FROM THE DIRECTOR

I am pleased to report that we had another productive year at the Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts University. Our discoveries, focusing on the role of nutrition and physical activity in healthy aging, made significant contributions to improving quality of life for older adults globally.

Our research continues to be guided by our strategic scientific priorities focusing on: 1) nutrition, neuroscience and the aging brain, 2) personalized nutrition, 3) obesity, 4) chronic diseases of aging including cancer and cardiovascular disease, 5) inflammation, immunity and infectious disease, 6) musculoskeletal defects, and 7) micronutrients. These priorities are guiding our research with the aim of changing the trajectory of a growing population of older adults world-wide from one burdened by disability and diseases to one that is healthy, active and a vibrant segment of the population.

Equally important to our scientific progress is our outreach; a major commitment of the HNRCA is sharing our findings with the public and health care professionals. Our community outreach took large steps forward last year. We increased the number of hosted seminars, symposiums, and conferences as well as enhanced our community outreach efforts.

As Tufts University embarks on its T10 Strategic Plan, we are well in line with its goals to advance research, promote transformative experiences for students and young scientists and elevate our positive impact on society over the next 10 years. We look forward to being an active participant in the Tufts Healthy and Active Aging Thematic Group, which will create a synergistic University-wide collective building upon existing strengths and resources in the field of aging.
Over 30 years ago, the HNRCA came into existence because the US Congress found that... "...there is evidence of a relationship between nutrition and many of the leading causes of death in the U.S.; that improved nutrition is an integral component of preventive health care; that there is a serious need for research on the effects of diet and degenerative diseases and related disorders."
Today, we are more than 270 employees comprised of basic, clinical and epidemiological scientists and researchers, postdoctoral fellows, visiting scientists, trainees, and research and administrative staff. We continue to explore the relationship between nutrition, physical activity and healthy and active aging.

HNRCA Administration

Simin Nikbin Meydani
D.V.M., Ph.D.
Director

Dr. Simin Nikbin Meydani is a Senior Scientist and Professor of Nutrition and Immunology. In addition to serving as the Director of the Center, she leads the Immunology Laboratory at the Center. Dr. Meydani’s scientific interests include the impact of nutrition on the aging process and age-associated diseases, the role of nutrition on immune and inflammatory responses and predisposition to infectious diseases in developed and less developed countries.

Sarah Booth
Ph.D.
Associate Director

Dr. Sarah L. Booth is a Senior Scientist and Professor of Nutrition. In addition to serving as the Director of the Vitamin K Lab, she is also Associate Director of the Center for which she oversees the HNRCA’s six scientific core units. Dr. Booth’s research laboratory focuses on vitamin K food composition, dietary assessment, nutritional assessment, and bioavailability.

Mark Wesley
B.S.
Administrative Director

As Senior Director of Administration and Finance, Mr. Wesley oversees the annual operating budget, financial planning, sponsored program accounting, administrative core, materials management, facilities operations, and the non-research aspects of the University’s cooperative agreement with the USDA-ARS. Mr. Wesley has held comparable administrative and financial management positions at M.I.T. Lincoln Laboratory, the Berklee College of Music, and the Broad Institute.

RESEARCH LABS
ANTIOXIDANTS
BONE METABOLISM
CARDIOVASCULAR NUTRITION
ENERGY METABOLISM
NEUROSCIENCE AND AGING
NUTRITION & CANCER BIOLOGY
NUTRITIONAL EPIDEMIOLOGY
NUTRITION, EXERCISE, PHYSIOLOGY AND SARCOPENIA (NEPS)
NUTRITION AND GENOMICS
NUTRITIONAL IMMUNOLOGY
NUTRITION & VISION RESEARCH
OBESITY METABOLISM
VASCULAR BIOLOGY
VITAMINS & CARCINOGENESIS
VITAMIN K
VITAMIN METABOLISM

SCIENTIFIC CORES
BIOSTATISTICS
COMPARATIVE BIOLOGY
DIETARY ASSESSMENT
MASS SPECTROMETRY
METABOLIC RESEARCH
NUTRITION EVALUATION

ADMINISTRATIVE CORES
ADMINISTRATION
PHYSICAL PLANT/FACILITIES
SCIENTIFIC COMPUTING

TODAY, WE ARE MORE THAN 270 EMPLOYEES COMPRISED OF BASIC, CLINICAL AND EPIDEMIOLOGICAL SCIENTISTS AND RESEARCHERS, POSTDOCTORAL FELLOWS, VISITING SCIENTISTS, TRAINEES, AND RESEARCH AND ADMINISTRATIVE STAFF. WE CONTINUE TO EXPLOR THE RELATIONSHIP BETWEEN NUTRITION, PHYSICAL ACTIVITY AND HEALTHY AND ACTIVE AGING.

ReSEARCH LABS
Antioxidants
Bone Metabolism
Cardiovascular Nutrition
Energy Metabolism
Neuroscience and Aging
Nutrition and Cancer Biology
Nutritional Epidemiology
Nutrition, Exercise, Physiology and Sarcopenia (neps)
Nutrition and Genomics
Nutritional Immunology
Nutrition and Vision Research
Obesity Metabolism
Vascular Biology
Vitamins and Carcinogenesis
Vitamin K
Vitamin Metabolism

Scientific cores
Biosstatistics
Comparative Biology
Dietary Assessment
Mass Spectrometry
Metabolic Research
Nutrition Evaluation

Administrative cores
Administration
Physical Plant/Facilities
Scientific Computing

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Support (FY2013)

Operating Revenue
- Government grants and contracts: 86.9%
- Private grants: 11.3%
- Other contributions: 1.8%

Grant Applications Submitted
- Federal: 57.9%
- Private: 30.5%
- Other: 11.6%
RESEARCH HIGHLIGHTS

270 published academic papers
25 new external grants awarded
29 national and international committees served on
+200 lectures and seminars given globally
14 honors and awards received
Bone Metabolism Lab
Lab Director: Bess Dawson-Hughes, M.D.

Vitamin D supplementation does not reduce the progression of knee pain and cartilage volume loss in patients with established symptomatic osteoarthritis.

Knee osteoarthritis (OA) is a cartilage disorder that currently has no effective medical treatments. Previously, it was thought that vitamin D may protect against structural progression in OA. Researchers in the Bone Metabolism Lab conducted a 2-year-long study with 146 participants receiving either a placebo or oral treatment of vitamin D for the duration of the study. Their study showed no reduction in knee pain or cartilage volume loss in patients with symptomatic knee OA. This finding shifts our view on the potential role of vitamin D in this disease and scientists can now redirect future studies around OA.


Antioxidants Lab
Lab Director: Jeffrey Blumberg, PhD.

A new tool for measuring biomarkers in whole wheat and rye

Validating food intake data gathered from observational studies and clinical trials is an important aspect of nutrition research. Using test tube experiments with human liver cells, the Antioxidants Research Lab identified specific compounds resulting from the metabolism of whole grain wheat and rye. This discovery provides a new objective measure for the intake of selected whole grains. “In investigating the effects of whole grains on diseases such as cancer and diabetes, this novel biomarker will influence the design of new human studies,” said Dr. Oliver Chen, Scientist I in the Antioxidants Research Lab and senior author of the paper.


Body Composition Lab
Lab Director: Joseph Kehayias, Ph.D.

Field body composition tools provide a novel way to gauge frailty

Depleted muscle mass limits functionality and increases the risk of disabilities. Investigators in the Body Composition Lab have developed portable tools that can quickly and easily identify functional impairment and frailty in the field. For the first time, we can also measure and monitor the level of severity of frailty. In looking for ways to best manage muscle loss and function that accompanies old age, this is an invaluable tool.


Carotenoids and Health Lab
Lab Director: Guangwen Tang, Ph.D.
Dietary antioxidants may play a role in the prevention or delay of age-related cognitive decline.

All aging humans will develop some degree of decline in cognitive capacity as time progresses, but detering onset and severity is possible. Researchers in the Carotenoids and Health Lab analyzed dietary antioxidants from blood samples from nearly 300 octogenarians and centenarians. Additionally, brain tissue were analyzed for dietary antioxidants from 47 centenarians who agreed to donate these tissues upon death. The relationship between antioxidant concentrations in blood and brain and a battery of cognitive measures was evaluated. They found that the blood and brain samples of subjects with higher levels of the antioxidant lutein were related to better cognition. “These findings suggest that lutein supplementation might reduce age-related cognitive decline,” said Dr. Elizabeth Johnson, Scientist I in the Carotenoids and Health Lab and co-author of the publication.


Cardiovascular Nutrition Lab
Lab Director: Alice H. Lichtenstein, D.Sc.
Front-of-pack labeling system positively influences diet and is associated with a lower risk of cardiovascular disease.

The American Heart Association’s (AHA) Heart-Check mark exists on food products to help consumers eat heart-healthy foods meeting AHA nutrition requirements. Researchers in the Cardiovascular Nutrition Lab reviewed data from 11, 296 men and women who were both consumers and non-consumers of AHA Heart-Check Food Certification Program-certifiable foods. The lab calculated intakes of these foods based on the percentage of energy intake and discovered that a higher intake of eligible foods (on the basis of energy intake) was associated with lower risk of obesity and higher diet quality.

Neuroscience and Aging Lab
Lab Director (Interim): Irwin H. Rosenberg, M.D.

Low B vitamin status affects cognition and mood.

In the past, high levels of homocysteine, common amino acids in our blood acquired mostly from meat, have been associated with increased risk of cognitive decline. Additionally, B vitamins were thought to aid in lowering homocysteine levels. Researchers in the Neuroscience and Aging Lab examined data from 2000 human subjects to find that low levels of vitamin B-6 and B-12 are associated with an increased risk of impaired cognition. Further, the team found that low levels of B-12 were associated with an increased risk of depression. “This study adds further weight to the interpretation of the assessment of the relation between B vitamin intake and cognitive decline in elders. The relationship appears to be a direct one and not necessarily mediated by effects of the B vitamins on homocysteine and blood vessels in brain.” stated Dr. Irv Rosenberg, an author on the paper and Interim director of the Neuroscience and Aging Lab.


Nutrition and Cancer Biology Lab
Lab Director: Xiang-Dong Wang, M.D., Ph.D.

Tomato products prevent high fat diet/obesity related insulin resistance, oxidative stress, inflammation and cancers.

In 2014, an estimated 33,190 adults will be diagnosed with primary liver cancer. Fatty liver causes inflammation and damage, which may lead to cancer. One disease control strategy is the prevention of obesity-related liver cancer development through nutrition. In a study conducted on mice, researchers in the Nutrition and Cancer Biology Lab demonstrated for the first time that a metabolite generated from lycopene, found in tomato products, can inhibit high fat diet-promoted liver cancer development. These findings have led to increased interest in the role of tomato and tomato products for prevention of obesity associated diseases.


Energy Metabolism Lab
Lab Director: Susan B. Roberts, Ph.D.
Success of work-based weight loss programs

The Centers for Disease Control and Prevention (CDC) has predicted 42 percent of Americans will be obese by 2030, contributing to premature death, disease and skyrocketing health-care costs. Past workplace weight loss programs have not been very effective. Scientists from the Energy Metabolism Lab took a more scientific approach to workplace weight loss, focusing on the psychological component of food choices. Employees categorized as overweight or obese based on Body Mass Index (BMI) who enrolled in the six-month program lost 18 pounds compared to a two pound weight gain in a control group. Obesity is estimated to cost U.S. companies $15 billion per year; these programs could have a major impact on a company’s annual health-care expenses.


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Nutritional Epidemiology Lab
Lab Director: Paul F. Jacques, D.Sc.

Magnesium intake is associated with less arterial calcification.

Dietary magnesium, found in a broad range of foods including whole grains, green leafy vegetables, almonds, coffee, and dark chocolate, has been linked to a lower risk of cardiovascular disease, stroke and coronary heart disease in animals. Looking at data from the Framingham Heart Study, scientists in the Nutritional Epidemiology Lab found that subjects with high magnesium intake had a lower risk of having any coronary artery calcium or any abdominal aortic calcification than those with a lower intake. This finding, suggests a mechanism through which magnesium may affect the occurrence of strokes and fatal coronary heart disease.


Nutrition, Exercise, Physiology and Sarcopenia Lab (NEPS)
Lab Director: Roger A. Fielding, Ph.D.

Essential amino acid metabolism affects muscle mass, insulin resistance and inflammation in older adults.

Falls are the leading cause of fatal injury among older adults. Insulin resistance (when the body produces insulin but does not use it effectively) and inflammation have previously been linked with reduced muscle mass in older adults, which has a direct impact on mobility. To better understand processes related to insulin resistance, inflammation and muscle mass, researchers in the NEPS Lab identified associations between specific essential amino acids, muscle mass and markers of insulin resistance or inflammation using human studies. These associations could be a way to preemptively identify reduced muscle mass and initiate interventions to reverse it.

Nutrition and Vision Research Lab
Lab Director: Allen Taylor, Ph.D.
Diets lower in fats and carbohydrates protect against age-related macular degeneration (AMD).

As most of us age, we will confront age related vision problems. Scientists in the Nutrition and Vision Lab studied dietary patterns of 4,088 study participants at different stages of AMD development. Two dietary patterns were identified in the groups: 1) Oriental Dietary patterns with higher intake of vegetables, legumes, fruit, whole grains, tomatoes, and seafood; and 2) Western Dietary patterns with higher intake of red meat, processed meat, high-fat dairy products, fast food, refined grains, and eggs. Scientists found that people who consumed the Oriental diet pattern, which has lower fat and carbohydrates, are better protected against AMD than people who consume the typical American diet pattern comprised of more fatty foods.


Nutritional Immunology Lab
Lab Director: Simin Nikbin Meydani, D.V.M., Ph.D.

Flu infection is a leading cause of death among older adults, and the vaccine that is recommended for it is only 40% effective in that age group. In a study of older mice, researchers in the Nutritional Immunology Lab found that wolfberries, or goji berries, increased the efficacy of the influenza vaccine to offer additional protection against the flu virus. They further showed that wolfberries may increase the activity of dendritic cells, which play an important role in the ability of the immune system to defend the body from viral infections. These findings offer a nutritional strategy to improve vaccine efficacy in older adults and increase protection against the flu virus.

Du, X; Wang, J; Niu, X; Smith, D; Wu, D; and Meydani, SN. “Dietary wolfberry supplementation enhances protective effect of flu vaccine against influenza challenge in aged mice.” J Nutrition. 2014; 144 (2): 224-29.

Nutrition and Genomics Lab
Lab Director: José Ordovás, Ph.D.

It might not be so much what you eat, but when you eat it.

Roughly 50% of American adults are trying to lose or maintain their weight. Researchers in the Nutrition and Genomics lab followed subjects eating a Mediterranean-style diet as a weight loss treatment for a 20-week period and found that those who ate later in the day lost weight at a slower rate. The researchers believe that eating later in the day may alter the body’s internal clock, known as circadian rhythm, which might slow down metabolism. Energy intake, dietary composition, estimated energy expenditure, appetite hormones and sleep duration was otherwise similar between both groups. This finding can have a significant impact on success rates of individual weight loss attempts.


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Consuming turmeric influences lipid metabolism and suppresses atherogenesis (thickening of artery walls).

According to the World Health Organization, at least 2.8 million people globally die each year as a result of being overweight or obese. Scientists in the Vascular Biology Lab fed mice low fat or high fat diets supplemented with curcumin, the principal substance in turmeric, for 16 weeks. They found that curcumin reduced the adverse effects of a high fat diet on weight gain, fatty liver development, elevation of lipids in the blood, and atherosclerosis. Further, a medium dose of curcumin in a high fat diet was more effective than a higher dose of curcumin. This suggests that components of the spice turmeric may help maintain a healthy weight and reduce the prevalence of obesity and related diseases.


Quieting a gene in mice helps in resisting unhealthy meals

Researchers in the Obesity Metabolism Lab bred a strain of mice born without the gene which codes for a protein that regulates the storage of fat within cells (perilipin-2). This group of mice ate less, were more physically active and burned more fat over a 12-week period compared to the control mice, with conventional genes. Humans also carry the perilipin-2 gene; these findings could eventually lead to ways to fight obesity and diabetes. “This is an exciting observation because it provides an opportunity to identify new pathways that modulate food intake, physical activity and potentially, metabolism of fat,” explained Dr. Andrew Greenberg, who leads the lab.


Vitamin K Lab
Lab Director: Sarah Booth, Ph.D.

**Vitamin K and heart health**
While animal studies have shown that vitamin K treatment reduces vascular calcification, an indicator of heart disease, human data are limited. Scientists from the Vitamin K Lab collaborated on an analysis to assess the association between vitamin K status and coronary artery calcium (CAC) progression in the Multi-Ethnic Study of Atherosclerosis. The study included 296 participants with extreme CAC progression and randomly selected participants without extreme CAC progression. Researchers found that low levels of vitamin K1 were much more significantly associated with CAC progression in participants taking high blood pressure medications. “While findings from this study suggest there is an interaction between blood pressure lowering medications and vitamin K, we need to conduct more research to determine what the clinical implications are,” explained Dr. Sarah Booth who leads the lab.


Vitamins and Carcinogenesis Lab
Lab Director: Joel B. Mason, M.D.

**A possible connection between Vitamin B6 supplements and colonic inflammation**
Inflammatory bowel disease (IBD) is a relatively common condition but ideal means of treating the disease are lacking. Scientists in the Vitamins and Carcinogenesis Lab conducted a 12-week study in mice predisposed to developing colitis giving them elevated, lower than normal, and lowest possible levels of vitamin B6. As expected, the researchers found that low levels of dietary vitamin B6 resulted in a decrease in colonic inflammation compared to the group receiving normal amounts of the vitamin. What was particularly novel, however, was the fact that supplemental levels of the vitamin also protected against inflammation compared to mice receiving the basal requirement. “We are currently pursuing a more thorough understanding of this finding since supplemental levels of vitamin B6 could offer a potential treatment strategy for IBD.” said Jimmy Crott, Ph.D., Scientist II in the Vitamins and Carcinogenesis Lab.

Vitamin Metabolism Lab
Lab Director: Jacob Selhub, Ph.D.
The effects of high levels of folic acid on embryonic development

Folic acid is added to enriched bread, flour, cornmeal, rice, pasta, and other grain products. The regulation grew out of evidence that the risk of spina bifida and other neural tube defects in newborn infants dropped if mothers consumed more folic acid before pregnancy. While incidence of neural tube defects has diminished since the regulation began, little was known about the effects of excess folic acid. Researchers in the Vitamin Metabolism Lab found that a moderately high intake of folic acid has a negative impact on the development of embryos in mice. Pregnant mice were fed a control diet (recommended folic acid intake) or a diet that was 10-fold higher than the recommended folic acid intake. At 14.5 days, maternal folic acid supplementation was associated with embryonic loss, embryonic delays, a higher incidence of congenital heart defects, and thinner left and right ventricular walls, compared to mothers who were fed the control diet.

“These results point to the importance of maternal nutrition for the health of the fetus and the newborn,” said Ligi Paul Pottenplackel, Ph.D., Scientist III in the Vitamin Metabolism Lab and co-author of the publication.

OUTREACH AND EDUCATION

- 50 undergraduate, masters and Ph.D. researchers
- 738 unique media hits
- 561 research study volunteers
- 3 senior living centers using the HNRCA's Fit-4-Life program
- 26 scientific seminars hosted
- 5 public events held

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5 public events held
Public outreach
As a means to share scientific knowledge with the public, we created a partnership with the Massachusetts Horticultural Society in 2013. Current initiatives within the partnership include the Talk and Taste public lecture series held at the HNRCA and a community vegetable garden housed in the lobby of the Center. Both activities offer an opportunity for the public to benefit from the research conducted at the HNRCA by gaining knowledge of the role of nutrient-rich foods in chronic disease prevention, maintaining good overall health and incorporating nutrition into everyday cooking.

Distinguished visitors
Visitors to the HNRCA in 2013 included Kathy J. Greenlee, the Administrator of Community Living and Assistant Secretary for Aging at the U.S. Department of Health and Human Services and Kevin Concannon, the Under Secretary for Food, Nutrition, and Consumer Services in the USDA, among others. While many people see the results of our research on nutrition and aging in policy development and publications, visitors to our Center are able to see the development of evidence-based recommendations first hand.

Training the next generation of nutrition scientists
We continue our commitment to providing significant opportunities for junior scientists and trainees to grow beyond their defined areas of interest through mentoring, coaching, seminars and workshops. The HNRCA Student Innovation Fund, a crowdfunding effort, gives Ph.D. students the opportunity to pursue innovative student-proposed projects that enhance the learning and scientific value of the doctoral thesis. In 2013, we hosted 26 visiting scientists, an integral facet to the HNRCA, which offers an opportunity to learn and share new techniques and approaches to aging research with scientists from around the globe.
It is estimated that by 2050, there will be 395 million people living to be 80 years old.
Tackling the global obesity epidemic, one country at a time

Nutrition scientists in the Energy Metabolism Lab developed a workplace weight-loss program (as described earlier in this report) that has had stunning results. They are expanding this successful and sustainable approach to weight loss to a global level.

Around 3.4 million adults in the world die each year as a result of being overweight or obese. How and what people eat depends on where they live, their culture, and the overall food environment. The International Obesity Consortium, currently consisting of 32 researchers from 7 countries, will be looking at all of these factors in China, India, Brazil, Kuwait, Finland, and Ghana, among other countries to develop culturally appropriate and effective strategies to address the global epidemic of obesity.

Life expectancy has increased dramatically and research and technology have been rushing to catch up with it. The HNRCa has been looking at novel ways to expand upon our current impact on society. As we increase the ways our research can improve quality of life for older adults and reduce healthcare costs, areas of scientific focus have become even more unique than they have ever been.
The Microbiome
Several scientists at the HNRCA are focusing on the gut microbiome and its modulation by diet and exercise to better understand the role it plays on our overall health. Researchers are looking at ways it can be utilized in the fight against diabetes, obesity and cancer; stimulate your immune system and break down toxins.

Developing diets that complement genetic makeup
HNRCA scientists have discovered a new genetic mechanism that might protect some people against cardiovascular disease; especially if they eat more polyunsaturated fat. José Ordovás, PhD, director of the Nutritional Genomics Lab is leading research around personalizing nutrition at the HNRCA “Food intake is the environmental factor to which we are all exposed permanently, from conception to death,” says Ordovás. “As such, dietary habits represent a key environmental factor that modulates gene expression throughout our lives.”

Determining whether vitamin D supplementation is safe and effective in delaying the onset of type 2 diabetes
1 in 3 people in the United States have pre-diabetes. And the American Diabetes Association estimates that diabetes cost the U.S. health care system approximately $245 billion in 2012. The NIH-funded Vitamin D and type 2 diabetes (D2d) study is the first definitive large-scale trial (in 17 states) to investigate if vitamin D supplementation helps prevent or delay type 2 diabetes. The D2d study will enroll approximately 2,400 participants who are at risk of developing type 2 diabetes and follow them for up to 4 years. Dr. Bess Dawson-Hughes, Director of the Bone Metabolism Laboratory at the HNRCA, is the co-investigator on the project which is led by Anastassios G. Pittas, M.D., MS.

Prenatal, maternal and paternal health and offspring life-long disease risk
What your mother and father ate has a direct effect on your health later in life. Scientists in several laboratories at the HNRCA are looking at the impact of obesity and dietary factors during pregnancy as well as parental nutrition on lifelong resistance to infectious and chronic diseases in offspring.

Using stem cells to advance research in age-related neuroscience disorders, physical function and cancer
The effects of nutrition on the brain in the aging process is currently the HNRCA’s number one research priority. With a new case of Alzheimer’s disease diagnosed every 70 seconds, the global data on the costs of dementia and age-related dementia illness suggests that cognitive decline in the elderly presents an immense cost burden to caretakers and governments as well as a negative effect on quality of life. Scientists in the Neuroscience and Aging Lab, headed by the newly-appointed Lab Director Dr. Dennis Steindler, are looking at nutritional modification of stem cells to repair the aged brain which could lead to treatments for Alzheimer’s disease and other brain declines. Stem cell alteration can be applied to create self-renewing cells also in other tissues, which could lead to postponing and possibly reversing sarcopenia as well as cancer.

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