University of Illinois at Urbana-Champaign
Division of Nutritional Sciences

2015 NUTRITION SYMPOSIUM

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

MARCH 19, 2015

Welcome

On behalf of the Nutritional Sciences Graduate Student Association (NSGSA), Division of Nutritional Sciences (DNS), and all participating presenters, we would like to welcome you to the 2015 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 provides 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 Experimental Biology and American Society of Animal Sciences.

This year, NSGSA is honored to have Dr. Michael Grandner deliver the keynote address, "What do we know about the relationship between diet and sleep? Data from population and laboratory studies." Dr. Grandner will discuss the emerging evidence of sleep and its role in food intake and metabolism, and the reciprocal role of diet in sleep/wake regulation. Further, he will explain how this relationship may partially explain the association between sleep duration and obesity risk.

Additionally, NSGSA is proud to highlight the work of world-class faculty members through a mini-symposium. This year's presentations address nutrition throughout the life cycle and will feature Drs. Yuan-Xiang Pan, Sharon Donovan, Margarita Teran-Garcia, and Karen Chapman-Novakofski.

We are grateful to the many people involved with this meeting and program. We would like to first thank our keynote speaker, Dr. Michael Grandner. 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. We also thank the many others who contributed to this undertaking, including DNS staff and College of ACES Advancement Office staff. 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 Board

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 to DNS as well as giving 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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Nutritional Sciences Graduate Student Association

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Schedule of Events

MARCH 19, 2015

***8:15 a.m. – 9:15 a.m. .....Breakfast**
Sims Executive Conference Room, ACES Library

Sponsors, 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. Matthew R. Panasevich

9:30 a.m. Patricia G. Wolf

9:45 a.m. Anthony A. Wang

10:00 a.m. Marta K. Zamroziewicz

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. Joshua W. Smith

10:45 a.m. Natasha C. Cole

11:00 a.m. Tzu-Wen Liu

11:15 a.m. Sasha M. McCorkle

11:30 a.m. – 12:30 p.m. .....Lunch
Heritage Room, ACES Library

DNS students and sponsors are invited, RSVP required

12:30 p.m. – 12:45 p.m......**Break**

***12:45 p.m. – 2:45 p.m.**.....**Faculty Mini-Symposium**
Monsanto Room, ACES Library

"Nutritional sciences: Impacting health at every age"

12:45 p.m. Dr. Yuan-Xiang Pan:
Maternal nutrition programs physiological consequences through epigenetics in animal models

1:15 p.m. Dr. Sharon M. Donovan:
Breastfeeding reduces circulating inflammatory cytokines and inflammatory gene pathways in immune cells compared to formula-feeding in the first 6 months of life

1:45 p.m. Dr. Margarita Teran-Garcia:
Emerging adulthood: An opportunity to prevent chronic disease

2:15 p.m. Dr. Karen Chapman-Novakofski:
Nutrition and the older adult

2:45 p.m. – 4:00 p.m......**Break**

***4:00 p.m. – 5:00 p.m.**.....**Keynote Address by Dr. Michael Grandner, University of Pennsylvania**
180 Bevier Hall

"What do we know about the relationship between diet and sleep? Data from population and laboratory studies."

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, DNS students, faculty, and staff are invited

**Open to the general public*

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Keynote Speaker: Dr. Michael A. Grandner

Dr. Grandner is an Instructor in the Department of Psychiatry at the University of Pennsylvania. He is board certified in Behavioral Sleep Medicine. His research focuses on how sleep and sleep-related behaviors are related to cardiovascular disease, diabetes, obesity, neurobehavioral functioning, mental health, and longevity. He is currently studying how sleep patterns are related to health and functioning, and the social, environmental, and behavioral factors that determine how we sleep. Dr. Grandner earned his B.A. in Psychology from the University of Rochester and his Ph.D. in Clinical Psychology from the joint doctoral program at San Diego State University and the University of California, San Diego. He completed a postdoctoral fellowship in Sleep and Circadian Neurobiology at the University of Pennsylvania, as well as an accredited fellowship in Behavioral Sleep Medicine and a Masters in Translational Research at Penn. He has published over 50 articles and chapters on issues relating to sleep and health. He serves on the Mental Health Task Force for the National Collegiate Athletics Association (NCAA). He has received awards and honors for his work from the Society of Behavioral Sleep Medicine, Sleep Research Society, American Academy of Sleep Medicine, American Heart Association, Population Association of America, and other groups. He has also received two separate Outstanding Professor Awards for his teaching of statistics.

"What do we know about the relationship between diet and sleep? Data from population and laboratory studies"

For over 50 years, epidemiologic literature has documented an association between habitual short sleep duration and mortality risk. Since that time, and especially in the past decade, there have been a number of studies that have sought to understand the reasons for this association. Obesity has emerged as a potentially important link between sleep and mortality. There have been over 60 studies documenting associations between short sleep duration and obesity. To unpack this association, studies have examined a number of factors, including physiologic studies of insulin/glucose regulation, secretion of metabolic hormones such as leptin and ghrelin levels of adipokines, the role of sleep loss in inflammatory processes, etc. Other studies have examined the behavioral as well. For example, there is a rich literature documenting deficits in decision making associated with sleep loss, and recent studies that this phenomenon extends to food choices. Other studies have examined the role of sleep loss on the timing, amount and composition of food intake. In addition, reciprocal directions of causality, whereby meal timing, amount, and composition may play a role in sleep/wake regulation. Regarding associations between sleep and nutrients, there have been a few studies that examined relationships between habitual sleep variables and dietary nutrients. For example, in a study of women enrolled in the Women's Health Initiative, shorter objective sleep duration was associated with a greater intake of fat in the diet, as was increased levels of subjective (but not objective) napping, suggesting links with daytime tiredness. Another study examined national-representative data from the National Health and Nutrition Examination Survey and found that habitual short and long sleepers were more likely to have a diet that had less variety than normative sleepers. This was borne out in macronutrient profiles which showed differences, especially in protein and carbohydrate consumption. In examining sleep symptoms, some special diets were associated with sleep disruptions as well. In examining micronutrients, some preliminary evidence from these studies suggests that nutrients, including some fatty acids, amino acids, vitamins, and minerals may have unique relationships to sleep. Taken together, there is emerging evidence that sleep plays a role in food intake and metabolism, which may feed back and play a reciprocal role in sleep/wake regulation. Further, this relationship may partially explain the association between sleep duration and obesity risk.

Dr. Michael A. Grandner's Keynote Address
4:00 – 5:00 p.m. in 180 Bevier Hall

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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

Faculty Mini-Symposium *"Nutritional Sciences: Impacting health at every age"*

12:45 p.m. – 2:45 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 31

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Abstracts

Graduate Student Oral Presentations Session 1

Moderately-fermentable potato fiber attenuates symptoms during experimental colitis

Matthew. R. Panasevich, J. M. Allen, J. A. Woods, R. N. Dilger
Division of Nutritional Sciences, University of Illinois at Urbana-Champaign, Urbana, IL

Potato fiber (PF), a co-product of potato starch isolation, is a moderately-fermentable dietary fiber that was evaluated for its efficacy in attenuating the acute inflammatory response in a dextran sodium sulfate (DSS)-induced colitis mouse model. We hypothesized that PF would attenuate the inflammatory response through production of short-chain fatty acids (SCFA). Male C57Bl/6J mice (N=67) were randomized based on initial body weight to diets containing either cellulose (CELL; N=34) or PF (N=33) for the 22 d feeding study. On study d 14, mice were provided either distilled water or 2% (wt/vol) DSS in drinking water for 5 d, and tissues were collected at study termination. Daily weights of mice, food, and water were collected from d 14 through d 22. Colon and cecum tissues were analyzed for changes in gene expression, and SCFA concentrations were quantified in cecal contents. Mice provided the PF/DSS treatment exhibited a delayed ($P < 0.05$) loss in body weight compared with mice provided the CELL/DSS treatment at d 4 and d 5 post-DSS administration. Furthermore, a diet by water treatment interaction ($P < 0.05$) was noted for cecal SCFA concentrations, which were higher in the PF/DSS treatment compared with the CELL/DSS treatment. Overall, dietary PF attenuated body weight loss due to experimental colitis in mice, potentially due to the production of SCFA.

Colonic microbes contributing to hydrogen generation and utilization correlate with breath methane and functional symptoms in patients with chronic constipation and constipation predominant irritable bowel syndrome

Patricia G. Wolf[1], N.Chia[2], A.E Bharucha[2], H.R. Gaskins[1]
[1]*Division of Nutritional Sciences, University of Illinois Urbana-Champaign, Urbana, IL*
[2]*Mayo Clinic, Rochester, MN*

This study evaluated relationships between hydrogenogenic and hydrogenotrophic microbes, breath methane, and functional symptoms in 25 constipated patients and 25 healthy controls. Breath hydrogen and methane production after oral lactulose, gastric emptying, and small intestinal and colonic transit by scintigraphy were measured. Stool and sigmoid colonic mucosal biopsy microbial abundance was quantified using Real-Time qPCR targeting the functional genes methyl coenzyme M reductase A (mrcA), dissimilatory sulfite reductase A (dsrA), and FeFe (FeFe-hydA) and Fe-only (Fe-hydA) hydrogenase A. Abundance of all functional gene targets were significantly higher in constipated mucosal samples, which correlated with being functionally constipated and negatively correlated with colonic transit at 24 h. Methane production positively correlated with Fe-hydA at baseline, and mucosal mcrA abundance at 60 and 120 min after oral lactulose intake. In stool, dsrA positively correlated with methane production at all time points. Functional constipation correlated with delayed gastric emptying, slowed colon transit, and 2 h breath methane levels. These data indicate hydrogenogenic and hydrogenotrophic microbes are more abundant in patients with chronic constipation than healthy controls, correlating with delayed colon transit, gastric emptying, and higher breath methane in patients.

Cumulative effect of SNP polymorphisms in gut-microbiota related genes are associated with obesity phenotypes in preschool age children

Anthony A. Wang[1], K. Harrison[2], S.M. Donovan[1], M.D. Teran-Garcia[1], STRONG Kids Research Group
[1]*Division of Nutritional Sciences, University of Illinois at Urbana-Champaign, Urbana, IL;* [2]*Institute for Social Research, University of Michigan, Ann Arbor, MI*

Childhood obesity is a nutrition-related disease with multiple underlying etiologies. While genetic factors contribute to obesity, the gut microbiota has been implicated through fermentation of non-digestible polysaccharides to short chain fatty acids (SCFA). SCFA provide additional substrate for energy harvest and storage, and are postulated to be signaling molecules effecting expression of gut hormones. This study investigated the cumulative effect of single nucleotide polymorphisms (SNP) of genes involved in SCFA recognition and metabolism on obesity in preschool-age children. Study participants were from the STRONG Kids Illinois and Michigan cohorts (n=472). Height and weight were measured to calculate obesity-related phenotypes. Genomic DNA was extracted from saliva, and the Fluidigm® SNP genotyping platform was used. Statistical analyses were performed in SAS 9.3 with age and sex as covariates. Of 47 SNPs in 20 candidate genes, 4 gene variants (PPARϒ, CD36, IL6, and SLC16A3) contributed 3.67% of the variability in BMI z-score. A categorical variable was constructed by summing risk alleles each individual carried for these SNPs and by separating the data into tertiles. Children in the upper tertile (5-7 alleles, 7.1% of cohort) had higher BMI z-score compared to those in the carrying 0-2 alleles (0.16±0.9 vs. 0.80±0.71, p=0.0002). These data confirm the cumulative effect of these genetic variants on early-onset obesity, warranting further investigation into the mechanisms driving these associations.

Nutritional neuroscience in cognitive aging: A role for anterior cingulate cortex in the mediation of O3PUFAs on executive function

Marta K. Zamroziewicz[1], E.J. Paul[1], R. Rubin[1], A.S. Keck[2,3], A.K. Barbey[1,3]
[1]*Decision Neuroscience Laboratory, Beckman Institute for Advanced Science and Technology, Urbana, IL;* [2]*Carle Foundation Hospital, Urbana, IL;*[3]*Division of Nutritional Sciences, University of Illinois at Urbana-Champaign, Urbana, IL*

Although diet has a substantial influence on the aging brain, the relationship between biomarkers of diet and aspects of brain structure remains unclear. This study examines the neural mechanisms that mediate the relationship between omega-3 polyunsaturated fatty acids (O3PUFAs) and executive function in at-risk, cognitively healthy older adults. We hypothesized that higher levels of O3PUFAs are associated with better performance on tests of executive function and that this relationship is mediated by gray matter volume within specific regions of the frontal cortex. We studied 40 cognitively intact adults between the ages of 65 and 75 with the APOE e4 polymorphism, examining the relationship between biomarkers of O3PUFAs, tests of executive function (measured by the Delis-Kaplan Executive Function System), and gray matter volume within regions of the frontal cortex. A mediation analysis revealed that gray matter volume of the left rostral anterior cingulate cortex partially mediates the relationship between O3PUFA biomarkers and executive function. The results provide evidence to support the role of the anterior cingulate cortex in the mediation of O3PUFAs and executive function in at-risk healthy older adults. Through their link to executive function and neuronal measures of frontal cortex volume, O3PUFAs show potential as a nutraceutical agent to prevent dysfunction in the aging brain.

Abstracts

Graduate Student Oral Presentations Session 2

A role for *BCO1* beyond carotenoid metabolism: Effects on androgen status and prostatic homeostasis

Joshua W. Smith[1], N.A. Ford[2], S.K. Clinton[3], J.W. Erdman, Jr [1]
[1]*Division of Nutritional Sciences, University of Illinois at Urbana-Champaign, Urbana, IL;* [2]*Nutrition Research, Hass Avocado Board, Irvine, CA;* [3]*The James Cancer Hospital and Comprehensive Cancer Center, The Ohio State University, Columbus, OH*

Genomic alterations in carotene-15,15′-monooxygenase (*BCO1*) alter metabolism of dietary carotenoids, but functions of BCO1 beyond carotenoid cleavage are unknown. In humans, higher serum levels of the carotenoid lycopene (Lyc) are inversely associated with risk of prostate cancer, which is driven by androgens. We hypothesized that *Bco1* genotype would interact with dietary Lyc or tomato powder (TP) to alter murine androgen and prostatic biology. We conducted three studies in which 9- to 14-week-old male wild-type (WT) and *Bco1*$^{-/-}$ mice were fed AIN-93G control or diets containing 10% TP or matched levels of Lyc for four days. Across all three studies, we found that *Bco1* gene loss significantly and consistently depressed androgen status and disrupted prostatic homeostasis – independent of Lyc or TP feeding. *Bco1* loss decreased testicular *Hsd17b3* mRNA - a key enzyme in testosterone (T) synthesis - by 29% and reduced serum T by 79%. Regardless of diet, prostate weight was reduced 14-19% in *Bco1*$^{-/-}$ mice vs. WT. In agreement with this, we observed reduced androgen signaling in prostates of *Bco1*$^{-/-}$ mice (*Msmb* mRNA, -30%, *Igfbp3* mRNA, +20%) as well as decreased mRNA expression of markers of proliferation (*Pcna*, -12%; *Ki67*, -44%) and cell cycle entry into mitosis (*Aurkb*, -54%; *Ccnb2*, -51%). In summary, BCO1 seems to play a significant role in androgen and prostate physiology independent of its function in carotenoid metabolism.

Perceived picky eating behaviors in preschoolers is influenced by polymorphisms in chemosensory genes

Natasha Chong Cole, A.A. Wang, S.Y. Lee, S.M. Donovan, M.D. Teran-Garcia
Division of Nutritional Sciences, University of Illinois at Urbana-Champaign, Urbana, IL

Picky eating behavior may have both biological and environmental determinants. We tested the hypothesis that variation in genes that affect taste perception would influence picky eating behavior and body mass index (BMI) by exploring associations with nine genetic variants in six chemosensory-related genes (*TAS2R19*, *TAS2R38*, *CA6*, *TAS1R1*, *TAS1R2*, and *TAS2R1*). Cross-sectional analysis was conducted on data from 144 non-Hispanic white preschoolers (2-5 years). Parents responded to survey questions about their children's eating habits, including picky eating. Height and weight were measured and saliva was collected for genotyping. Generalized linear models were used to examine differences in picky eating behaviors and BMI z-scores associated with selected single nucleotide polymorphisms (SNPs). Two *CA6* polymorphisms were associated with picky eating behavior. Both SNPs were in Hardy-Weinberg equilibrium and the minor allele frequency was 12.5% and 9.0%, respectively. *CA6*-rs2274327 T-homozygosity was associated with parental perception of picky eating, (χ^2=3.99, p<0.05), while *CA6*-rs2274333 G-homozygosity was associated with children's preference for specific food-preparation methods, (χ^2=4.74, p<0.05). Children's BMI z-scores were not correlated with picky eating behaviors or genotypes. These results are the first to show that variations in the *CA6* gene influences picky eating behavior.

Prebiotics impact fecal microbiota and gut physiology in diet-induced obese mice

Tzu-Wen Liu[1], H.D. Holscher[2], K.D. Cephas[1], K.R. Kerr[1], H.F. Mangian[1], K.A. Tappenden[1,3], K.S. Swanson[1,2]
[1]Division of Nutritional Sciences, [2]Department of Animal Sciences, [3]Department of Food Science and Human Nutrition, University of Illinois at Urbana-Champaign, Urbana, IL

Obesity is associated with compromised intestinal barrier function and shifts in microbiota that may contribute to inflammation. Previous research suggests benefits of fibers, but the impacts of fermentable vs. non-fermentable fibers are not well understood. **Objective:** To determine the impact of cellulose vs. fructan (short-chain fructooligosaccharides [scFOS] or inulin) supplementation on fecal microbiota and gut physiology in obese mice. **Methods:** 18-wk old C57BL/6J mice (n=6/group) were fed high-fat diets (45% kcal fat) containing 5% cellulose, 10% cellulose, 10% scFOS or 10% inulin for 4wk. Cecum and distal colon were collected to assess barrier function, histomorphology and gene expression. Fecal DNA was used to perform 16S rRNA Illumina MiSeq sequencing and analysis with QIIME. **Results:** Both fructans increased intestinal transmural resistance and crypt depth but reduced mRNA abundance of ZO-1 and occludin. Principal coordinates analysis of weighted and unweighted UniFrac distances of fecal microbiota revealed a sharp separation between fructan and cellulose groups. Alpha diversity revealed lower species richness with fructan supplementation. Fructans reduced the relative abundance of *Firmicutes* and increased *Actinobacteria* and *Verrucomicrobia* (*Akkermansia*). **Conclusion:** Fructan may modulate gut microbiota and physiological responses via multiple mechanisms.

Reliability of heterochromatic flicker photometry in measuring macular pigment optical density among preadolescent children

Sasha M. McCorkle[1,2], N.A. Khan[2], L.B. Raine[2], B.R. Hammond Jr.[3], L. Renzi[3], C.H. Hillman[1,2]
[1]Division of Nutritional Sciences, [2]Department of Kinesiology and Community Health, University of Illinois at Urbana-Champaign, Urbana, IL; [3]Department of Psychology, University of Georgia, Athens, GA

Macular pigment optical density (MPOD) – assessed using heterochromatic flicker photometry (HFP) - has been previously related with better cognitive performance as well as brain levels of lutein among adult populations. However, the reliability of HFP to measure MPOD has not been directly investigated in children. Accordingly, this study assessed inter-session reliability of MPOD using HFP among 7-10-year-olds (*N*=32) on two non-consecutive days. HFP is measured by a macular densitometer in order to calculate the participant's MPOD score. The results from this study indicated that there was no significant difference between the two sessions [*P*=0.92 (session 1: 0.58 ± 0.33; session 2: 0.57 ± 0.28)] and no significant difference was found between boys and girls (*P*=0.53). Furthermore, there was a significant correlation between sessions (Y = 0.44x + 0.32; *r*=0.52, *P*=0.002), with an intersession reliability of 0.68 (Cronbach's). This evidence indicates that there is moderate reliability for the use of HFP to measure MPOD in preadolescent children. These findings are important because they provide preliminary support for future studies that would aim to conduct noninvasive assessments of retinal lutein and study its association with cognitive performance in preadolescent children.

Abstracts and Biographies

Faculty Mini-Symposium
"Nutritional Sciences: Impacting health at every age"

Maternal nutrition programs physiological consequences through epigenetics in animal models

Yuan-Xiang Pan, Ph.D.
Department of Food Science and Human Nutrition, Division of Nutritional Sciences, Illinois Informatics Institute (I3), University of Illinois at Urbana-Champaign, Urbana, IL

ABSTRACT: Dietary disturbances during the period of gestation and lactation program the offspring to have long-term physiological and pathological outcomes. As the western diet has become more and more prevalent and accessible in the past decades, health issues of consuming this diet have been raised and brought to public attention. In order to unravel the potential health risks and mechanisms underlying this phenomenon, animal studies utilizing a high fat dietary treatment have been extensively conducted, revealing a multitude of biological consequences for the offspring in sex-dependent manner and associated with region-dependent histone modifications. As the prevalence of obesity increases, determining the mechanisms behind how high fat diet affects physiological changes may become the key to its prevention. We are beginning to gradually understand how nutrition and environment may influence not only immediate outcomes, but also health throughout the course of a person's life. Understanding both the role of early life diet in the varying expression of a genome and the role of epigenetics in the varying responses to diet are fundamental to improving human health.

BIOGRAPHY: Dr. Yuan-Xiang Pan is an Associate Professor in the Department of Food Science and Human Nutrition (FSHN), a member of the Division of Nutritional Sciences (DNS) and Illinois Informatics Institute (I3) at University of Illinois at Urbana-Champaign (UIUC), where he has been a faculty member since 2006. He graduated with a B.S. degree in cell biology from Lanzhou University and received both his M.S. and Ph.D. in Animal Nutrition from Virginia Tech where he studied protein metabolism. He completed his postdoctoral training in nutritional control of mammalian gene expression in the Department of Biochemistry and Molecular Biology at the University of Florida, College of Medicine. Dr. Pan's research investigates early nutrition programming with an emphasis on molecular mechanisms of developmental origins of chronic diseases in offspring. Dr. Pan teaches several advanced nutrition classes to undergraduate and graduate students and has been included on the "Incomplete List of Teachers Ranked as Excellent by their Students" many times for different courses. Dr. Pan has over 50 peer-reviewed publications and book chapters (h-index 34) and receives grant support from the National Institutes of Health (NIH), the United States Department of Agriculture, and industry.

Breastfeeding reduces circulating inflammatory cytokines and inflammatory gene pathways in immune cells compared to formula-feeding in the first 6 months of life

Sharon M. Donovan, Ph.D., R.D.
Department of Food Science and Human Nutrition, Division of Nutritional Sciences, University of Illinois at Urbana-Champaign, Urbana, IL

ABSTRACT: Newborn infants possess a functional, but immature immune system. Clinical and epidemiological observations document differences in adaptive and innate immune development between breast-fed (BF) and formula-fed (FF) infants, including responses to infection and vaccination and long-term risk of autoimmune and inflammatory diseases. We hypothesized that circulating cytokines and immune cell gene expression of BF infants would reflect functional differences in immune regulatory pathways compared to FF infants. Blood samples were obtained from BF (n=60) and three sets of FF (n=186 total) infants at 1, 4 and 6 mos of age as part of a clinical trial in infants aimed at assessing how osteopontin (OPN) supplementation to formula impacts infant growth and immune development. Cytokines were measured in serum using ELISAs. PBMC were isolated, RNA extracted and gene expression assessed using the Affymetrix HuGene 2.0ST gene chip. To evaluate patterns of gene expression, Weighted Gene Correlation Network Analysis (WGCNA) was performed on 6,441 probe sets with an overall 4x3 ANOVA FDR p-value<0.3. Analysis of gene function pathways and networks was performed using MetaCore. Differences in circulating cytokines were observed, with lower concentrations of inflammatory cytokines (TNF-α and IL-6), but higher concentrations of cytokines involved in innate and adaptive immunity (IL-12 and IL-15). Approximately 700 genes were differentially expressed in immune cells (PBMC) between BF and FF infants. BF infants showed lower expression of proinflammatory cytokine genes than FF infants. BF infants also had lower expression of IL-17, which is associated with allergic responses. Genes that were expressed at a higher level in BF vs FF included genes controlling immune cell differentiation and transforming growth factor-beta (TGF-β), which is important in immune suppression and tolerance. These data support previous findings of reduced proinflammatory cytokines in the serum of BF vs FF infants and demonstrate for the first time distinct gene expression profiles in immune cells from BF and FF infants in the first 6 months of life. Importantly, human milk feeding supports a cytokine expression profile that favors a balanced immune response and reduced expression of cytokines associated with inflammation and allergy. This research was supported by Arla Foods Ingredients and BiosTime Inc. (Guangzhao, China). Ms. Kvistgaard is an employee of Arla. Drs. Donovan, Lönnerdal, and Peng have received grant funding from Arla and have served as paid consultants.

BIOGRAPHY: Sharon Donovan received her Ph.D. in Nutrition from UC Davis and completed a postdoctoral fellowship at Stanford University School of Medicine. She joined the Illinois faculty in 1991. Her laboratory conducts basic and translational research in the area of pediatric nutrition. On-going research is focusing on optimizing intestinal and cognitive development of neonates, development of the gut microbiome and prevention of childhood obesity and picky eating in children. She has published over 120 papers and receives funding from NIH, USDA, industry and foundations. She was President of the American Society for Nutrition (ASN) in 2011-2012.

Emerging adulthood: An opportunity to prevent chronic disease

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ABSTRACT: College-aged youth are often neglected as a target population for long-term interventions directed to obesity and chronic disease prevention. However, prior to design prevention or lifestyle intervention strategies, it is essential that the risk factors that contribute to obesity and/or chronic disease development within this distinct demographic population are identified. Although the US historically has had the highest prevalence of overweight and obesity in the world (70%), recently published rates in Mexico surpass the US (72%). Hispanics, mainly of Mexican origin, represent the largest minority group the US and the fastest growing ethnic group. Compared to non-Hispanic Whites, children of Hispanic origin in the US are more likely to be obese or overweight (39% vs. 32%). The obesity-related burden is particularly elevated in Hispanics (i.e. high prevalence of diabetes, dyslipidemia and hypertension). Obesity is the result of complex interactions among several factors, including genetic predispositions, lifestyle, and psychosocial conditions. Therefore multidisciplinary collaborations are needed to better understand the origins of obesity and the associations between obesity and health-related outcomes among Hispanics and other populations. The UP AMIGOS team (Universities of Illinois and San Luis Potosi: A Multidisciplinary Investigation on Genetics, Obesity and Social-environment) is actively contributing to this endeavor. We are building an integrated set of research and outreach projects focused on health promotion. Our aim is to develop tools to guide dietary intake based on individual lifestyle, risk factors and multiple genetic factors that could contribute to chronic disease prevention. This presentation will include new data on genetic and environmental determinants of obesity and metabolic disease risk in young adults and provide examples of opportunities for intervention.

BIOGRAPHY: Dr. Teran-Garcia was trained as a pediatrician in Mexico, and obtained her Ph.D. with a focus on nutrient-gene interactions and lipogenesis at the University of Texas. During her postdoctoral training, Dr. Teran-Garcia acquired expertise in genetic epidemiology methods while she investigated the role of individual genotype in cardiovascular and metabolic responses to exercise-training. Her current research focuses on genetic and environmental factors influencing the development of obesity and related metabolic diseases. Dr. Teran-Garcia leads the "cell" component of two multidisciplinary projects that are using a "Cell to Society" approach to collect primary longitudinal data on weight status and weight-related health outcomes in children (STRONG KIDS) and college-age individuals (UP AMIGOS). The two projects are now merged into a transdisciplinary research initiative with the goal of identifying the impact of genetic variation and environmental elements related to the risk of obesity and obesity-related traits during critical periods of the life cycle ("GET UP KIDS" project). In addition, a new collaboration with the bariatric center at Carle Foundation Hospital will investigate the Outcomes of Weight Loss Surgery in Illinois (I-OWLS) in young adults. All projects are expanding our knowledge of gene-environment interactions (dietary and exercise patterns), and psychosocial processes relevant to improve weight management, obesity prevention and development of obesity-related diseases. In addition to etiology, her research also explores inequalities in dietary and environmental exposures that may contribute to health disparities. Her long-term goal is to find early diagnostic biomarkers that will help in the development of effective and individualized interventions directed at preventing childhood and adult obesity, and the morbidity due to obesity-related diseases, while making a significant positive impact on health and well-being.

Nutrition and the older adult

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ABSTRACT: Optimal nutrition in the older adult is influenced both by the aging process and by the increased prevalence of chronic disease. Most of my work with older adults has related to bone health and diabetes. This talk will provide an overview of how the aging process influences both of these diseases, and how nutritional needs change as a result. Work that we have done in relation to calcium and vitamin D in the older adult will be presented, with a discussion of future directions. The challenges of changing intake of both nutrients is not only related to motivating dietary change in the older adult, but also in identifying and quantifying vitamin D and calcium in food. Diabetes presents a challenge to the older adult in terms of changing food intake and understanding health care recommendations. Our work in these areas will be presented, with an emphasis on achieving desired outcomes through community-based interventions and online. In addition, a recent research interest has been acyl glycated end products (AGEs) and their relation to diabetes complications. Because longitudinal accumulation of AGEs in the body appear to be most deleterious, this has particular importance to the aging population. Our research concerning AGEs impact on diabetes-related complications will be briefly presented, as well as our work on developing a dietary AGEs screener.

BIOGRAPHY: Dr. Chapman-Novakofski is an internationally recognized expert in the area of nutrition education, and has specifically addressed issues related to the older adult, including osteoporosis and diabetes. She has authored more than 200 publications, and is a recognized speaker nationally and internationally. She has received many awards for her teaching, research and outreach, including the prestigious Excellence in Nutrition Education award from the American Society for Nutrition. Prior to her academic career, Dr. Chapman-Novakofski was a research and nutrition support dietitian for a veteran's medical center for 12 years, where her love of working with the elderly began.

Abstracts

Graduate Student Poster Session

Immunohistochemical detection of gut-brain-axis markers along the gastro-intestinal tract of formula-fed piglets

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Intestinal neurotransmitters and hormones modulate neuronal signaling across the gut-brain-axis (GBA) and provide a means whereby dietary components and gut microbiota communicate with the brain to influence behavior and cognition. However, little is known about the expression of GBA markers in the neonatal gastrointestinal (GI) tract. Herein, regional differences in the expression of serotonin (5'HT), tyrosine hydroxylase (TH), and vasoactive intestinal peptide (VIP) were studied in pigs. Two-day-old, vaginally-delivered male pigs (n=24) were artificially-reared using milk replacer customized to meet pigs nutrient requirements. On d31, duodenum (duo), ileum (ile) and ascending colon (AC) samples were collected. Expression of 5'HT, VIP and TH were assessed by immunohistochemistry and confocal microscopy. Markers of the GBA were expressed as a proportion of either total cell number (5'HT) or area of positive staining in μm^2 (TH and VIP). Ratios of 5'HT-to-enterochromaffin (EC) positive cells ($P=0.02$), 5'HT- ($P<0.0001$) and EC positive-to-total cell number ($P=0.005$) were higher in the duo than all other regions. TH-positive expression tended to be higher ($P=0.09$) in the duo than the ile. VIP-positive expression in duo and ile was higher ($P=0.003$) than in the AC. In conclusion, for the markers assessed herein, a proximal-to-distal gradient of GBA marker expression exists along the GI tract of the pigs.

Dietary sodium intake in maintenance hemodialysis patients by point of purchase and food category

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Dietary sodium (DS) restriction is an important part of the diet of maintenance hemodialysis patients (MHD). Elevated DS intake has been associated with detrimental effects including higher fluid gains, intradialytic hypotension, and cardiovascular complications. However, little is known about the dietary intake of MHD patients. Our goal, therefore, was to describe the dietary intake of MHD patients and to examine major contributors to DS by point of purchase and food category. Methods: MHD patients (n=60) were recruited. A total of four 24-dietary recalls were obtained per participant, two on a dialysis day (DD) and two on a non-dialysis days (NDD), using the USDA 5-pass method. Foods were entered into Nutritionist Pro and separated by point of purchase (grocery store (GS), fast-food restaurants (FF), full-service restaurant (FS), other) and into 96-food categories from the 2003-2006 NHANES. Results: GS contributed 67% and FF almost 20% of total DS. The major DS contributors were condiments, sausage/bacon, cold cuts, and yeast breads, representing 36.8% of DS intake. Conclusion: Most of the DS came from foods purchased at GS. Registered Dietitians may benefit from spending added time focusing on counseling MHD patients on food items that are major contributors to DS.

Development and validation of a general nutrition knowledge questionnaire for adults in Uganda

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The framework and initial evaluation of a general nutrition knowledge questionnaire (GNKQ) for adults in Uganda are presented. *METHODS*. The GNKQ comprised of 59 questions structured into demographics and six constructs evaluating knowledge on recommendations, food groups, food choices, nutrition and disease linkages, food fortification, and sources of nutrition information. Five experts from the nutrition, health and education fields reviewed the survey online using Qualtrics. Questions were evaluated on relevance, simplicity, ambiguity and clarity to the target population using a 1-4 Likert scale. Experts also commented on wording, foods covered, and current nutrition policies. *RESULTS*. The inter-rater reliability (Gwet's AC1) was 0.75 (P<0.05) for the relevance of the whole GNKQ. Gwet's AC1 coefficients for relevance of the questions on recommendations (0.6), food groups (0.81), food choices (0.62), and nutrition and disease linkages (0.91) were high (P<0.05). Experts recommended addition of more questions to the food fortification (0.23) and sources of nutrition information (0.7) constructs. *CONCLUSION*. Questions had "good" to "excellent" reliability agreement and were deemed relevant to evaluate general nutrition knowledge. Reviews are necessary to improve clarity of questions. Upon validation, the GNKQ will be used to evaluate nutrition knowledge in Uganda.

Impact of dietary broccoli on liver cancer in B6C3F1 male mice fed a Western diet

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Westernized eating habits are highly associated with the prevalence of obesity. Obesity and related inflammation aggravate several chronic diseases, including non-alcoholic fatty liver disease (NAFLD) and liver cancer. The study was aimed to determine if long-term dietary broccoli can inhibit liver cancer development in mice receiving a Western diet. Male B6C3F1 mice were divided into 4 groups (n=18) and fed: control (AIN-93 M), 10% broccoli, Western (45% fat, 40.3% CHO and 14.7% protein by calories) or Western + 10% broccoli diets starting at 5 weeks of age. After 1 week, mice were treated with 45 mg/kg diethylnitrosamine (DEN; n=12/group) or saline (n=6/group) once per week for 6 weeks. Mice were killed 6 months after the last DEN treatment. Data were analyzed using 3-way analysis of variance. Results show that the Western diet increased body weight (P<0.0001), % liver weight (P<0.01), plasma alanine aminotransferase (ALT; P<0.01), NAFLD score (P<0.05), total liver triglyceride (TLTG; P<0.0001), visible liver nodule number (P<0.0001) and size (P<0.01). Inclusion of broccoli in the diet decreased plasma ALT (P<0.0001), NAFLD score (P<0.0001), TLTG (P<0.001) and visible liver nodule number (P<0.01) in both control- and Western-fed mice. We conclude that dietary broccoli protects against Western diet-enhanced NAFLD and liver cancer. *[Support: 5RO3CA162539 to EHJ]*

Low-lycopene tomato powder alters prostate biology in TRAMP mice

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The Transgenic Adenocarcinoma of the Mouse Prostate (TRAMP) model develops and progresses through all stages of carcinogenesis. We, (Zuniga et al., Cancer Prev. Res. 2013) previously demonstrated a high lycopene tomato powder (TP) was effective in reducing carcinogenesis in the TRAMP model. The objective of the current study was to determine if a low-lycopene TP (20 fold less than previously tested) impacted carcinogenesis and androgen biology at 3 time points. 8-week-old male C57BL/6 X FVB TRAMP mice were randomized to consume

either an AIN-93G + 10% TP diet (*N*=90) or the AIN-93G control diet (*N*=88) and assigned to one of three sacrifice ages: 12 (*N*=59), 16 (*N*=60), or 20 (*N*=59) weeks. There was no difference between diets in overall cancer incidence at each time point. TP significantly increased serum testosterone (p=0.01) and expression of prostatic androgen receptor in high-grade PIN lesions (p=0.01) at 20 weeks of age compared to the control, suggesting an interaction between tomato components and androgen status in pre-neoplastic prostate tissue. The results suggest that lycopene content of TP is a crucial modulator of PCa in TRAMP mice. We have shown that a low-lycopene TP is ineffective in reducing carcinogenesis in the TRAMP model. *[Support: USDA Hatch grant #ILLU-971-348 and UIUC Margin of Excellence Research award]*

A systematic literature review of nutrition-related mobile apps

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The use of mobile apps to deliver nutrition concepts to a wide range of audience is rapidly increasing. This systematic review was aimed at evaluating whether the use of nutrition mobile apps among healthy adults results in improved outcomes, including knowledge and behavior, compared to other educational interventions. Search terms: app(s), cellular phone, iPads, mobile phone, mobile telephone, smart phone, mobile, mHealth with diet, food and nutrition as qualifiers. Excluded were studies on app development, user satisfaction, feasibility, text messaging, digital photography, Internet, children or disease, or those not including apps or nutrition. Initial search (2008-2013) resulted in 12,010 (PubMed), 260 (CINAHL) and 4,762 (Web of Science) articles. These were reduced to four after reviewing titles and abstracts. Whole article quality evaluation using the AND Evidence Analysis Manual resulted in positive quality ratings given to three articles, where one reported knowledge outcomes (non-significant). Articles included suggested an advantage of app use on weight loss, increased adherence to diet monitoring (P<0.001), and decreased efforts to continue diet without app (P=0.024). Only few studies have systematically investigated the role of apps in nutrition education, which warrants further research.

Dietary supplementation with quercetin rejuvenates cognitive performance independent of adult hippocampal neurogenesis

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Nutritional supplementation with quercetin, phosphatidylserine-docosahexaenoic acid (PS-DHA) compound, CDP-choline (citicholine), 5-methyltetrahydrofolic acid (5-MTHF), and α-tocopherol have been suggested to ameliorate cognitive aging, but mechanisms are not known. The objective of this study was to measure the effect of these micronutrients on adult hippocampal neurogenesis and cognitive performance in a mouse model. Aged female and male C57BL/6J mice 18 months old were fed 8 different treatment diets for 4 months, before being tested on a battery of cognitive behavioral tasks. The 8 treatment diets (n=10 males and 10 females per group) were: 1) control (AIN93M), 2) 50% deficient in vitamins and minerals, 3) 150% elevated vitamins and minerals, 4) low dose of quercetin, 5) high dose of quercetin, 6) PS-DHA, 7) a combined supplement of CDP-choline, 5-MTHF, and α-tocopherol, and 8) a diet containing all mentioned supplements. Animals were euthanized at the end of the study to quantify numbers of new neurons by immunohistochemical detection of doublecortin (dcx). Young (2 months old) mice were also measured without dietary

manipulation to serve as a reference for the aging-induced decline in the outcome measures. Quercetin significantly rejuvenated cognitive performance on the active avoidance learning and memory task, and the effect was enhanced when combined with the other micronutrients. No differences in number of dcx-positive cells were observed. Results confirm pro-cognitive effects of quercetin in an aging population, but mechanisms appear independent of adult hippocampal neurogenesis and remain unknown.

Beta-Hydroxy-Beta-Methylbutyrate (HMB) clearance in hemodialysis patients

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Beta-hydroxy-beta-methylbutyrate (HMB) is a metabolite of the amino acid leucine that has been shown to attenuate muscle loss in catabolic populations, but has not been studied in hemodialysis (HD) patients. Approximately 20 percent of supplemental HMB is cleared by the kidney in healthy adults; however, the clearance in HD patients is unknown. HD patients (n=8) were recruited from dialysis clinics in Champaign, IL. On day 1, blood was obtained at 0 and 3hrs into a standard HD treatment. One week later, patients consumed 3g HMB at the beginning of HD treatment. Blood was obtained at 0, 1, 2, 3, 4, and 48 hours, as well as 7 days later. Plasma HMB was analyzed by gas chromatography-mass spectrometry. Basal plasma HMB concentrations were reduced by approximately 50 percent during a standard HD treatment. After HMB consumption, plasma concentrations peaked at 3 hrs and decreased to approximately 5 percent of peak values within 48 hours. This clearance primarily occurred between dialysis sessions and without significant kidney function. Plasma HMB returned to baseline concentrations by day 7 in all patients. These results suggest that supplemental HMB is cleared in HD patients. We are currently performing a double-blind placebo-controlled multi-site clinical trial investigating the effects of 6 months of daily HMB supplementation on lean mass, strength, physical function, and quality of life in HD patients.

Maternal high fat diet-induced *Il-12b* overexpression in male offspring rats is associated with DNA hypomethylation

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Both developmental and postnatal exposure to a high-fat diet has been linked to the development and progression of non-alcoholic fatty liver disease (NAFLD), a condition characterized by an increase in inflammatory cytokine release from hepatocytes and resident macrophages (MΦ). This activates the innate immune system and leads to MΦ polarization from a phagocytic phenotype towards a pro-inflammatory response (M1), with MΦ interleukin-12b (IL12b) as the specific marker of the inflammatory hepatic milieu. To determine the dietary regulation of the pro-inflammatory switch in liver by a maternal and/or post-weaning HF diet, female Sprague-dawley rats were fed maternally with either a control (C) or high-fat diet (HF). At weaning, male pups were assigned to either the HF or C diet, which generated four groups with distinct HF dietary exposures: control (C/C), maternal (HF/C), postweaning (C/HF), and lifelong (HF/HF). All HF groups had increased steatosis and activation of the innate immunity in response to a HF. The hepatic mRNA expression of the Il12b gene was increased in all HF groups. This increase was correlated with marked DNA hypomethylation within the coding region flanking a CpG island identified using MeDIP-seq technology. We conclude that maternal high fat exposure regulates hepatic pro-inflammatory switch of the innate immune system possibly through long lasting changes in DNA methylation in male offspring, and thus contributes to the initiation and progression of NAFLD.

Impact of the dietary lipid matrix on neurodevelopmental patterns of the piglet

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Using the piglet as a biomedical model, we assessed the impact of dietary fat composition on postnatal neurodevelopment. Two-day old piglets (n=9-10/treatment, 1.5 ± 0.2 kg initial BW) were fed 1 of 4 isocaloric dietary treatments: T1, artificially-reared (AR) control formula; T2, T1 + 45% total dietary fat replaced with pre-digested fat (PDF); T3, T2 + novel lipid blend; T4: sow-reared (SR) control. At conclusion of the 25-d study, pigs were subjected to MRI procedures to assess brain structure. Overall, SR pigs exhibited higher ($P < 0.05$) BW gain and whole-brain weights compared with AR treatments. Diffusion tensor imaging revealed that SR pigs had greater ($P < 0.05$) average whole-brain fractional anisotropy (FA) values compared with all AR treatments, suggesting differences in the degree of myelination. Hippocampal tissue analysis revealed neutral lipid DHA concentrations were greater ($P < 0.05$) in T3-fed pigs compared with T1-fed and SR pigs. Hippocampal phospholipid DHA concentrations of T2- or T3-fed pigs were intermediate to T1-fed and SR pigs. Overall, these results suggest similarities in myelination and diffusion rate along and across axonal fibers of the internal capsule in T3-fed pigs compared with SR pigs, and replacing part of formula triacylglycerols with PDF + novel lipid blend may elicit preferential accretion of brain DHA due to compositional manipulations of the lipid matrix.

Fermented berry beverage phenolics reduce fat mass and fasting blood glucose in high-fat fed mice

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The objective was to determine the potential of phenolic compounds from a fermented 30:70% blueberry-blackberry beverage to reduce obesity and hyperglycemia in three week old male diet-induced obese C57BL/6j mice. Mice (n= 12/group) were randomized into six groups to drink: an alcohol-free fermented beverage (AFFB) containing 65.1 ± 1.6 mg cyanidin-3-glucoside (C3G) equivalents/L, three doses of a phenolic extract from AFFB: 6.4 (0.1x), 59.6 (1x) and 192.4 (3x) mg C3G eq./L, sitagliptin (30 mg/kg BW/d), or water. After a week, mice started a 60% fat diet. The BW/food intake ratio and sucrose consumption were similar ($p > 0.05$). After 3 weeks of treatment, all groups had fasting blood glucose (FBG) above 126 mg/dL. At the end of the study (week 12), FBG for 1x and 3x groups was significantly lower (168 and 184 mg/dL, respectively) than the water (222 mg/dL), and the sitagliptin group (217 mg/dL, $p < 0.05$). Mice in the 3x group had the lowest body weight gain (10.3 ± 0.3 g) and the water group the most weight gain (16.7 ± 1.2 g, $p < 0.05$), which was attributed to a gain in fat mass (18.0 ± 0.8 % BW for 3x vs. 31.3 ± 1.1 % BW for water) and correlated with visceral fat (0.8 ± 0.1 g for 3x vs. 2.4 ± 0.2 g for water), while absolute lean mass did not differ ($p > 0.05$). Overall, phenolic compounds, mainly anthocyanins, from a fermented blueberry-blackberry beverage reduced BW gain, fat mass accumulation, and FBG in diet-induced obese mice.

Maternal high fat programs hepatic *Il-6* expression through differential DNA methylation in male pups

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Environmental stressors such as dietary high fat (HF) are known to disrupt maternal programming, which leads to metabolic disorders in the offspring later in life. Maternal high-fat diet leads to chronic inflammation which stimulates a hepatic inflammatory response characterized by higher circulating levels of Interleukin-6 (*Il-6*), thus compromising the functions of hepatocytes. The aim of

our study was to examine the programming effect of maternal high fat diet on the *Il-6* gene. Female Sprague-Dawley rats were fed with either control (C) or HF diet and after weaning, the pups were given either C or HF diet, generating the four groups of rats on control diet (C/C), maternal high-fat (HF/C), prenatal high-fat (HF/C), and lifelong high-fat diets (HF/HF). mRNA expression analysis showed a significant increase on hepatic *Il-6* in HF/C and HF/HF groups, compared to C/C. Methylated DNA Immunoprecipitation analysis showed a marked reduction of methylation between exons 2 and 4 of the *Il-6* gene in HF/C and HF/HF. The hypomethylation of these regions of the gene is correlated with the increase in gene expression. This study demonstrates a maternal effect on the epigenetic programming in pup's hepatic pro-inflammatory response, through DNA hypomethyation of elements within the *Il-6* gene, which in turn promotes the deterioration of hepatic function.

Postnatal iron deficiency impairs white matter development in neonatal piglets

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Iron deficiency (ID) is the most prevalent micronutrient deficiency, affecting approximately 2 billion people worldwide and 40% of children in developing countries. This is grave, as studies link ID in early life with poorer cognition, reduced attention, and increased sensory latencies. Additional research is needed to understand how ID affects brain development. The present study examined the effects of ID on brain development in a translational neonatal piglet model. The hypothesis was that postnatal ID would alter brain development, particularly by reducing white matter (WM) integrity. Artificially reared piglets were fed either an ID or iron adequate milk replacer from 2-28 d of age and were then subjected to magnetic resonance imaging to assess brain macrostructure (T1 MP RAGE), microstructure (diffusion tensor imaging; DTI), and neurochemistry (MR spectroscopy). Voxel-based morphometry revealed widespread decreases in WM in ID piglets, including areas of the hippocampus and corpus callosum. In ID piglets, gray matter volume decreased in the thalamus, prefrontal cortex and parietal lobe, and increased in the olfactory bulbs and hippocampus. DTI showed reduced fractional anisotropy in ID piglets, suggesting a decrease in WM integrity. No changes were found in brain metabolites. These results indicate postnatal ID affects both macrostructural and microstructural brain development, particularly in WM.

Differences in utilized mealtime strategies between home-and center-based daycare providers and parents

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It is estimated that one-third of children under age 5 are enrolled in daycare where they are usually served at least 1 meal per day. Though millions of children attend daycare, little is known about the mealtime strategies used at daycare and whether those differ from strategies used at home. Herein, differences in utilized mealtime strategies between parents and daycare providers were investigated. Families of 3-5 year old children enrolled in home-based (HBDC; n=25) or center-based (CBDC; n=26) daycare and the care providers were recruited. Parents completed the Parent Mealtime Survey and daycare providers completed the Teacher Mealtime Survey, which contained the same 14 mealtime strategies. Parents and providers were asked to rate how often each strategy was used on a 1-5 scale from always to never. Responses were dichotomized into Yes (1-3)/No (4-5) response categories. Chi-square analysis revealed that 6 mealtime strategies differed ($p<0.05$) between parents and daycare providers, 2 differed ($p<0.05$) between HBDC providers and HBDC parents, and 8 differed ($p<0.05$) between CBDC providers and CBDC parents. Thus, children are exposed to different mealtime strategies in daycare and home environments. Preschool is an important time for establishing life-long eating behaviors. Inconsistent messages around mealtimes between daycare and home may detrimentally impact food acceptance and mealtime behaviors.

Nutrition environment survey development for elementary school settings

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To address childhood overweight, interventions have targeted the school environment. These may include school meal offerings, nutrition education, or healthy eating promotions involving school staff workers. Resources, barriers and perceived benefits of interventions can impact their adoption. With no current reliable survey to measure all these variables, our objective was to create a survey that allows for baseline nutrition environment assessment of elementary schools in order to design and evaluate healthy interventions. Surveys were developed for elementary school principals, teachers, community workers/health educators, and food service directors/managers. After exemption by the IRB, a panel of reviewers were identified to cover the breadth of occupations and perspectives (n=7) for content and face validity. Feedback from individual panel members was gathered through interview and written comments. The Food Service Manager and Teacher survey changes primarily reflected changes in federal or local health policies or food procurement/service refinement. Overall, development of a baseline survey that assesses the nutrition environment, policies, and nutrition education may help researchers, public health officials, and school workers have a foundation for planning and evaluating healthy environmental changes in elementary school settings.

Effects of text messaging health interventions on college-aged Latinos

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Due to rising rates of obesity and the trend of unhealthy eating patterns, dietary intervention is needed in the Latino community. Intervention by mobile phone is a relatively new, but potentially effective method. Latinos between the ages of 18-25 are a very attractive target audience for mobile phone intervention since they are at a highly transitional stage of life. The objective was to make subjects more aware of—and hopefully improve—their unhealthy dietary habits such as not drinking enough water, not eating breakfast regularly, and not eating the recommended amounts of vegetables and fruits. Subjects were young adults between the ages of 18 and 25 years (n=25). A preliminary survey was sent out to 5 randomly chosen subjects to find out about their communication/texting preferences and capabilities. After collecting the 26 subjects, a pre-survey was sent out to ask more in-depth questions about their eating and health habits. This survey was also used to collect phone numbers and service carriers. After receiving phone numbers, 2-3 text messages a day for five consecutive weekdays were delivered. A post-survey was then sent out and collected to find out what the subjects thought of the texting service. The only statistically significant finding was the decrease in fast food consumption ($p = 0.02$). Variables such as consumption of water, breakfast, fruits, and vegetables had no significant changes. The decrease in fast food consumption is a very promising sign for this study, given that the intervention took place over five days.

Hippocampal metabolites correlate with neuroimaging outcomes in the piglet

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By combining magnetic resonance imaging (MRI) and metabolomic profiling techniques, our objective was to elucidate relationships between brain structure and hippocampal metabolites in the piglet. Two-day-old, male piglets (n=24) were artificially reared by

feeding a custom milk replacer formulated to meet piglet nutrient requirements. MRI procedures were performed at 30 d of age, and brain tissue was collected 24 h post-MRI for metabolomic and lipodomic profiling of hippocampal tissue. Analysis of MRI data in 19 brain regions yielded microstructural details of water movement in the brain as measured by diffusion tensor fractional anisotropy (FA), and radial (RD), axial (AD), and mean (MD) diffusivities. Comparison of fatty acids in n-3, n-6, and n-9 categories with MRI measures yielded correlations ($P < 0.05$) in 150 of 2726, 162 of 3596, and 129 of 2494 possible outcomes, respectively. Neuroimaging outcomes that were highly correlative across fatty acid categories included MD, RD, and AD in the internal capsule and right hippocampus, suggesting ongoing myelination. Nervonic acid, a fatty acid known to be prevalent at peak myelination, was correlated with 26 of 58 total outcomes, further supporting the link between metabolism and neurodevelopment. The significant correlations between metabolic and structural outcomes in the brain emphasize targets whereby dietary manipulation may alter neurodevelopmental patterns. *[Support: Mead Johnson Nutrition]*

A novel neonatal feeding intolerance and necrotizing enterocolitis risk scoring tool is easy to use and valued by nursing staff

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Consistency in nursing assessments may facilitate improved outcomes for preterm infants, who are at increased risk of developing feeding intolerance (FI) and necrotizing enterocolitis (NEC). Objective: Develop an easy to use scoring tool valued by nurses to predict FI/NEC. Methods: Following Institutional Review Board (IRB) approval, a novel risk scoring nursing tool was implemented in a University of Illinois-affiliated 48-bed level III neonatal intensive care unit. Data was collected from all preterm infants with parental consent from August 2013 to July 2014. Scoring accuracy, ease of use, and nurses' attitudes toward the tool were assessed at the study site and by evaluators at the 2013 National Association of Neonatal Nurses (NANN) conference. Results: Study site nurses scored 241 tools on the 89 enrolled infants. Twenty-three tools (9.5%) contained errors. Mean study site ease of use, on a scale from 1 (very difficult) to 10 (very easy) was 8.1 (SD 2.2), and 100% of study site nurses responded "yes" when asked whether the scoring tool raised their awareness of risk factors that contribute to FI/NEC. Ninety percent of NANN attendees "agreed" or "strongly agreed" that the tool addressed important gaps of knowledge within the field of neonatal nursing. Conclusion: The tool is easy to use and valued by nurses. Ongoing refinement and validation will improve its accuracy and predictive utility.

Do grocery store tours prepare consumers to adopt healthy purchasing behaviors? A systematic review of evidence

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The purpose of this systematic review was to evaluate research concerning grocery store tours to assess their efficacy as a nutrition education medium. Online databases were searched with varying combinations of predetermined keywords. Bibliographies of relevant articles were manually searched and recent citations of the relevant articles were also evaluated. Inclusion criteria were applied and data extracted from studies that met criteria. Quality analyses and design classifications were conducted for each included article. Of the 10 studies included, 7 had "D" class designs (non-controlled trials). Two studies included primarily women, 2 studies included primarily children, 1 study had primarily men, and 4 did not include any descriptive characteristics about participants. Of the 6 studies that evaluated behavior change, all reported positive results. Knowledge was assessed in 5 studies and

positive results were reported in 3. No studies evaluated knowledge or behavior outcomes beyond three months post-lesson. Grocery store tours needs more evidentiary support to verify their efficacy impacting health behaviors. Future research should utilize stronger study designs. Knowledge and behavior should not only be assessed pre and post-lesson but also at least six months after the lesson to see if any knowledge is retained and if behavior changes are maintained.

Effects of a high-protein, high-fiber diet on weight loss, voluntary physical activity, body composition, and serum chemistry profiles in overweight cats

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Obesity is a major nutritional disorder in cats and is associated with several comorbidities and reduced life span. The objectives of this study were to determine the effects of feeding a high-protein, high-fiber diet on weight loss, physical activity levels, body composition, and serum chemistry profiles in overweight cats. During a 4-wk baseline period, 8 adult neutered male cats (mean BCS=7.6/9) were fed to maintain BW. For 18 wk following baseline, cats were fed to lose weight at a rate of ~1.5% BW/wk. Daily food intake, twice-weekly BW, and weekly BCS were recorded. As expected, BW and BCS decreased ($P<0.05$) over time. The NRC maintenance energy requirement (MER) for overweight cats is $130(BW_{kg}^{0.40})$. In comparison, the mean MER during baseline in our study was $104(BW_{kg}^{0.40})$. During wk 1-4, 5-8, and 9-18, the energy levels to sustain weight loss were 76%, 64%, and 58% of MER=$104(BW_{kg}^{0.40})$, respectively. Body fat percentage decreased ($P<0.001$), while lean mass percentage increased ($P<0.0001$) over time. Mean daily activity tended to be higher ($P=0.061$) at wk 12 vs. wk 0. The light:dark ratio of activity was increased ($P<0.05$) at wk 18. Blood triglycerides were decreased ($P< 0.05$) with weight loss. In conclusion, restricted feeding of a high-protein, high-fiber diet is a safe and effective means for weight loss in cats. Based on our data, the current MER estimates for cats appear to be too high and should be reconsidered.

α2-Heremans-Schmid glycoprotein (AHSG) polymorphism and HOMA-IR in young Mexican adults

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Circulating AHSG binds saturated fatty acids (SFA) and increases pro-inflammatory signal cascade via toll-like-4 receptor activation. The gene-nutrient interaction between SFA intake and polymorphisms in AHSG could contribute to the physiopathology of Metabolic Syndrome (MetS). We aim to identify if variations in AHSG relate to biomarkers of metabolic disease and SFA intake. Subjects were college applicants to the UASLP (18-25 years, n=414). Fasting blood was collected for analysis of biomarkers and genotyping. Dietary and health surveys were collected. HOMA-IR was calculated using glucose and insulin levels. Two single nucleotide polymorphisms (SNPs) in AHSG were genotyped (rs2518136 and rs4917). Both SNPs were in HWE and had minor allele frequencies greater than 10%. Mean HOMA-IR was lower in AHSG-rs2518136 T-allele carriers when compared to non-carriers ($P<0.05$, respectively). There was no interaction with AHSG SNPs and SFA intake. Neither SNPs were associated with BMI. Lower triglycerides values were observed in AHSG-rs4917 C-allele carriers compared to non-carriers ($P<0.05$). AHSG polymorphisms were associated with HOMA-IR, suggesting a possible link to insulin resistance. Our findings suggest that individual and ethnic variations in the AHSG genotypes might

contribute to obesity-related phenotypes and its comorbidities. *[Support: USDA 2011-67001-3010, NIFA #600109-698000-698354 and ACES FIRE grant]*

Development of a murine model of chemobrain to evaluate the efficacy of nutritional intervention

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Chemobrain refers to long-lasting deficits in cognitive performance resulting from chemotherapy. Objective evidence for chemobrain is mixed and mechanisms unknown. One leading hypothesis is that the chemotherapeutic agents cross the blood-brain barrier and reduce the progenitor cell population in the hippocampus, a critical region for learning and memory that continues to generate new neurons throughout life. The purpose of this study was to first determine whether a reliable behavioral deficit can be found in mice in response to administration of the chemotherapeutic agents standardly used to treat breast cancer in humans, and second whether a nutritional intervention could ameliorate those deficits in association with increased adult hippocampal neurogenesis. Mice received doxorubicin (IV, 4mg/kg), cyclophosphamide (IP, 80mg/kg) and 5-fluorauracil (IP, 40mg/kg) and were injected with bromodeoxyuridine (BrdU, 50mg/kg) to label dividing cells. Following recovery from the chemotherapy, mice received intervention diets containing fish oil rich in omega-3 & 6 fatty acids or a standard control diet. Behavioral performance on a battery of learning and memory tasks was conducted at the end of the study to determine whether chemobrain can be detected in the task and whether it can be ameliorated from the nutritional intervention. Chemotherapy was correlated with impaired performance on the Morris water maze and a reduction in hippocampal neurogenesis. These deficits were not ameliorated from the dietary interventions. Results suggest reliable behavioral and neurological deficits can be found from chemotherapy using our mouse model but that an alternative dietary intervention will be needed to reverse these deficits.

Diet-gene interaction in arachidonic (ARA) and docosahexaenoic (DHA) acid synthesis shows compensatory upregulation

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ARA and DHA share the same synthetic pathway. FADS2 encodes the 1st step of the synthesis in mammals. Minor alleles of SNP in the human FADS2 region are associated with low serum ARA and DHA, indicating low capacity of synthesis. Fads2+/+ (WT) and Fads2+/- (HET) mice were fed one of the following for 3 months (n=6 each): 7% fat from flaxseed oil + canola oil (FCO), soybean oil (SO) or corn oil (CO) with LA/ALA at 1/1, 7/1 and 44/1, respectively. In WT liver, Fads2, Fads1 and Elovl2 mRNA was higher in CO than in FCO and SO. The same dietary effects were observed on Fads1 and Elovl2 mRNA in HET liver, whereas Fads2 mRNA was about half of that in WT in both HET liver and brain. Fads1 mRNA was higher in HET liver than in WT when fed FCO or SO. In both WT and HET, ARA in liver and gastrocnemius muscle of CO was more than 2X compared with FCO, whereas brain ARA and DHA were similar in all dietary groups. Although genotypes showed little effects on tissue ARA, 20:3 n6 was consistently lower in HET compared to WT in all tissues. The gene expression of inflammatory cytokines, IL1B, IL6 and TNF , was unaffected by either diets or genotypes in liver and brain. These findings suggest that high dietary LA/ALA greatly increased the tissue ARA in both genotypes most likely due to high substrate

as well as the compensatory induction of synthetic pathway to maintain DHA synthesis. In HET, compensatory induction of downstream Fads1 maintained tissue ARA and DHA close to WT.

Sulforaphane reduces inflammatory gene expression in microglia from aged mice

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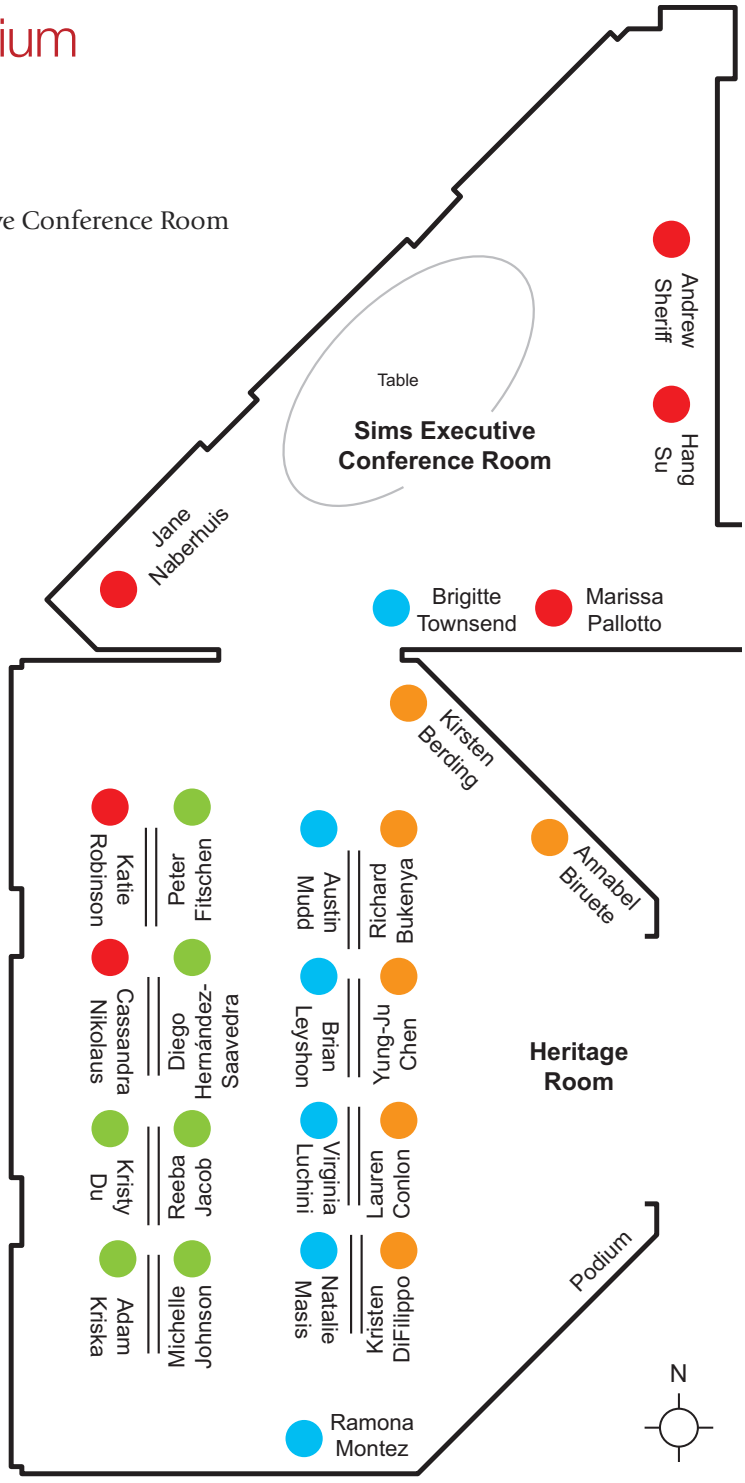
Heightened microglial activation during normal aging is associated with increased inflammation and oxidative stress, behavioral and cognitive impairment, and risk of neurodegenerative disease. The nuclear factor E2-related factor 2 (Nrf2) pathway induces antioxidant response element (ARE) genes that regulate oxidative stress. Here, brain $CD11b^+$ microglial cells isolated from young adult and aged mice were used to investigate the effects of sulforaphane (SFN), a Nrf2-inducing bioactive, on ARE and inflammatory gene expression associated with increased age. We hypothesized that SFN would upregulate ARE genes and attenuate elevated proinflammatory cytokine expression in microglia from aged mice. In support of our hypothesis, SFN upregulated ARE genes NAD(P)H dehydrogenase, quinone 1 (NQO1), heme oxygenase-1 (HMOX1), and glutamate-cysteine ligase, modifier subunit (GCLM) primary microglia. Microglia from aged mice had higher expression of interleukin (IL-)1β, IL-6, and inducible nitric oxide synthase (iNOS) than microglia from young adult mice, and SFN reduced IL-1β and iNOS. Taken together these data indicate that SFN is a potential therapeutic supplement that may be beneficial for reducing microglia-mediated neuroinflammation and oxidative stress associated with aging. *[Support: NIH RO1AG16710]*

Nutrition Symposium Poster Session

ACES Library, 1st Floor
Heritage Room and Sims Executive Conference Room
Thursday, March 19, 2015
5:15 p.m. – 6:40 p.m.



Poster Judges

Orange Team
Dr. De Lisio (captain)
Dr. Stravkovsky
Dr. Khan

Green Team
Dr. Teran-Garcia (captain)
Dr. Akbar
Dr. Radlowski

Blue Team
Dr. Stein (captain)
Dr. Holscher
Dr. Barnes

Red Team
Dr. Pan (captain)
Dr. Mun
Dr. Pence

Presenting Author Index

Winners of the 2014 University of Illinois Nutrition Symposium poster and oral competitions with keynote speaker, Dr. David Levitsky.