use in HD. Patients rated a high frequency and ease of following a low-sodium diet, despite low PBC. It is possible that high AB and SN account for the positive feelings concerning the diet. It will be important to implement this tool in conjunction with dietary records and interventions to fully model behavioral intentions and change. Further investigation will focus on statistical factor analysis of the three constructs.

Retinoic acid induces differential expression pattern depending on polarization status in macrophages

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INTRODUCTION: Atherosclerosis is an inflammatory disorder that underlies cardiovascular diseases, the main cause of death worldwide. It results from the accumulation of lipids within the vascular intima, driving the formation of atherosclerotic plaques that thicken the arterial walls and occlude the bloodstream. Macrophages appear to be the main cell type involved in atherosclerosis development and progression. By engulfing cholesterol carried by lipoproteins, accumulating lipids and secreting proinflammatory cytokines, macrophages contribute to worsen/exacerbate atherosclerotic plaques. However, these immune cells can also alter their phenotype according to microenvironmental signals to exert tissue repair functions. It has been hypothesized that the balance between pro-atherogenic (M1) and anti-inflammatory (M2) macrophages within the plaque can determine the fate of the injury, either promoting tissue damage or repairing the lesion. Considering the broadly evidenced effects of Vitamin A in reducing lipid content and inhibiting the production of inflammatory cytokines in different cell types including macrophages, we hypothesize that vitamin A will attenuate pro-inflammatory signals in macrophages by promoting changes on gene expression.

METHODS: For this purpose, we used RNAseq technology as an unbiased approach to analyze genetic differences between the main macrophage polarization states (M1 vs M2), and the effect of a retinoic acid (RA) exposure, the active form of vitamin A. We used murine bone marrow derived macrophages differentiated with M-CSF for a week, and further polarized to pro-inflammatory, pro-atherogenic phenotype (M1) using a combination of LPS and INF or to anti-inflammatory, tissue repairing macrophages (M2) using IL-4 for 24 hours. Unpolarized macrophages (M0) were used as a control. Upon polarization, we added 1μM of RA for 6 hours, to further isolate and purify total RNA.

RESULTS: Using pathway analysis, we aim to find the molecular pathways regulated by RA in macrophages, an area of research poorly understood by the scientific community.

CONCLUSION: We believe that understanding the molecular mechanisms by which RA regulates macrophage polarization will set the bases for future studies regarding atherosclerosis and its relationship with vitamin A.

The impact of external beam radiation therapy on oxidative damage in the transgenic adenocarcinoma of the mouse prostate (TRAMP) prostate cancer model

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INTRODUCTION: External beam radiation therapy (EBRT) is one of the most common treatments for primary prostate cancer. The primary limitation for EBRT is the potential for damage to surrounding tissues. Epidemiological evidence indicates that tomato products are associated with reduced PCa progression. Tomatoes contain carotenoids and other potent antioxidants that may protect the surrounding tissue from the detrimental effects of EBRT. The objective of this study is to determine if tomato feeding can alter early oxidative and inflammatory events following a single dose of radiation that may predict a more successful therapeutic outcome.

METHODS: To test our hypothesis, male TRAMP mice (n=60) were provided a powdered AIN-93G diet (Control) or an AIN-93G diet modified to contain 10% lyophilized tomato paste (TP; n=30) beginning at 4 weeks of age. Mice were monitored by ultrasound biweekly for in vivo tumor detection and 3-D volumetric growth measurement. Tumors were irradiated with 7.5 gy (n=15 per diet) or 0 gy (sham, n= 15 per diet) of radiation by a Cobolt-60 source once the animal had

a 1000 mm^3 tumor. Animals were euthanized after 24 hours and carotenoids were measured by high performance liquid chromatography (HPLC) in the tumor and liver. Sections of tumor, liver, kidneys, bladder, lymph, bladder and intestines were stained by hematoxylin and eosin-stained (H&E) and were assessed for tumor grade and inflammatory markers. Pro-inflammatory cytokines (IL-6 and TNFα) will be measured from the serum and tumor tissues by ELISA. Oxidative damage will be analyzed through the γH2AX assay and through measurement of reduced glutathione.

RESULTS: This study will be the first to explore the effects of tomato powder on the PCa tumor microenvironment following irradiation. We hypothesize that lifelong tomato consumption will delay tumor growth; will protect surrounding tissues from inflammatory and oxidative damage (reducing circulating pro-inflammatory cytokines); and will reduce histopathological markers of inflammation in surrounding tissues following a single exposure to 60-CO radiation in the TRAMP model.

Free fatty acids rewire cancer metabolism in obesity-associated breast cancer through estrogen receptor and mTOR signaling

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INTRODUCTION: Obesity is a risk factor for postmenopausal estrogen receptor alpha positive (ER(+)) breast cancer. Molecular mechanisms activated by the factors from plasma that contribute to this risk and how these mechanisms affect ERα signaling are yet to be elucidated.

METHODS: To identify such mechanisms, we performed whole metabolite and protein profiling in plasma samples from women at high risk for breast cancer, which led us to focus on factors that were differentially present in plasma from obese vs. non-obese post-menopausal women. These studies combined with in vitro assays identified free fatty acids (FFAs) as circulating plasma factors that correlate with increased proliferation and aggressiveness in ER(+) breast cancer cells.

RESULTS: FFAs activated both ERα and mTOR pathways and rewired metabolism in breast cancer cells. Pathway preferential estrogen-1 (PaPE-1), which targets ERα and mTOR signaling, was able to block changes induced by FFAs. In fact, PaPEs were more effective in the presence of FFAs, suggesting a role for obesity-associated gene and metabolic rewiring in providing new targetable vulnerabilities for ER(+) breast cancer in postmenopausal women.

CONCLUSIONS: Our findings provide a basis for preventing or inhibiting obesity-associated breast cancer by using PaPEs that would reverse these newly discovered metabolic properties of breast tumors in obese postmenopausal women.

Potato ingestion as an effective race fuel alternative to improve cycling performance in trained cyclists

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INTRODUCTION: Carbohydrate (CHO) ingestion is an established strategy to improve endurance performance. Race fuels should not only sustain performance, but also be readily digested and absorbed, as well as replenish electrolytes. Potatoes are a cost-effective option that fulfills these criteria; however, their impact on endurance performance remains unexamined. We aimed to compare the effects of potato purée (POT) ingestion during endurance cycling, on subsequent performance, versus commercial CHO gel (GEL), or a control (water, CTL).

METHODS: Ten trained cyclists (28.2±5.6y; 70.1±7.4kg; 1.7±0.1m; 62.7±9.3mL/kg/min) consumed

a standardized breakfast then performed a 2h cycling challenge (60-85%VO_2max) followed by a time trial (6kJ/kg body mass) while consuming POT, GEL, or CTL in a randomized-crossover design. POT, GEL and CTL were administered with U-[$^{13}C_6$]glucose for an indirect estimate of gastric emptying rate. Repeated blood samples were collected.

RESULTS: Time trial performance significantly improved ($p<0.01$) with POT (32.2±1.9min) and GEL (32.4±1.9min) versus CTL (38.6±1.9min); no difference between POT and GEL was observed ($p=1.00$). Post challenge blood glucose concentrations were lower ($p<0.01$) with CTL (77.9±4.2mg/dL) versus POT (95.5±4.4mg/dL) and GEL (95.6±4.4mg/dL). Similar results ($p<0.001$) were observed post time trial for blood glucose concentrations (WAT, 68.5±4.2 mg/dL; GEL, 97.5±4.2mg/dL; POT, 92.0±4.2mg/dL). No difference ($p=0.88$) in blood glucose concentrations were observed between GEL or POT conditions at both time points. Post-challenge blood lactate concentrations were higher ($p=0.005$) with GEL (5.1±0.4mmol/L) versus POT (3.4±0.4mmol/L). Blood U-[$^{13}C_6$]glucose enrichments were not different between GEL or POT ($p>0.05$).

CONCLUSIONS: Potatoes served as a viable alternative to commercial gels by sustaining performance and blood glucose concentrations during endurance cycling events in trained cyclists.

Applying machine-learning to human gastrointestinal microbial species to predict dietary intake

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INTRODUCTION: To better understand host-microbe interactions, a more computationally intensive, multivariate, machine learning approach must be utilized. Accordingly, we aimed to identify biomarkers with high predictive accuracy for dietary intake.

METHODS: Data were aggregated from five randomized, controlled, feeding studies in adults (n=199) that provided avocados, almonds, broccoli, walnuts, or whole grain oats and whole grain barley. Fecal samples were collected during treatment and control periods for each study for DNA extraction. Subsequently, the 16S rRNA gene (V4 region) was amplified and sequenced. Sequence data were analyzed using DADA2 and QIIME2. Marginal screening using the Kruskal-Wallis test was performed on all species-level taxa to examine the differences between each of the 6 treatment groups and respective control groups. The top 20 species from each diet were selected and pooled together for multiclass classification using random forest. The resultant bacterial species were further decreased in a stepwise fashion and iteratively analyzed with the variable importance generated from random forest to determine a compact feature set with a minor loss of accuracy in the prediction of food consumed.

RESULTS: When all six foods were analyzed together using the top 20 species of each diet, oats and barley were frequently confused for each other, with 44% and 47% classification error, respectively, and the overall model accuracy was 66%. Collapsing oats and barley into one category, whole grains, reduced the classification error of the whole grain category to 6% and improved the overall model accuracy to 73%. Refitting the random forest with the top 30, 20, and 10 important species resulted in correct identification of the 5 foods (avocados, almonds, broccoli, walnuts, and whole grains) 75%, 74%, and 70% of the time, respectively.

CONCLUSIONS: These results reveal promise in accurately predicting foods consumed using bacterial species as biomarkers. Ongoing analyses include incorporation of metagenomic and metabolomic data into the models to improve predictive accuracy and utilize the multi-omics dataset to predict health.

Relationship between urine hydration indices and 24-hour urinary cortisol concentrations

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INTRODUCTION: Epidemiological evidence indicates that the majority of individuals in the United States are chronically insufficiently hydrated, as indicated by increased urine concentration. However, the relationship between urine hydration markers and physiological adaptations to chronically low hydration has not been thoroughly studied. Accordingly, the aim of this study was to investigate the relationship between urine specific gravity (USG) and color (UC), and 24-hour urinary free cortisol (UFC) concentrations in an adult population.

METHODS: Adult participants aged 26-45 years (N=51, 33 females) were recruited from the central Illinois area. Participants collected their urine over a 24-hour period. Pooled urine samples were analyzed for USG and color. UFC concentration was measured using an enzyme-linked immunosorbent assay. Whole-body adiposity (%Fat) was assessed via dual energy x-ray absorptiometry (DXA). Pearson and Spearman correlations were conducted to assess bivariate relations between variables. Age and sex were also included as covariates in partial correlation analyses.

RESULTS: Pearson correlations revealed a positive association between UFC concentrations and hydration biomarkers in both the 24-hour pooled ($r=0.57$, $p<0.01$) and FMU samples ($r=0.71$, $p<0.01$). These associations persisted following adjustment for age, %Fat. Additionally, Spearman correlations revealed a positive relationship between UFC concentrations and 24-hour pooled urine color ($rho=0.45$, $p=0.01$).

CONCLUSIONS: Greater urine concentration, as indicated by elevated USG and color, was related to higher UFC concentrations. Additional experimental work is necessary to determine the extent to which changes in water intake contribute to urinary cortisol and other markers of stress.

Graduate Student Poster Session Floor Plan

ACES Library, 1st Floor
Heritage Room and Sims Executive Conference Room
5:15 p.m. – 6:40 p.m.

Poster Judges

Orange Team
Dr. Elvira de Mejia
Dr. Erik Nelson
Dr. Hans Stein*

Green Team
Dr. Jaume Amengual
Dr. Maria de Godoy
Dr. Yuan-Xiang Pan*

Blue Team
Dr. John Erdman*
Dr. Marcia Siegel
Dr. Andrew Steelman

Red Team
Dr. Anna Arthur
Dr. Juan Loor*
Dr. Margarita Teran-Garcia

* Team captain