Department of Human Health & Nutritional Sciences

College of Biological Science

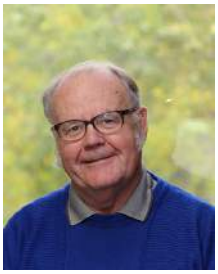
Research in Dietary Fatty Acids in Health and Disease

The Department of Human Health and Nutritional Sciences conducts innovative, world-class research exploring the biological aspects of human health. We aim to advance our understanding of aging and chronic disease, with an emphasis on the impact of sensory contributions, nutrition, physical activity, and biomechanics as powerful determinants of human health.

University of Guelph

Changing Lives Improving Life

Research on dietary fatty acids in the Department of Human Health and Nutritional Sciences goes beyond the view of fat as an energy source, to examine how their potent biological effects can be applied not only to disease development but also in the prevention and treatment of chronic diseases. An emphasis is placed on omega-3 and 6 polyunsaturated fatty acids, whose unique characteristics appear to lead to a multitude of physiological benefits. Our own Dr. Bruce Holub was one of the first to uncover the health benefits of omega-3 fatty acids, and has pioneered the development of omega-3 fortified foods in an effort to ensure adequate omega-3 consumption. Diverse areas of expertise allow us to uniquely approach research from multiple perspectives, and results in significant collaboration among faculty members.



Bruce Holub, PhD

Beneficial effects of DHA/EPA omega-3 fatty acids on human health

Dietary fats possess the ability to alter biochemical pathways in the body, and the results may be beneficial or detrimental to human health depending on the type of fat consumed. My research program has primarily focused on the potential benefits of omega-3 fatty acids on cardiovascular health, including the development of omega-3 fortified foods in order to address the ongoing issue of inadequate omega-3 consumption. In addition, I have also studied the negative effects that trans fatty acids can have on human health.

Holub BJ, Mutch DM, Pierce GN, Rodriguez-Leyva D, Aliani M, Innis S, Yan W, Lamarche B, Couture P, Ma DW. Proceedings form the 2013 Canadian Nutrition Society conference on advances in dietary fats and nutrition. Appl Physiol Nutr Metab. 2014; 39:754-62.

Holub BJ, Swidinsky P, Park E. Oral docosapentaenoic acid (22:5n-3) is differentially incorporated into phospholipid pools and differentially metabolized to eicosapentaenoic acid in tissues from young rats. Lipids. 2011; 46(5):399-407.

For more information, please visit www.uoguelph.ca/hhns/People/BHolub.html

Graham Holloway, PhD

Polyunsaturated fatty acids and mitochondrial function in health and disease

Long chain polyunsaturated fatty acids (omega-3 and 6) possess unique physiological characteristics that have the potential to affect mitochondrial function. This has important implications for many diseases including type 2 diabetes, heart failure, and various neuropathologies, where alterations in mitochondrial function appear to play a significant role in their progression and/or development. Part of my research program aims to understand how these fatty acids can affect mitochondrial function, and how this knowledge can be applied to the prevention and treatment of disease.

Herbst EA, Paglialunga S, Gerling C, Whitfield J, Mukai K, Chabowski A, Heigenhauser GJ, Spriet LL, Holloway GP. Omega-3 supplementation alters mitochondrial membrane composition and respiration kinetics in human skeletal muscle. J Physiol. 2014; 592(Pt 6):1341-52.

Matravadia S, Herbst EA, Jain SS, Mutch DM, Holloway GP. Both linoleic and α-linolenic acid prevent insulin resistance but have divergent impacts on skeletal muscle mitochondrial bioenergetics in obese Zucker rats. Am J Physiol Endocrinol Metab. 2014; 307(1):E102-14.

For more information, please visit www.uoguelph.ca/hhns/People/GHolloway.html

Lindsay Robinson, PhD

Fatty acids and obesity-related inflammation

In obesity, fat cells and immune cells (e.g. macrophages, T cells) in fat tissue interact with one another leading to the secretion of a variety of mediators (called adipokines) that lead to inflammation in fat tissue. Such fat tissue inflammation contributes to more widespread metabolic problems, such as whole body insulin resistance, a key feature of obesity-associated type 2 diabetes. It is important to understand how such immune cells interact with fat cells, in order to identify targets for preventative and treatment strategies to reduce obesity-associated. inflammation. My research group is particularly interested in omega-3 fatty acids called EPA and DHA that have the ability to reduce inflammation in the body. We are currently studying how omega-3 fatty acids improve immune cell communication with fat cells in fat tissue, as this has implications for reducing obesity-associated health problems.

Tishinsky JM, De Boer AA, Dyck DJ, Robinson LE. Modulation of visceral fat adipokine secretion by dietary fatty acids and ensuing changes in skeletal muscle inflammation. Appl Physiol Nutr Metab. 2014; 39(1):28-37.

De Boer AA, Monk JM, Robinson LE. Docosahexaenoic acid decreases pro-inflammatory mediators in an in vitro murine adipocyte macrophage co-culture model. PLoS One. 2014; 9(1):e85037.

For more information, please visit www.uoguelph.ca/hhns/People/LRobinson.html

David Mutch, PhD

Omega-3 fats, nutrigenomics, and health

Dietary fats are important signaling molecules that influence whole body metabolism and, consequently, a person's health. Omega-3 fats are particularly interesting because these dietary molecules are thought to reduce inflammation and improve insulin sensitivity. However, specific genes can influence omega-3 metabolism. I have a strong interest to better understand which genes influence omega-3 metabolism, as well as how differences in these genes may alter the health benefits of omega-3 fats.

Roke K, Mutch DM. The Role of FADS1/2 Polymorphisms on Cardiometabolic Markers and Fatty Acid Profiles in Young Adults Consuming Fish Oil Supplements. Nutrients. 2014 Jun 16;6(6):2290-304.

Zulyniak MA, Perreault M, Gerling C. Spriet LL, Mutch DM. Fish oil supplementation alters circulating eicosanoid concentrations in healthy young men. Metabolism. 2013; 62(8):1107-13.

For more information, please visit www.uoguelph.ca/hhns/People/DMutch.html

Kelly Meckling, PhD

Omega-3 fatty acids in the prevention and treatment of cancer

Omega-3 fatty acids have the ability to affect a wide array of physiological processes in normal cellular metabolism, and thus may potentially have implications for diseases where cellular metabolism is altered. My core research program is focused on the interaction of the biochemical pathways of omega-3s and vitamin D in normal blood and breast tissue development, and how this can be applied to preventing or treating the dysfunction in these pathways that occurs during the development of breast and blood cell cancers.

Dyck MC, Ma DW, Meckling KA. The anticancer effects of Vitamin D and omega-3 PUFAs in combination via cod-liver oil: one plus one may equal more than two. Med Hypotheses. 2011; 77(3):326-32.

Cha MC, Lin A, Meckling KA. Low dose docosahexaenoic acid protects normal colonic epithelial cells from araC toxicity. BMC Pharmacol. 2005: 23;5-7.

For more information, please visit www.uoguelph.ca/hhns/People/KMeckling.html

Lawrence L. Spriet, PhD

Effects of omega-3 fatty acids on skeletal muscle metabolism and membrane function

Omega-3 fatty acids have a wide array of physiological effects, including the potential to affect energy metabolism. Skeletal muscle is a significant site of carbohydrate and fat metabolism at rest and during exercise; however, little attention has been directed to examining the effect of omega-3s on membranes and energy metabolism in skeletal muscle. My goal is to examine how omega-3 fatty acids can affect the composition of skeletal muscle membranes and energy metabolism and to determine the underlying mechanisms that may be responsible for these effects.

Gerling CJ, Whitfield J, Mukai K, Spriet LL. Variable effects of 12-weeks of omega-3 supplementation on resting skeletal muscle metabolism. Appl Physiol Nutr Metab. 2014; 39(9):1083-91.

Logan SL, Spriet LL. Omega-3 fatty acid supplementation increases resting metabolic rate in healthy community-dwelling older adults. Med Sci Sports Exerc. 2014; 46(Suppl):S476.

For more information, please visit www.uoguelph.ca/hhns/People/LSpriet.html

David W.L. Ma, PhD

Dietary fatty acids in health and disease

The quality of fat consumed in the diet has significant implications on human health outcomes. My research program evaluates how exposure to a variety of fatty acids influences health through the lifecycle with a focus on health promotion and chronic disease prevention. Major contributions include demonstrating a direct linkage between omega-s and breast cancer prevention; anticancer effects of conjugated linoleic acids,; enhanced bone quality by omega-3s; reduced brain inflammation by omega-3s; novel effects of flax on the prevention of fatty liver disease; influence of genetics on fatty acid metabolism; and the development of fatty acid reference ranges.

Leslie MA, Abdelmagid SA, Perez K, Muller WJ, Ma DW. Mammary tumour development is dose-dependently inhibited by n-3 polyunsaturated fatty acids in the MMTV-neu(ndl)-YD5 transgenic mouse model. Lipids Health Dis. 2014 Jun 11;13(1):96. PMID: 24916956. Open Access article. Funded by CIHR and CFI/MRI.

Clarke SE, Kang JX, Ma DW. The iFat1 Transgene Permits Conditional Endogenous n-3 PUFA Enrichment both in vitro and in vivo. Transgenic Res. 2014 Mar 13. PMID: 24622775. Open Access article. Funded by CIHR and CFI/MRI.

For more information, please visit www.uoguelph.ca/hhns/People/DMa.html

The needs of the Department of Human Health and Nutritional Sciences are constantly evolving as we strive to produce top-level research in the health sciences. We are continually seeking collaborative partners who share our passion for human health and the promotion of a healthy lifestyle for the maintenance of health, aging, and the treatment of chronic disease.

Opportunities include:

- Contractual research partnerships
- Graduate Student Support
  PhD Student – $19,300/year (4 years)
  MSc Student – $15,300/year (2 years)
- Support in the form of research grants and awards

For more information about our research and how you can collaborate with the Department of Human Health and Nutritional Sciences, please visit www.uoguelph.ca/hhns, or contact the department Liaison Officer by phone (519-824-4120 ext. 54104) or email (hhnsliaisonofficer@uoguelph.ca).

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