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From the Director
The Power of Partnerships

While knowledge defines our research, it’s the power of partnerships that ultimately drives the success of the Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts University.

These partnerships are of such high importance that they have been carefully woven into our name. The first part of our name reflects Jean Mayer, the former Tufts University president and esteemed nutritionist, and aptly denotes our academic home at Tufts. USDA of course suggests the U.S. Department of Agriculture, which almost 40 years ago established the center and a working relationship defined through a cooperative agreement. The final accent in our name is Aging and highlights our mandate to investigate the fundamentals of the aging process and connect nutrition and physical activity with healthy aging which has allowed us to create a community of thousands of older adults with whom we conduct our human studies and connect to dozens of other networks focused on older adults.

Prominent in our partnership tapestry is our world renowned scientists. Just look inside any one of our 17 laboratories and you’ll see outstanding Senior Scientists working side by side with innovative junior researchers and young students. Looking over the hundreds of manuscripts they publish each year you’ll see collaborations with other brilliant minds around the globe.

Funding is critically important and we could not operate without the support of the USDA, National Institutes of Health as well as the private sector, commodity boards and other supporters.

We are also committed to translating our research in ways that influence public policy and raise awareness about lifestyle choices among individuals. This part of our mandate has resulted in alliances with such groups as AARP Foundation and municipalities, including Boston, committed to the Age-Friendly Cities Initiative. Our scientists play leadership roles in many influential associations such as the American Society of Nutrition, the Gerontological Society of America, American Aging Association, the American Heart Association.

Our Tufts University partnerships are very important and include mentoring and training Friedman School of Nutrition students to be future leaders in the field as well as research collaborations with the medical school and Sackler graduate school of biomedical sciences among others. The service our scientists provide by sitting on key advisory boards and committees, and editing prestigious journals allow the HNRCA to impact the dialogue influencing the field of healthy aging and nutrition.

Our partnerships are shaped by mutual interests and nourished through shared values that focus on scientific research designed to improve the quality of life through nutrition, physical activity and other lifestyle choices that provide people with a path to healthy aging/longevity and vitality.
ABOUT THE HNRCA

We promote Healthy and Active Aging, through research, education, and practice. Our work fosters better understanding of the aging process and identifies the best nutrition, physical activity and healthy living choices that encourage vitality.

Programs
Antioxidants
Body Composition
Bone Metabolism
Cardiovascular Nutrition
Energy Metabolism
Neuroscience and Aging
Nutrition & Cancer Biology
Nutritional Epidemiology
Nutrition, Exercise, Physiology & Sarcopenia
Nutritional Genomics
Nutritional Immunology
Nutrition & Vision
Obesity Metabolism
Vascular Biology
Vitamins & Carcinogenesis
Vitamin K
Vitamin Metabolism

Scientific Cores
Biostatistics
Comparative Biology
Dietary Assessment
Mass Spectrometry
Metabolic Research Unit
Nutrition Evaluation Laboratory

Research Clusters
Cancer
Cardiovascular Disease
Inflammation, Immunity, & Infectious Disease
Obesity

Administrative Cores
Administration
Physical Plant/Facilities
Scientific Computing
SUPPORT

87% Government grants and contracts

11% Private grants

2% Other contributions
RESEARCH HIGHLIGHTS

125 editorial boards and advisory committees served on

250 peer-reviewed academic papers published

50+ honors and awards received

100 seminars presented globally
Antioxidants Lab

Cranberry juice increases antioxidant capacity in healthy older adults

In a study examining the effects of a low-calorie cranberry juice drink on antioxidant capacity in 10 healthy older adults, the Antioxidants Lab found that phenolic compounds in cranberry juice are bioavailable and increase antioxidant capacity in healthy older adults. This study is the first to demonstrate that cranberry bioactive compounds, believed to improve oral health and prevent urinary tract infections and stomach ulcers, remained present in healthy older adults over a 24 hour period.

Bone Metabolism Lab

Potassium bicarbonate supplementation lowers bone turnover

Modern diets are typically high in grains and low in fruits and vegetables, an imbalance that results in a dietary acid load. This acid load may be contributing to a decline in bone and muscle mass in older adults. Researchers in the Bone Metabolism Lab conducted a 3 month, double-blind, randomized, placebo-controlled study in 244 men and women age 50 years and older to determine the effect of supplementation with the alkaline salt, potassium bicarbonate, on rates of bone turnover. A high turnover rate is a strong predictor of bone loss and fracture. They found that the dose of potassium bicarbonate that neutralized the acid load significantly lowered the bone turnover rate by 22%. Researchers have identified the need for long-term trials to further assess the effect of alkali on bone mass and fracture risk.

Cardiovascular Nutrition Lab

Objective plasma biomarkers of diet can predict heart disease risk

The relationship between dietary fats and heart disease have typically been evaluated using diet questionnaires that are subjective and inconsistent. Researchers from the Cardiovascular Nutrition Lab took a novel approach and used objective measures of diet to examine plasma phospholipid fatty acids profiles in 2,448 postmenopausal women participating in the Women’s Health Initiative observational study. The research showed that fish with omega 3 has a positive effect on heart disease while fatty acids were negatively associated with heart disease. The researches hope to expand on this more objective approach to associating specific measures of diet to heart disease in older women.

Energy Metabolism Lab

The brain can be trained to like healthy food

Craving unhealthy high calorie food is a common problem that makes it hard to lose weight. Scientists in the Energy Metabolism Lab used functional magnetic resonance imaging (fMRI) to provide the first ever demonstration that the brain can be retrained to learn to like healthy foods. The 13 overweight or obese adults randomized to a control group or a weight-loss intervention underwent MRI examinations that identified a change in responsiveness of the brain’s “reward” (addiction) center resulting in increased liking for healthy food and decreased liking for unhealthy food.
Neuroscience and Aging Lab

Extracellular vesicles (EVs) may help in new treatments for Alzheimer’s and Parkinson’s disease

The spread of brain cancers, Parkinson’s and Alzheimer’s may involve nano-sized extracellular vesicles (EVs) that all cells normally release as cell state messengers during standard operation as well as during the transmission of disease. The Neuroscience and Aging Lab is working to understand the patient and disease-specific biomarkers contained within EVs to better facilitate real-time monitoring of patient disease risk, onset and progression, and response to different therapies. This research, which brings together diverse investigative fields including immunology, neuromedicine, oncology, infectious disease and nutrition hopes to aid in the discovering of new treatments for many diseases.

Nutrition and Cancer Biology Lab

Carotenoids in tomatoes reduces risk of liver disease and liver cancer

The prevalence of diabetes and obesity is contributing to nonalcoholic steatohepatitis (NASH) leading to increased risk of cancer and liver damage. Researchers in the Nutrition and Cancer Biology Lab have shown that the supplementation of lycopene, a major carotenoid from tomato and tomato products, is effective in inhibiting high fat diet-promoted nonalcoholic fatty liver disease and liver cancer development. Because liver cancer has a high mortality rate and a poor prognosis, these results can be used to motivate human consumption of tomato and lycopene, thereby, reduce the risk of high fat diet-related liver injury and cancer.

Nutritional Epidemiology Program

Two studies show a potential link between sugary drinks and metabolic problems across different weight groups

Through two studies the Nutritional Epidemiology Program found a potential link between sugar-sweetened beverages and adverse health outcomes in people, regardless of their weight. Using cross-sectional data from the Framingham Heart Study, researchers looked at obese, overweight and normal weight subgroups and found those consuming sugar-sweetened beverages are more likely to have adverse metabolic problems such as hypertension, high blood sugar, increased triglycerides levels, low HDL cholesterol, and insulin resistance.

Nutrition, Exercise Physiology and Sarcopenia Lab

Weekly physical activity maintains mobility for active older adults

In a first-of-its-kind 3 year study, researchers found that physical activity can help older adults maintain mobility and prevent physical disability. Sedentary men and women between ages 70 and 89 experiencing some mobility problems were sorted into two groups – half participated in structured aerobic, flexibility and strength training two times a week while half attended workshops on healthy aging and stretching exercise classes that were limited to the upper body. The exercising seniors significantly lowered their risk of developing mobility problems and experienced fewer cardiovascular and fewer diabetes-related health events during the trial.
Nutrition and Genomics Lab
More than a dream: A good night’s sleep and lower BMI

Short sleep duration has been associated with an increased likelihood of being obese or developing hypertension, diabetes, and cardiovascular disease. Research from the Nutrition and Genomics Lab observed that longer sleep duration is associated overall with lower BMI and may be modified by CLOCK genetic variants that regulate appetite. By conducting meta-analyses and using 9 cohort studies, including up to 14,906 participants of European descent, they found associations between sleep duration and a genetic variant on polyunsaturated fatty acid intake and between sleep duration and another genetic variant on protein intake, suggesting that the human CLOCK gene could influence and modify the associations between sleep duration and dietary intake.

Nutritional Immunology Lab
Vitamin E increases resistance of older mice to S. pneumoniae infection

HNRCA researchers showed for the first time that supplementation with α-tocopherol (α -Toc) form of vitamin E regulates pulmonary inflammation and significantly enhances resistance to Streptococcus pneumoniae infections, a significant cause of morbidity and mortality in older adults. Testing young and old mice, researchers in the Nutritional Immunology Lab in collaboration with those at the department of microbiology in the Medical School found that aged mice were more susceptible to S. pneumoniae but that α -Toc enhanced resistance of aged mice to bacterial pneumonia through lowering lung bacteria count and inflammation.

Nutrition and Vision Lab
Solving a century-old enigma regarding how nature makes our eye lens clear

The eye lens must be clear in order to allow us to see. In order to create a clear lens, most lens cells must remove their cell nuclei. How this process was regulated has remained a mystery for over 100 years. Researchers in the Nutrition and Vision Lab showed that CDK1 controls this process, specifically, CDK1 phosphorylates components of the nuclear membrane which leads to the destruction of the cell nucleus. This is important because this unidirectional process of destruction of the cell nucleus seems to have been borrowed from the initiation of nuclear membrane disassembly that precedes mitosis or cell division that results in reassembly of the nucleus in two daughter cells.

Obesity Metabolism Lab
Reduction in the protein ACSL5 increases body’s ability to burn fat and delay absorption of fat

As part of its objective to understand the mechanisms that contribute to obesity, researchers in the Obesity Metabolism Lab used mouse knockout models to demonstrate that a reduction in the protein ACSL5 allows the body to burn more calories and slow the absorption of fat. The study showed that ACSL5 contributes significantly to total ACSL activity within several tissues including brown adipose tissue, liver, and jejunal mucosa. Researchers expect to build on these observations using tissue-specific knockout of ACSL5 to further define its local contribution to changes in energy metabolism which will allow them to identify therapeutic strategies to prevent the development of obesity and related complications.
Vascular Biology Lab

**Modified form of Vitamin E stimulates formation of new blood vessels**

This study done by researchers in the Vascular Biology Lab showed that a modified form of vitamin E known as alpha-tocopheryl phosphate increased expression of the vascular endothelial growth factor (VEGF), a substance that stimulates the formation of new blood vessels in cultured cells. This form of vitamin E may act as a sensor to detect the formation of fats in the body. Understanding this could lead to applications that assist with the healing of wounds or injured tissue, that prevent loss of blood supply to the brain, heart, organs and tissues and that regulate the formation of blood vessels during the development of a fetus or tumors, both of which require the formation of new blood vessels.

Vitamins and Carcinogenesis Lab

**Women with low concentrations of folate in the breast have diminished expression of the tumor suppressor gene, p16(INK4a)**

Scientists in the Vitamin and Carcinogenesis Lab conducted the first human study examining folate concentrations in normal breast tissues. Lower breast folate levels were linked to impaired expression of p16(INK4a), a gene that protects against development of breast cancer. Further they found that alcohol consumption was associated with lower levels of breast folate. They also found that women carrying variant alleles of two genes involved in folate metabolism were more likely to have increased p16 (INK4a) promoter methylation, which is the means by which cells ‘turn off’ expression of the gene, suggesting that folate metabolism may be an important determining factor in breast cancer. This cross-sectional study was conducted in a sample of 138 healthy women without breast cancer who had undergone routine breast reduction.

Vitamin K Lab

**Adults with low plasma vitamin K are more likely to have joint and knee damage**

A study of older adults with very low plasma vitamin K levels showed they were more likely to have joint and knee damage progression after three years compared to those with sufficient plasma vitamin K. The research, designed to clarify if joint tissues’ vitamin K are relevant to osteoarthritis, used MRIs from 791 older adults from the Healthy, Aging, and Body Composition study (Health ABC), an ongoing cohort that examines age-related changes in physical function and body composition in older black and white adults. Future studies are needed to clarify mechanisms underlying the role of vitamin K in osteoarthritis.

Vitamin Metabolism Lab

**High plasma folate concentration associated with shorter telomeres**

While low folate has been associated with shorter telomeres, the Vitamin Metabolism Lab working with colleagues at Framingham Heart Study discovered the same result with too much folate and concluded there is a bell-shaped relationship between plasma folate/folate intake and optimal health. They also observed that multivitamin use was also associated with shorter telomeres. The researchers determined the relationship between telomere length of white blood cells and folate nutritional status (mean of 4 years) in participants of Framingham Offspring Study. Samples for this study had been collected before and after folic acid fortification of cereal grains mandated by FDA.
Alice Lichtenstein

Investigating the links between diet and cardiovascular disease is a major focus at the HNRCA where rigorous research, including landmark studies on dietary fats and cholesterol, have been instrumental in helping people better understand the connection between what they eat and the health of their heart. Alice H. Lichtenstein, D.Sc., leads this work in her roles as senior scientist and director of the Cardiovascular Nutrition Laboratory at the HNRCA and as the Stanley N. Gershoff Professor of Nutrition Science and Policy at the Friedman School.

“We must continue to pursue innovative, high-impact science to understand the ways that foods and nutrients influence our health,” says Dr. Lichtenstein. “We must start early, teaching our children the basic shopping and cooking skills they will need to develop lifelong healthy dietary habits.” Renowned nutrition scientists like Dr. Lichtenstein play an important role in making this happen. “We need to continue to nudge people toward healthier choices.”

Dennis Steindler

Confusion and memory loss clearly become more common with age. But the root causes remain largely mysterious. HNRCA researchers are looking at how inflammation may contribute to degenerative diseases like Alzheimer’s and Parkinson’s and how to prevent such age-related mental decline.

Inflammation is part of the body’s healthy response to infection. When immune cells attack foreign invaders, the surrounding area becomes temporarily swollen and painful. Unfortunately, many of the conditions of modern life, including a diet high in fat and processed sugar, lead to a state of chronic inflammation throughout the body. Over the past decade, researchers have linked chronic inflammation to heart disease, gum disease, and vision loss.

“Certain parts of the aging brain seem to be susceptible to inflammation,” says Dennis Steindler, Ph.D., senior scientist and director of the Neuroscience and Aging Lab. “This includes areas of the brain involved in new cell growth, memory, and learning.” Besides looking at how inflammation contributes to Alzheimer’s disease and other forms of dementia, Dr. Steindler and his team are examining how dietary changes and nutrient additives, in combination with new medicines, could help prevent and reverse these conditions. “We believe that some foods, many of those known to be good for you, can prevent inflammation and generate healthy cells to repair damaged nervous systems,” he says.
OUTREACH AND EDUCATION

179 volunteers participated in research studies

563 Media Hits

20 Seminars hosted
Healthy and Active Aging at Tufts (HA2T)

A new consortium of research focused on aging is being spearheaded by Tufts University and is led by the HNRCA director. The initiative known as Healthy and Active Aging at Tufts (HA2T) is pulling from the wealth of a vast research pool at Tufts that include neurologists, dentists, biomedical engineers, and veterinary doctors, to name a few. These researchers have started working on a collaborative level tackling aging from all angles with a goal of achieving synergy among university researchers that will further leverage Tufts as a key player in a global aging phenomenon which is changing the face of the world.

Global reach: from the White House to Davos, to Guinea Bissau

2014-2015 saw members from the HNRCA active in over 20 countries.

“*MyPlate for Older Adults provides examples of foods that contain high levels of vitamins and minerals per serving and are consistent with the federal government’s Dietary Guidelines for Americans*.”

— Alice H. Lichtenstein, DSc, senior scientist and director of the Cardiovascular Nutrition Laboratory at the USDA HNRCA.
LOOKING FORWARD
Global versus genome-based personalized dietary recommendations

At birth our genome provides us with the baseline of future risk of chronic diseases (as well as other less common diseases). Currently, we don’t have a way to predict at birth who will and who will not be predisposed to such diseases. Our Nutrition and Genomics lab is working to change that. In the near future, using a combination of knowledge, technology, and big data we will be able to genotype or sequence newborns and learn about their genetic predisposition. This will provide information to design the proper dietary strategy to counteract the genetic effect. Furthermore, sample gathering will not be invasive; a sample of saliva, or a buccal swab is enough to provide enough DNA to carry out genotyping or sequencing.

Using alkali (from fruits and vegetables or bicarbonate pills) to improve muscle and bone strength

As we age, our kidneys become less efficient at excreting acid which leads to an excessive amount of acidity in our blood. Typical diets impose a daily acid load. Proteins that we eat metabolize to acidic states but fruits and vegetables metabolize to alkali states. One can counter the common acid-producing diets by increasing fruit and vegetable intake or by taking alkaline salts of potassium such as potassium bicarbonate or potassium citrate supplements.

Large clinical studies done at the HNRCa have already shown that correcting the amount of acid within the diet lowers short-term indicators of bone loss in older men and women and improves muscle strength and power in the legs in older women. Next up is a long-term study to determine the optimal amount of alkali and then testing that amount in a large randomized trial to assess whether it improves muscle strength and bone mass over time.

The research goal of Dr. Bess Dawson-Hughes, who heads the Bone Metabolism Lab, is to reduce the rates of bone and muscle loss that occur gradually over many years and thereby to lower the risk of falls and fractures. “The results of this study could give us a new tool in preventative solutions and treatments that can easily be a part of each of our daily lives as we age.”

Another nutritional benefit of mushrooms

Portabella mushrooms and Shiitake mushrooms are good dietary sources of several macro- and micro-nutrients, and great sources of both soluble and insoluble fibers. Researchers in our Vascular Biology Lab are also starting to find that they may reduce inflammation of arteries and prevent development of atherosclerosis, a disease that causes plaque formation and blockages in the inner lining of the arteries.
Creating individual avatars as a way to test novel therapies for age-related diseases

Researchers in the Neuroscience and Aging Lab are developing a process that will allow engineered mice to be patient avatars that will lead to exploration of nutrient responses and studies of requirements. The lab has several models of neurodegenerative diseases and different cancers in these avatars that are essentially models of human diseases. These mice provide patient-specific tissues that will be invaluable for regenerative medicine testing in older populations and pinpointing personalized medicine regimens.

Optimizing nutrition research through diet-specific data collection: the ADAPT study

What if you could determine the feasibility of conducting future research studies among populations of individuals consuming a variety of popular diets? The Adhering to Dietary Approaches for Personal Taste (ADAPT) Study is working to do just that. The study of popular dietary patterns is unique and will consider the impact of personalized nutrition on parameters of healthy aging. Initial phases of the project are looking at Paleo, low-carb, vegetarian, vegan, raw, Mediterranean, gluten-free, low-fat diets.

Making your gut work for you

Everyone has what appears to be a unique microbiota within their guts which provides essential services for the body: extracting energy from food, absorbing and generating vitamins and amino acids and forming barriers against infections. Researchers in 8 of our labs are working to discover the impact diet has on these gut bacteria which could in turn have an impact on the entire body—potentially determining, for instance, whether an individual is obese or lean, or predestined to health or disease. This knowledge could revolutionize the way we think about gut bacteria in relation to weight loss, immunity, disease and the creation of essential nutrients.