Celebrating ten years of nutrition discoveries

Dear Friends,

With this report, I am pleased and proud to let you know that the UNC Nutrition Research Institute is celebrating its tenth anniversary this year. As we look back at the impact we have made in precision nutrition this past year—which your generosity has made possible—we also make note of our first decade of progress.

From inception to today, the NRI has been home to some of the most experienced and innovative scientists in the world who, daily, explore the human genome, brain, metabolism, and environment in search of the how’s and why’s of individualized nutritional needs. Their discoveries in nutrition science are leading to successes in preventing or mitigating the negative effects of chronic diseases and aging, and in improving human development, even prior to conception.

Use this report for a glimpse into the myriad ways in which your contributions to our institute are put to work advancing nutrition science for everyone. Thank you for your support.

Sincerely,

Steven H. Zeisel, MD, PhD
Director
Nutrition Research Institute
University of North Carolina at Chapel Hill

Guiding Scientific Premise
Each of us is metabolically unique. The NRI is dedicated to finding out how these differences affect an individual’s health so that current one-size-fits-all dietary guidelines can be replaced with customized nutritional recommendations and actions to improve a person’s health and quality of life. With NRI’s discoveries, physicians and dietitians will soon be able to create diet and exercise plans customized to your unique needs.

Mission
The NRI is leading research in precision nutrition by developing an understanding of how our genes, the bacteria in our gut, and our environment create differences in our metabolism that affect our individual requirements for and responses to nutrients.

FUNDAMENTALS

Nutrigenomics and Metabolomics
In Nutrigenomics, we study common variations in the spelling of our genetic code and in the “switches” that turn our genes on and off, and relate these to differences in our metabolites and nutritional needs. The gene tests we are developing will allow gene-guided recommendations for individual nutrition.

With Metabolomics, we can measure thousands of metabolites in blood or other tissues using a single, small sample. This makes possible a complete view of our metabolism that was not possible before. Now, we can add to gene tests the ability to see what the changes in genes are doing to our metabolism, and use this to make metabolite-guided recommendations for individual nutrition.

The Nutrition Research Institute is an international leader in both of these new fields of science.
Appointments
Carl L. Cheatham, PhD
- Member, External Advisory Committee, Division of Nutrition Sciences, University of Illinois, Urbana-Champaign, Champaign, IL
- Fellow, Frank Porter Graham Child Development Institute, University of North Carolina - Chapel Hill, Chapel Hill, NC

Martin Kohlmeier, MD, PhD
- Founding editor-in-chief of BMJ Nutrition, Prevention & Health, a new nutrition journal
- President, International Society of Nutrigenetics/Nutrigenomics
- Co-editor of Principles of Nutrigenetics and Nutrigenomics, published by Elsevier

Philip A. May, PhD
- Faculty member of Delta Omega, The Honourary Public Health Society, Theta Chapter, Gillings School of Global Public Health, University of North Carolina at Chapel Hill
- International Ambassador, National Organization for Fetal Alcohol Spectrum Disorders, Australia

Discoveries in the News
Stephen D. Hursting, PhD, MPhil featured in “The connection between diet, obesity, and cancer: Nutrition experts explore the evidence” at MedicalXpress.com (March 2018)

Martin Kohlmeier, MD, PhD, quoted in “2gandMe for Weight loss” in Prevention magazine (April 2018)

Philip A. May’s findings that prevalence of fetal alcohol spectrum disorders may be as high as 1 percent in US communities covered by worldwide media including Forbes, Time, New York Times, and Daily Mail.

Presentations
Carol L. Cheatham, PhD. “Assessing Neonatal Cognitive Development in the Human” (Summer 2017). Origins and Benefits of Biologically Active Components in Human Milk, FASEB Science Research Conference, Lisbon, Portugal

Carol L. Cheatham, PhD. “DHA and the Science of Delivering More to the Brain” (Summer 2017). Power of Three Congress: Leading the Future with Faster Learning, Manila, Philippines

DISTINCTIONS
Martin Kohlmeier, MD, PhD. “How to make the most of high-density genetic data for nutrition research” (October 2017). Keynote presentation at the IUNS International Congress of Nutrition, Buenos Aires, Argentina

Philip A. May, PhD. “The Prevalence and Select Characteristics of FASD in Four Regional Communities of the United States” (June 2016). FASD Study Group of the Research Society on Alcoholism, San Diego, CA

Steven H. Zeisel, MD, PhD featured in “Choline: The essential but forgotten nutrient” in The Seattle Times (November 2017)
KEY FINDINGS

NUTRITION, OBESITY AND CANCER

Obesity and diet are known to alter cancer outcomes, but exactly how is often not understood. Research conducted by NRI faculty is providing answers that will help in prevention and treatment.

For example, folate (vitamin B9) is important in early pregnancy to prevent neural tube defects in babies because it is needed by rapidly dividing cells (e.g., those of a developing embryo) for DNA synthesis and cellular energy production. However, aggressive cancers are also defined, in part, by their rapidly dividing cells, and antifolate drugs such as methotrexate are first-line chemotherapeutics. Whether dietary folate, either through vitamin supplements or fortified foods, could contribute to cancer progression is unclear, as existing studies of the effects of low-folate diets on cancer have produced conflicting results.

Several NRI faculty collaborated to clarify the folate-cancer connection. Sergey Krupenya, PhD, and Stephen Hursting, PhD, MPH, along with NRI visiting scholar Mirko Hennis, PhD, and their laboratories looked at the effects of folate restriction on the metabolic properties of three breast cancer cell lines (Ashkanian et al., 2012). They compared macroscopic cell properties including proliferation, migration, and invasion, and also looked at cellular levels of specific metabolites in order to understand molecular changes within the cells that were caused by folate-restricted feeding. They found that folate restriction causes changes in certain mitochondrial levels and the expression of specific genes. Folate restriction also causes changes in cellular energy metabolism, and decreases cells’ invasiveness. Overall, folate restriction shifted cancer cells toward less aggressive phenotypes.

This study shows that folate restriction does alter the properties of cancer cells, but that the specific cellular changes are dependent on the cancer subtype. This means that the decision to target the folate pathway, either through dietary or pharmacologic means, will depend on the nature of an individual’s cancer.

In another example, researchers in Hursting’s laboratory (Bowser et al., 2018) sought to identify differences in tumors growing in normal-weight versus obese mice in order to better understand how obesity contributes to breast cancer development. They profiled the tumors and identified groups of genes whose expression was markedly different between the two tumor types. Several of these gene groups that were related to tumor growth were also associated with obesity. Further analysis identified leptin as a master regulator of the metabolic pathways defined by these genes.

Leptin is a hormone that signals satiation. Resistance to leptin signaling is often found in obesity, and leptin levels are elevated in the obese. This study confirms a role for leptin in pro-tumorigenic potential, and through its use of RNA sequencing and pathway analysis, also identifies genes downstream of leptin that need to be investigated as more direct effectors of obesity-induced susceptibility to breast cancer, with the ultimate goal of identifying drugable targets (Smith et al., 2018).


NUTRITION AND ALCOHOL DURING PREGNANCY

NRI scientists Susan Smith, PhD, Philip May, PhD, and Sandra Mooney, PhD, study how alcohol causes developmental disorders and the prevalence of fetal alcohol spectrum disorders (FASD).

Philip May’s research group has studied the prevalence of drinking during pregnancy and its consequences in Kannapolis and throughout the world. They have consistently found that, while most people know that drinking during pregnancy is bad for the future health of their child, drinking during pregnancy is still common and the number of children with the cognitive, physical, and behavioral deficiencies associated with FASD is much higher than thought, reaching as high as five percent in some American communities (May et al., 2018). These numbers are higher than previous estimates partly because of the more comprehensive data-gathering and analysis methods May’s group uses, which include in-person interviews and school-based assessments. The results suggest that the societal costs of FASD will be much greater than previously assumed, and highlight a need for new approaches to reduce alcohol consumption during pregnancy.

Research in the Smith and Mooney laboratories looks at how alcohol affects fetal development and growth and development and whether other factors (e.g., diet) contribute to worsening or lessening these effects. While the link between alcohol consumption during pregnancy and FASD is unequivocal, the relationship between how much and what drinks and how has a child’s FASD symptoms are not straightforward. One potential cause of this discrepancy is maternal nutrition: A healthy maternal diet may protect an infant from the effects of alcohol, while a poor maternal diet worsens the effects of alcohol. But what, in terms of FASD protection, constitutes “health?”

Recent research (Hurtel et al., 2018; Hublicher et al., 2018) suggests that sufficient iron consumption during pregnancy is protective against some alcohol-induced problems. Studies in animals find that when mothers have sufficient levels of iron and drink alcohol, their babies have better cognitive outcomes than babies whose mothers are iron deficient and drink alcohol (note that, regardless of iron levels, babies from mothers who drank alcohol had worse cognitive outcomes than babies from mothers who avoided alcohol). Iron is important for the fetal brain, a development of cognitive function. And alcohol depletes iron away from the brain. Thus, maternal alcohol consumption causes babies to become iron deficient, even if the mother consumes sufficient levels of iron. However, monitors who consume sufficient iron, alcohol has an additive impact on the babies than if the mother is iron deficient.
BRAIN DEVELOPMENT & COGNITION


CANCER & METABOLICS


Antibiotic-induced acceleration of type 1 diabetes alters maturation of immune intestinal immunity. Zhang, X; Li, J; Kraatzle, KA; Iadi, M; Bartaglia, T; Borher, PC; Koh, H; Ng, S; Sibley, RA; Li, Y; Pathmanasi, W; Jindal, S; Shieldo-Cutter, RR; Hillman, B; Al-Ghalib, GA; Ruiz, VE; Livanos, A; Woot, A; Nagalingam, N; Rogers, AR; Summer, SJ; Knights, D; Denn, ML; Ele, R; Riggles, B; Beate, E; Williamson, MB; Ranish, M; Blaser, M (2018). Cell 173:703-718.

NUTRIGENETICS


The NIH’s 13 administrative staff members support the institute and its scientific staff—from operations and personnel to finance and fundraising—throughout the year. Also supporting our 18 faculty members in FY18 were 3 research scientists, 7 research associates, 10 postdoctoral fellows, 12 research associates and technicians, 5 doctoral students, and 4 interns.

Administration

Eduardo Servano
Associate Director for Research Administration

Susan Durante
Director of Development and Community Outreach

Brian D. Gillette
Assistant Director for Training Programs and Partnerships

Scott Jarrard
Applications Analyst and IT Consultant
EDUCATION & ENGAGEMENT

On May 1 and 2, 2018, the NRI hosted 96 participants at a Defining Precision Nutrition Symposium. Eight expert speakers from universities across the country and around the world delved into the tools and approaches needed to study and practice Precision Nutrition—from early discoveries based on genetics to powerful new methods like metabolomics, and developments in our understanding of gut microbes that absorb and metabolize nutrients.

Results of their work in these fields were brought together for examination and instruction.

Nutrigenetics, Nutrigenomics
and Precision Nutrition
Short Course

The NRI is dedicated to answering questions of how our genes and diet interact (the science fields of nutrigenetics and nutrigenomics), and how we can use these answers to develop a precision nutrition approach that maximizes each individual’s health. Such “NGs” research spans scientific concepts ranging from cell biology to dietsetics. Staying abreast of current developments in all of these various fields is difficult for researchers and practitioners, creating barriers that impede translation of research results from laboratories to populations.

The NRI’s third annual NGs Workshop, June 4-7, 2018 enabled interdisciplinary communication in Nutrigenetics, Nutrigenomics, and Precision Nutrition by bringing together graduate students, health professionals and nutrition scientists from academia and industry. Sixteen presenters led 96 participants through the 4-day short course, which provided fundamental concepts through cutting-edge presentations and hands-on experiences using the latest tools to analyze participants’ genetic data and understand their nutrigenetic profiles.

APPETITE FOR LIFE

Our research is complex, but our purpose is very human. To help make NRI science accessible and relatable, we offer opportunities for community involvement because, ultimately, our science is about you. Free Appetite For Life programs featured cooking demonstrations and nutrition talks focusing on fall and spring cooking to promote good health.

In our partnership with Johnson & Wales University in Charlotte, North Carolina, two Appetite For Life programs featured cooking demonstrations and nutrition talks focusing on fall and spring cooking to promote good health.

In the past year, audiences learned about:

- Vitamin and Human Health from Fola O. Idriss, PhD
- Navigating Holiday Cooking from Susan M. Smith, PhD
- Whole Foods and Nutrient Synergy from Carol L. Chestnutt, PhD
- Effects of Genes and Environment on Our Health from John E. French, PhD
- Understanding Individual Health and Response to Diet from Susan J. Sumner, PhD
- Diet and Prostate Cancer from Emma H. Allott, PhD

NRI SEMINAR SERIES

The NRI invites faculty from UNC-Chapel Hill, across the U.S. and around the world to give lectures on their research discoveries to faculty at the NRI. Guest speakers presented seven seminars this past year on such topics as:

- Glucose and amino acid metabolism in cancer. Jason Locasale, PhD, Duke University
- MicroRNA mediators of prenatal alcohol effects: From bench to bedside and back. Rajesh Misra, PhD, Texas A&M University
- Polyphenols and health: the good (science), the bad (science), and the ugly (truth). Daniel Dell’Ava, PhD, University of Padua, Italy
- N-3 fatty acid derived metabolic deficits impair immunological and metabolic responses in obesity. Faezia Shahab, PhD, UNC-Chapel Hill
- Assessing neurocognitive brain and cognitive development in the primate model. Ryan Dilger, PhD, University of Illinois

Appetite For Life at Restaurant Forty-Six in Minneapolis.
Corporate & Foundation Funding

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PHILANTHROPY 2008 - 2018

Thank you to those who have supported our research over the last decade, helping make precision nutrition discoveries possible.

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James H. Woodward

“I work as an obesity medicine physician and also as a bariatric physician. I am also a rheumatologist. I see the role nutrition has to play in people’s health and disease, and I support your efforts to help change people’s lives for the better.”

– Dr. Sally Nicks

Donor gifts provide crucial funds for exploring new ideas to prove they are worthy of larger federal funding. Donations also make possible our recruitment of the world’s best minds in nutrition science and support hands-on education and mentoring of students. Your gifts make all the difference to our success. Thank you.

“I continue to be inspired with the research and work being done at NRI. Supporting your mission to understand the benefits of personalized nutrition will help ensure their contributions to improving health and changing lives for the better.”

– Rina K. Shah