ASSOCIATE PROFESSOR LINDSAY ROBINSON

Observing omega-3 in obesity

Associate Professor Lindsay Robinson explains how her interest in nutrition and immunometabolism led her to begin conducting research on fish oil-derived omega 3-fatty acids, with the aim of promoting a healthy lifestyle.

You are currently based at the University of Guelph where you are an associate professor. What is your field of study?

My research programme at the University of Guelph, Ontario, is focused on nutrition and immunometabolism in obesity. I am particularly interested in how dietary fatty acids, like fish oil-derived omega-3 fatty acids, modulate inflammatory mediators and immune processes within adipose tissue, and the ensuing implications for obesity-related chronic diseases, such as type 2 diabetes. My interests are both at the basic science level of these relationships (understanding mechanisms by which fatty acids modulate immune function), and also in determining nutritional strategies, such as increased consumption of omega-3 fatty acids that may be incorporated into a healthy lifestyle to promote optimal health.

How has your background shaped the research you conduct today?

My interest in this area developed from two key events that occurred during my fourth year of undergraduate studies in biology at Acadia University in Nova Scotia. The first was taking an elective nutrition course and the second was my laboratory-based research project. These actions revealed my love for both nutritional sciences and research. Combining these interests led me to the University of Alberta, where I obtained my PhD in Nutrition and Metabolism with a focus on dietary fat, immunology and cancer. Following this, I held a Natural Sciences and Engineering Research Council of Canada (NSERC) Postdoctoral Fellowship at the University of Guelph to study carbohydrate metabolism in insulin resistant states, such as obesity and diabetes. Altogether, this...

Fighting fat with fish

A team based at the University of Guelph is testing unique methods in a bid to uncover the true potential of omega-3 polyunsaturated fatty acids in preventing and treating obesity-associated diseases such as type 2 diabetes.

IN MODERATION, AND in the right composition, fat is an essential part of any human diet. High-fat diets, for instance, particularly those that are rich in saturated fatty acids, have been strongly linked to the onset and prevalence of obesity – a growing epidemic of the 21st Century – as well as a number of other chronic diseases, such as type 2 diabetes. Research into the types of fatty acids being consumed in the diet, and the extent to which individual fatty acids exert unique biological effects, is therefore fundamental to adequately manage such conditions.

Obesity occurs as a result of excessive adipose tissue mass – adipocytes (more commonly known as fat cells) are a predominant component of metabolic control, the secretion of which can lead to an accumulation of fat. As a result, it is important to examine the physiological characteristics of adipose tissue to better understand the mechanisms by which obesity-associated inflammation arises. Led by Associate Professor Lindsay Robinson, a team of researchers based at the University of Guelph’s Department of Human Health and Nutritional Sciences is examining this link in the hopes of identifying preventive and treatment options to reduce obesity-related inflammation.

OPPORTUNITIES FOR OMEGA-3

At Robinson’s laboratory, which is currently funded by the Natural Sciences and Engineering Research Council of Canada (NSERC) and receives an infrastructure grant from the Canadian Foundation for Innovation, the main focus is on fish oil-derived omega-3 polyunsaturated fatty acids, namely eicosapentaenoic (EPA) acid and docosahexaenoic (DHA) acid. The unique characteristics of these acids could potentially lead to a multitude of physiological benefits, including the capability of mitigating dysregulated inflammatory processes.

The team has shown that EPA and DHA increased secretion of adiponectin – an anti-inflammatory, insulin-sensitising adipokine – from 3T3-L1 murine adipocytes and primary human adipocytes. “In addition, we have also shown that DHA may lessen the degree of inflammatory mediators (eg. MCP-1 and IL-6) secreted from adipocytes, and may reduce the degree of pro-inflammatory M1 macrophages recruited to adipose tissue, thereby decreasing the intensity of pro-inflammatory communication between adipocytes and macrophages in obese adipose tissue,” Robinson enthuses. She hopes their research will contribute towards the improvement of the inflammatory microenvironment in adipose tissue, and ultimately, the related metabolic processes and functional outcomes that impact the pathogenesis of obesity-associated diseases.

METHOD LAB

Robinson and her group are spearheading efforts to monitor responses to nutritional manipulation in various systems, including adipocytes and immune cells grown in cell...
work has led to my research programme and the work we are currently doing in the area of nutrition and immunometabolism in healthy and obese states.

In your scientific investigations, you have zeroed in on omega-3 and omega-6 polyunsaturated fatty acids (PUFAs). Why have you focused on these two acids?

My reasons for focusing on omega-3 and omega-6 fatty acids are threefold. Firstly, given that omega-3 fatty acids are increasingly found in a plethora of functional foods and supplements in the marketplace and are widely consumed by many individuals as a strategy to promote health, it is important to continue studying their effects on various aspects of health, including inflammation and metabolic processes in the body. Secondly, although many health benefits of omega-3 fatty acids have been reported, it is important to understand the basic biological processes by which these bioactive nutrients impact health and disease. Finally, it is typically believed that omega-6 fatty acids promote inflammation in the body, whereas omega-3 fatty acids, especially fish oil-derived eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), exert anti-inflammatory effects and thus may be beneficial under situations of too much inflammation in the body.

Have you made any novel discoveries to date, either in this study or in other investigations you have undertaken?

Most recently, we have shown that the early obese adipose tissue cellular microenvironment of CD8+ T cells and adipocytes can be recapitulated in a co-culture model ex vivo. We investigated fish oil-enriched CD8+ T cells in co-culture with 3T3-L1 adipocytes in a CD8+ T cell: adipocyte ratio to mimic CD8+ T cells in obese adipose tissue in the absence or presence of the inflammatory stimuli, lipopolysaccharide. Using this model, we have provided the first evidence that fish oil-enrichment of CD8+ T cells can drive subsequent CD8+ T cell-adipocyte communication in a beneficial anti-inflammatory and anti-chemotactic direction that reduces subsequent macrophage chemotaxis, providing a basis for further studies assessing the mechanisms that underlie interactions among CD8+ T cells, adipocytes and macrophages. This is an exciting direction for us as we aim to further understand the inflammatory microenvironment in obese adipose tissue.

Is there a particular aspect of your work or discovery you have made of which you are most proud?

We are very excited to be moving beyond the macrophage in adipose tissue to study other immune cells, such as T cells and how they can be affected by omega-3 fatty acids within adipose tissue. This will help us to develop a more comprehensive picture of the inflammatory microenvironment in obese adipose tissue.

INTELLIGENCE

FATTY ACIDS AND INFLAMMATORY MEDIATORS IN HEALTH AND DISEASE

OBJECTIVE

To investigate the impact of omega-3 fatty acids on adipose tissue biology, inflammation and metabolic processes, such as insulin resistance, that are implicated in obesity-related diseases, such as type 2 diabetes.

KEY COLLABORATORS

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Dr Krista Power, Agriculture and Agri-Food Canada, Canada

FUNDING

Natural Sciences and Engineering Research Council of Canada (NSERC)
Canadian Foundation for Innovation (CFI)

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