HUMAN & ENVIRONMENTAL PHYSIOLOGY RESEARCH UNIT

NEWSLETTER

HOME OF OPERATION HEAT SHIELD CANADA

Generating the science to help Canadians adapt and prepare to rising temperature extremes

APRIL 2023 • VOLUME 2 • ISSUE 1

THE SPRING EDITION

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NEWS AND NOTEWORTHY

THANK YOU TO OUR PARTICIPANTS!

Over the past 4 years, HEPRU has been hard at work on a world-first series of studies evaluating the effects of daylong exposure to hot weather on the physiology and health of older adults. Since 2019, we have completed almost 300 daylong heat exposure trials, collecting over 3,200 hours of high-quality data on the impacts of heat on our physiology, from the whole-body perspective, right down into the individual cells of the body. This endeavour has required incredible input from not only our team of scientists and students but also from you – our participants. Without committed and enthusiastic volunteers, this work would not be possible.

We are sincerely thankful to all those who have participated thus far!

Not only does your contribution reflect an important step forward in our understanding of the physiological and health impacts of extreme heat, it will and has led to the development of guidance for protecting vulnerable persons during heatwaves. Health agencies including the World Health Organization, Health Canada, and the British Columbia Centres for Disease Control are already integrating our data on the impacts of simulated indoor overheating to support the creation of the first-ever indoor temperature upper limits in Canada. For more information on the need for indoor upper limits, click here to see the recent report by Canada's Chief Public Health Officer, Dr. Theresa Tam.

We are also happy to announce that the first peer-reviewed scientific article stemming from daylong heat exposure studies was accepted in Environmental Health Perspectives, the flagship journal of the U.S. National Institute of Environmental Health Sciences (NIEHS). This work represents the first-ever evaluation of the effectiveness of visiting cooled locations like an air-conditioned shopping mall or a cooling centre for preventing hyperthermia and physiological strain during heatwaves. All individuals on our mailing list will receive a copy of this work, along with an associated expert perspectives article, published by the journal highlighting important new scientific advancements in environmental health!

Watch this space for more exciting news!

A MESSAGE FROM THE DIRECTOR

Dr. Kenny and the Human and Environmental Physiological Research Unit are playing a key role in assisting the World Health Organization develop heat-mitigation guidance for health and housing authorities around the world in protecting heat vulnerable persons from indoor overheating.

Spring is here, and assuming winter will release its grasp, we will soon experience warm sunny days once again. While this can be an exciting time, we can't forget that summer is also fast approaching bringing along some very hot and humid days that can threaten the health and well-being of many. With your help, our team has been leading the charge in developing heat-mitigation strategies and guidance to safeguard the health and well-being of individuals and communities during these hot summer days. Over the past few months, in partnership with Health Canada, we have conducted several new studies that include research evaluating the benefits of limb immersion (legs) in cool water and fan use to protect heat-vulnerable older adults. The results of this work and that of our many other recently completed studies (i.e., the use of cooling centers and the development of indoor temperature limits to protect the health and well-being of heat-vulnerable populations) will be used to create new recommendations and messaging that will be shared with our public health partners in Ottawa (Ottawa Public Health) and across Canada (e.g., British Columbia Centre for Disease Control, National Collaborating Centre for Environmental Health, Institut National de Santé Publique du Québec, Toronto Public Health and others). The outcomes of our work will also be shared with World Health Organization (WHO) to support decision-making for health and housing authorities around the world in protecting heat-vulnerable occupants from indoor overheating.

Throughout the summer will be continuing our work, which will include conducting studies directed at developing heat exposure limits for older workers and individuals with common chronic diseases (e.g., type 2 diabetes, hypertension). For decades, workers across Canada have relied upon heat exposure guidelines that assume a one size fits all and fail to consider that heat tolerance can differ between men and women and young and older adults. Our team will lead the charge in developing sex- and age-specific exposure limits and advice to ensure that all workers are provided equal protection while performing their jobs in hot environments. Other studies include assessing the effects of menopause on heat tolerance and evaluating the effects of heat stress on the body's immune response. In early fall, in partnership with Health Canada, we will be commencing a third phase of our work that will be directed at understanding the benefits of fans in protecting older adults who may be confined to their beds for extended periods (such as those individuals in hospitals or long-term care facilities). As many of you are aware, many long-term care facilities in Ontario do not have air conditioning. Consequently, alternative heat-mitigation strategies such as fans are employed. While they are widely used, as our preliminary work demonstrates fans may not adequately protect heat-vulnerable individuals in extreme heat conditions.

The success of work today is possible because of the unparalleled support of the hundreds of volunteers like you who have generously provided their time and energy to assist in this important research. If you are interested in participating in the next phase of our work, please send me an email at gkenny@uottawa.ca. We are looking for men and women up to 85 years of age with and without diabetes and or hypertension. All eligible participants will receive a full fitness assessment.

Finally, over the next months, our research unit will be undergoing a transformation, with new state-of-the-art tools and instruments to be added and a new large environmental chamber. We will be sharing some pictures with you in our next newsletter. You are also welcome to visit our unit any time. On behalf of my team at the Human and Environmental Physiology Research Unit and our partners at Health Canada, thank you to all those individuals that volunteered in our studies.

Dr. Glen P. Kenny

Director
Human and Environmental Physiology Research Unit

PREPARING FOR THE SUMMER SEASON AHEAD

Your home is an important barrier to the external environment. Consider the following list of building characteristics and identify those that best represent your home living environment. These are important factors that will affect your home's resiliency to overheating. If you have identified one or more factors in each category, your home may be a risk of overheating. Review your options to reduce overheating in your home.

Residential Assessment Checklist

With summer fast approaching, it is important to perform an annual pre-summer assessment to check your home's preparedness for the summer heat. **If you know your home gets hot in the summer, it is highly likely that you will experience potentially dangerous increases in indoor temperatures during an extreme heat event.** You should assess your home before temperatures begin to rise. This will ensure adequate time to address any concerns, especially if larger modifications to your home are required.

Location

- ☐ Located in a neighbourhood with dense housing and limited yard space and tree coverage.
- ☐ Newly developed housing community with little vegetation and trees.
- ☐ Located in or near an industrial area with large warehouses, tires, parking lots and few trees.
- ☐ Primary living space (bedroom, living and dining room) facing West (sunset) or East (sunrise) exposure.
- ☐ Located next to the road with high traffic.
- ☐ Located in an open space but with no tree covering.

Building Characteristics

- ☐ Multi-level home or apartment (living on upper floors).
- ☐ Older home (~30 years or older).
- ☐ Small home (1000 square feet or less on the main floor).
- ☐ Attic with no or limited ventilation.
- ☐ Dark roof shingles or flat roof.
- ☐ Vinyl or wood siding only or with little or no brick or stone.
- ☐ Home with no basement.

Windows & Ventilation

- ☐ Only a few windows with partial or full interior window coverings (e.g., curtains, blinds).
- ☐ Windows have no exterior overhangs, awnings, or shutters.
- ☐ Many and or large windows (especially facing East or West).
- ☐ Some windows are fixed (not operable) or do not open very much.
- ☐ Single-paned windows.
- ☐ No central air conditioning system or air cooling is limited to portable or wall/window-mounted air conditioners.
- ☐ No fans in primary living space and or limited to pedestal fans.

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UNDERSTANDING WHO IS VULNERABLE TO OVERHEATING IN YOUR HOME

In addition, to understanding those factors that can cause your home to overheat, you should also consider those personal factors that can limit your ability to cool, resulting in reduced tolerance to heat. Your ability to cope in the heat depends on several personal factors. **If you or your family member(s) have identified one or more factors below, you may be at greater risk of developing a heat-related injury at a lower indoor temperature.** To reduce your risk, consider implementing additional steps to reduce overheating in your home. Check all that apply below. Remember, the more checkmarks selected, the higher the potential risk for a heat-related injury, and the more action you should take to reduce overheating in your home.

Personal Risk Assessment Checklist

- [ ] **Older Adult (60 years+)**
  The body's natural cooling processes are impaired with age.

- [ ] **Presence of Chronic Disease**
  Individuals with chronic diseases such as diabetes, heart disease, respiratory disease, cancer and others can limit the body's ability to cool, causing dangerous increases in body temperature.

- [ ] **Mental Illness or Cognitive Disorders**
  Conditions such as anxiety disorders, depression, schizophrenia, and dementia, among others, can reduce awareness of heat-related risks.

- [ ] **Substance Dependency or Use**
  The ability to sense and respond to heat and remain hydrated may be altered due to the use of alcohol or drugs, especially in those with a substance dependency disorder.

- [ ] **Medication Use**
  Medications such as anti-adrenergic, beta-blockers, diuretics, NSAIDs, anticholinergics, antidepressants, antipsychotics and others can affect your body's ability to lose and dehydrate you.

- [ ] **Impaired or Decreased Mobility**
  People with impaired or reduced mobility might be less able to take protective measures during extreme events.

- [ ] **Living Alone or Socially Isolated**
  People who live alone or do not have strong social connections or support are at higher risk of a heat-related injury.

- [ ] **Poor Physical Fitness**
  People who are not engaged in regular physical activity have a reduced ability to lose heat when exposed to hot environments.

- [ ] **Previous Heat Injury**
  People who have previously experienced a heat illness or injury may be less tolerant of the heat.

- [ ] **Lack of Acclimatization**
  People who are not regularly exposed to heat have a reduced capacity to lose heat and may be less tolerance to heat.

- [ ] **Chronic Insomnia and Poor Sleep**
  Sleep deprivation can reduce heat tolerance.

- [ ] **Current or Acute Illness**
  People who are usually healthy but are temporarily unwell may be more susceptible to heat.

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Options to Reduce Overheating in Your Home

If one or more of the above characteristics listed apply to you, you can take action to make some modifications to limit overheating in your home this summer. When making decisions on steps to reduce overheating in your home, remember to also consider those personal factors that may apply to you or a family member. If you have heat-vulnerable people living in your home, give yourself adequate time to implement changes in your home to reduce overheating. This is especially important if larger modifications to your home are required.

Heat Reduction Actions	
Immediate	• Check that all windows that can be opened are functional to permit airflow. This includes the ability to open windows on opposite sides of the house to create a draft (cross ventilation) during cooler nighttime periods. For personal safety, avoid leaving your window open for extended periods, especially at night.
Short Term	• If possible, create a temporary summer living space in a cooler area such as the lowest level of the house (e.g., basement). • If you don't have a thermostat or direct access to a thermostat for your home, consider installing a temperature and humidity monitoring unit to track overheating in your home. • Purchase a pedestal fan or portable air conditioning unit to enhance air circulation in your home.
Moderate	• Consider permanent internal (e.g. blinds, drapes) or external (e.g. awnings, shutters, canopies) shading solutions to block the sun. • Install a ceiling fan in your primary living spaces. • Remove or relocate any reflective material (e.g., metal sheds) and glass barriers (e.g., greenhouses) around your home that can absorb and reflect the sunlight. • If you have an attic, make sure it is properly insulated and ventilated so that excess heat can escape. • Keep your yard as green as possible (e.g., grass, bushes and trees), as large asphalt, concrete or paved driveways can absorb and radiate more heat.
Long Term	• Plant trees in areas that would provide the most coverage to the primary living space of your home, especially in areas with large windows. • If you have many and/or large windows, consider solar control coatings to reduce the amount of solar radiation that can enter your living space. • Install a central air conditioner if you have existing ductwork or consider a ductless wall-mounted air conditioner. • If it is time to change your shingles consider a light-coloured roof as it can reduce the amount of heat absorbed by your home. • Replace single-paned windows with more energy-efficient double or triple-paned windows. • Install external solar control coatings to reduce heat gain from the sun. • Renovate your basement to create a permanent bedroom and living space in this cooler area of your home.

FRESH OFF THE PRESS

Impacts of age, diabetes, and hypertension on serum endothelial monocyte-activating polypeptide-II after prolonged work in the heat

W. Shane Journeay, James J. McCormick, Kelli E. King, Sean R. Notley, Nicholas Goulet, Naoto Fujii, Tatsuro Amano, Glen P. Kenny

Endothelial monocyte-activating polypeptide II (EMAP-II) is a protein that is produced by endothelial cells, which are cells that line the inner surface of blood vessels. EMAP-II has been shown to have various biological activities, including the ability to activate immune cells, stimulate angiogenesis (the formation of new blood vessels), and induce apoptosis (programmed cell death). EMAP-II has also been implicated in various physiological and pathological processes, such as inflammation, tissue injury, and tumor growth. Overall, EMAP-II appears to be an important mediator of immune responses and vascular function, and may have potential applications in the diagnosis and treatment of various diseases. To better understand the role of EMAP-II, we conducted the first study aimed at evaluating the effects of exercise and environmental heat on circulating EMAP-II concentrations. Following 3 hours of moderate-intensity exercise, representative of a typical workload among utility workers, serum EMAP-II concentrations remained unchanged after exercise. However, when exercise was performed in the heat, serum EMAP-II concentrations increased in healthy young adults, healthy older adults, and older adults with hypertension, albeit to a lesser extent in the two latter groups. Interestingly, serum EMAP-II concentrations did not increase in older adults with type II diabetes, even when exercise was performed in the heat. These findings raise many questions about the role that EMAP-II plays during exercise-heat stress and how the presence of common chronic disease may alter EMAP-II responses.

CLICK HERE TO READ MORE!

Elevations in serum brain-derived neurotrophic factor following occupational heat stress are not influenced by age or common chronic disease

Nicholas Goulet, James J. McCormick, Kelli E. King, Sean R. Notley, Gary S. Goldfield, Naoto Fujii, Tatsuro Amano & Glen P. Kenny

Brain-derived neurotrophic factor (BDNF) is a protein that plays a crucial role in the growth, development, and survival of neurons in the brain and nervous system. Research has shown that BDNF is involved in a wide range of physiological and pathological processes in the brain, such as learning and memory, synaptic plasticity, neurogenesis (the formation of new neurons. Given its important role in brain function and disease, BDNF is a promising target for the development of novel therapeutic interventions for various neurological and psychiatric disorders. Regular exercise has been shown to increase the production and release of BDNF. This is thought to be one of the key mechanisms through which exercise exerts its beneficial effects on brain function and cognition. In an acute manner, BDNF may play a neuroprotective role by mitigating inflammation and oxidative stress. This is particularly important in the context of heat-stress, which is associated with both inflammation and oxidative stress. Considering that age and common chronic disease (hypertension and type II diabetes) lead to reduced thermoregulatory function and exacerbated inflammation, we evaluated if BDNF responses to moderate-intensity exercise in thermoneutral and hot environments are altered throughout the lifespan. Our findings indicate that serum BDNF concentrations do not increase following 3 hours of exercise in a thermoneutral environment, however, they do increase when exercise is performed in the heat. Further, BDNF responses did not differ between healthy young men, healthy older men, and older men with hypertension or type II diabetes. These similar BDNF responses were observed despite reduced exercise tolerance time in those with chronic disease, yet with similar thermal and cardiovascular strain, suggesting that individuals with hypertension or type II diabetes may experience greater cellular stress during heat-stress.

CLICK HERE TO READ MORE!

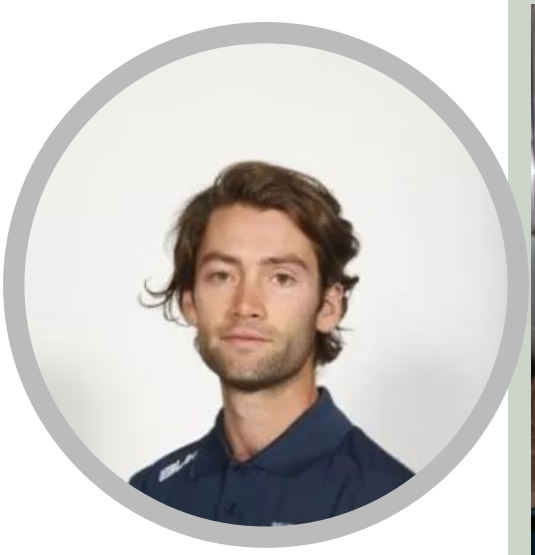
HEPRU TEAM HIGHLIGHT

MEET DR. FERGUS O'CONNOR

Dr. Fergus O'Connor joined HEPRU in Oct 2022, arriving from Australia, where he completed his PhD at Bond University.

Fergus' PhD studies investigated the thermal challenges faced by team-sport athletes training and competing in hot environments in conjunction with novel strategies to mitigate the detrimental effect of environmental heat exposure and improve exercise performance. Across his PhD studies and employment within the professional sporting industry, Fergus has worked with over 200 professional athletes across a diverse range of sports. At the completion of his PhD, Fergus' interest shifted from the impact of environmental heat stress on athletic performance to understanding the effects of prolonged heat exposures (i.e., day-long) on physiological outcomes in working environments and also during resting conditions.

For example, Fergus is currently leading a project designed to assess the efficacy of pedestal fans as an in-home cooling intervention during prolonged heat exposures. The results of this particular study will hopefully be published in the not-too-distant future and in time for summer! Looking further forwards, Fergus' aim is to continue to research the physiological outcomes of exposure to environmental extremes while exploring strategies to limit the detrimental effects of these environments and/or promote physiological adaptation



Dr. Fergus O'Connor
foconnor@uottawa.ca

HEPRU TEAM HIGHLIGHT (CONTINUED)

MEET KATIE WAGAR

Katie is a first-year master's student at the Human and Environmental Physiology Research Unit. She joined the laboratory in September 2022 after completing her undergraduate degree in human kinetics at Memorial University in St. John's, Newfoundland.

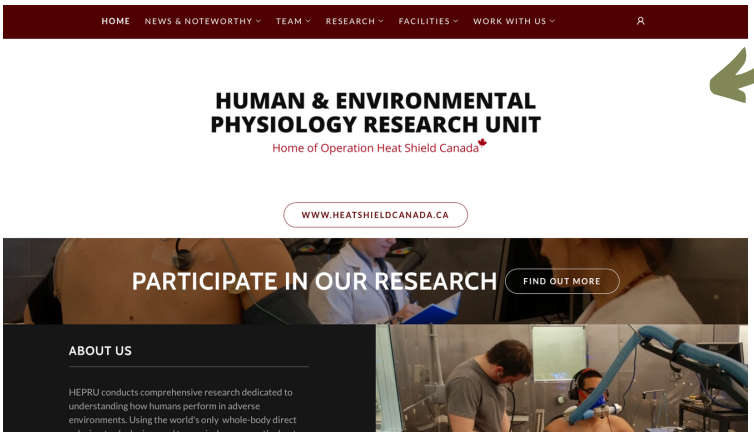
This year, Katie is working on assisting team members with ongoing quantitative and qualitative projects. She is currently involved in a project examining fan use during day-long heat exposure. In addition, she is working on projects examining public and occupational heat health messaging and the use of cooling interventions in the home.

Katie hopes to implement the research skills she has built into her thesis, which will look at safe work times for women completing moderate-intensity work in warm conditions. Specifically, Katie is interested to see if a second work bout (preceding an extended rest period like a lunch break) and a work bout completed the following day will impact safe working times and if refinements need to be made to current guidelines.

Katie Wagar

Click here to read more about Katie.

LEARN MORE ABOUT OUR TEAM AT WWW.HEPRU.CA



RECRUITMENT CORNER

PROTECTING WORKERS PERFORMING THEIR DUTIES IN THE HEAT

Occupational heat stress directly threatens workers' ability to live healthy and productive lives. Heat exposed workers are at an elevated risk of experiencing impaired work performance and cognitive function leading to a greater risk of work-related injuries, which includes traumatic injury (e.g., fractures) and heat-related illnesses (e.g., heat stroke, acute kidney injury, adverse cardiovascular events).

To mitigate this risk, safety organizations recommend upper limits for heat stress, typically defined by the level of effort and ambient conditions. Yet, heat stress continues to compromise worker health and safety. This can in part be attributed to the fact that employers underestimate the risks associated with heat stress and are given relatively limited guidance in how best to implement heat mitigation strategies.

Perhaps the strongest contributing factor is the fact that current occupational heat stress management guidelines assume a one size fits all approach and do not consider individual variability in physiological tolerance to heat stress, leaving many heat-vulnerable workers, such as women and older individuals under protected.

With climate change fueling an increase in the occurrence of hot weather, the risk of heat-related injury and disease is expected to rise dramatically in both prevalence and severity over the next decades.

To address the shortcomings of current heat management guidelines, we are conducting a study to generate safe work times to protect all workers, regardless of age or sex, that must perform their jobs in hot environments.

You can help protect our workers by participating in this important study. We are looking for healthy older (55-69 years) men and women who are habitually active but not engaged in endurance training activities. If you feel like you can contribute, reach out to Dr. Glen Kenny at gkenny@uottawa.ca to participate.

Learn more about our occupational heat stress research at www.hepru.ca

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RECRUITMENT CORNER

DOES MENOPAUSE AFFECT THE ABILITY TO COOL DOWN?

For women, menopause is a normal part of the aging process, however, there are often undesirable symptoms, such as hot flashes. Hot flashes are known to severely impact quality of life through consequences such as sleep deprivation, heat intolerance, and physical and general malaise. Moreover, hot flashes are associated with increased risk for cardiovascular disease and related deaths. Despite the impact that hot flashes have on up to 80% of menopausal women, there has been no comprehensive research assessing whether women who experience hot flashes have impairments in heat loss during a heat stress, and therefore a higher risk of heat-related illness.

Our team is initiating a series of studies aimed at understanding the effects of menopause on skin blood-flow, which is integral for dissipating heat to the environment.

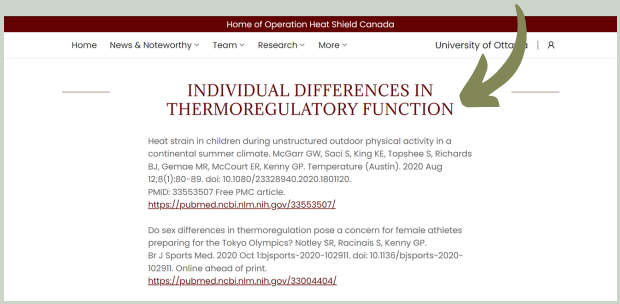
Our key focus is on women who may be the most vulnerable to heat-related illness: women with severe hot flashes and women with chronic health conditions. If you are in menopause, please consider participating in our study.

This study is looking for participants that meet the following criteria:

- Women 40-65 years of age
- Post-menopausal (>1 year since last menstrual cycle)
- With and without severe hot flashes
- May be physically active but not engaged in intense exercise training programs
- With and without type II diabetes
- No history of premature or surgically induced menopause

Please contact Dr. Glen Kenny at gkenny@uottawa.ca to participate.

Learn more about how age and sex affect thermoregulation at www.hepru.ca



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RECRUITMENT CORNER

DO COMMON CHRONIC DISEASES AFFECT HOW IMMUNE CELLS RESPOND TO EXERCISE?

Autophagy is a crucial process that takes place in almost all cells in the human body, which serves to protect normal cellular function when faced with physical stressors like exercise or high temperatures. If the stressor is too severe for the cell to handle, cell death mechanisms (apoptosis) are activated to eliminate the cell and prevent harm to surrounding cells or tissues.

To gain insight into these vital cellular mechanisms in humans, we are studying immune cell responses in numerous populations before and up to six hours after engaging in 30 minutes of semi-recumbent cycling exercise in temperate (25°C) and hot (40°C) environments.

Our findings thus far show that during exercise in a temperate environment, cellular survival mechanisms (autophagy) are activated, but when exercise is performed in the heat, there is a shift toward cellular death mechanisms (apoptosis).

We are currently looking for participants with hypertension and type II diabetes to continue investigating these responses across the lifespan. This research is critical to better understand how cells are affected during exercise- and heat-induced stress and to ultimately protect human health.

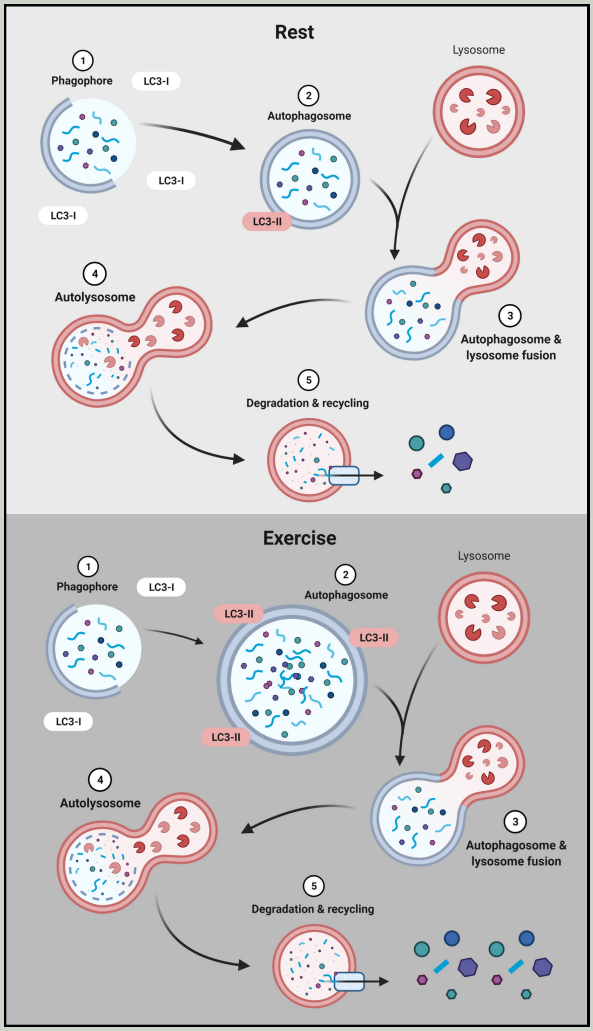

Figure. Summary of the autophagic process at rest (top panel) and during exercise (bottom panel). Increased levels of LC3-II during exercise reflect an increase in autophagosome content (misfolded and damaged proteins).

This study is looking for participants that meet the following criteria:

- Males and females 60-80 years of age
- With type 2 diabetes or hypertension
- May be physically active but not engaged in intense exercise training programs

Please contact Dr. Glen Kenny at gkenny@uottawa.ca to participate.

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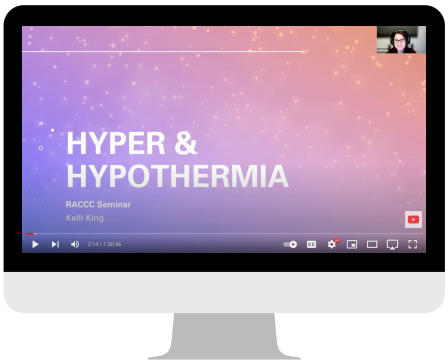
NEW IN THE NEWS

Over the course of the 2022 summer, HEPRUs research was highlighted by various local, provincial and national media outlets showcasing how our practical, action-oriented research is impacting public health in Canada. **Click the video links below to hear more!**

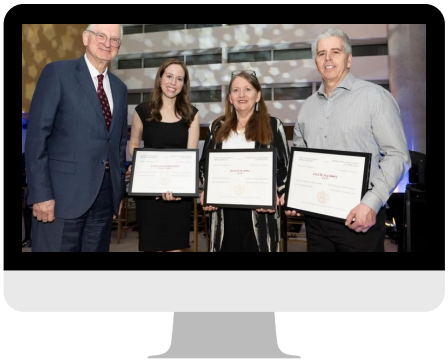


Webinar: Hyper- & Hypo-Thermia

Ottawa experiences a vast range in temperature fluctuations throughout the year which, if proper measures are not taken, can be dangerous for water sports. With an average high of 27°C with 65% relative humidity during the summer and an average low of -15°C during the winter, there is a year-round risk for hyperthermia (a rise in body temperature) or hypothermia (a decrease in body temperature). In this seminar, PhD Candidate Kelli King reviews the environmental considerations when kayaking and canoeing. This will include a detailed review of the physiological responses during cold and heat exposure (from the whole body to tissue level), preventative measures to avoid cold or heat injuries, as well as what to do during emergency situations (e.g., to swim or not to swim if stranded in cold water, addressing hypothermia and hyperthermia).

Webinar: Hot Topic - Lessons from the Deadliest Extreme Heat Event in Canadian History

In late June-early July 2021, the deadliest weather event in Canadian history occurred - claiming the lives of 619 British Columbians and 66 Albertans. Millions of Canadians from the Canada-US border to the Arctic Circle were affected by the Heat Dome, and thus it is critical to study, reflect and apply the lessons learned from this event. The team at HEPRU have been working in partnership with Health Canada over the past year to conduct a series of analysis on everything from how the media communicated the Heat Dome through news articles and images, how the heat event intersected with other public crises, and the broader implications to infrastructure, social systems, the environment, and occupational health. The project series lead Emily Tetzlaff and Dr. Glen Kenny share some of their findings and how this work informs policy and action within the Canadian heat-health preparedness network.



Dr. Kenny Awarded the 2021-2022 University of Ottawa Excellence in Research Award

Dr. Glen Kenny was recently awarded the 2021-2022 University of Ottawa Excellence in Research Award in the Sciences Stream (science, engineering, health sciences, medicine) for the academic year 2021-2022. This award celerbates professors who inspire students and conduct transformative research every day!

APUO Excellence Awards: Lisa D'Ambrosio (teaching), and Glen Kenny and Ruth Kane (research).

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