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FIRST PERSON

First person – Hope Welhaven

First Person is a series of interviews with the first authors of a selection of papers published in Biology Open, helping early-career researchers promote themselves alongside their papers. Hope Welhaven is first author on 'Effects of mechanical stimulation on metabolomic profiles of SW1353 chondrocytes: shear and compression', published in BiO. Hope is a PhD student in the lab of Ron June at Montana State University, USA, investigating the metabolism of musculoskeletal-related tissues (e.g. chondrocytes) during times of disease, injury, and aging to gain insight into unknown metabolic mechanisms that influence homeostasis and pathology.

Hope Welhaven

What is your scientific background and the general focus of your lab?

I am a second-year PhD student at Montana State University in Bozeman, MT, USA, in the Department of Chemistry and Biochemistry. I obtained two degrees (Health Sciences and Public Health) at Carroll College in Helena, MT. As an undergraduate student, I was a member of Dr Alyssa Hahn's Biomechanics and Orthopedics Research Laboratory at Carroll College. Here, I was supported by NASA's Montana Space Grant Consortium where I studied joint health before, during, and after spaceflight. My goal was to apply mass spectrometry and metabolomics to improve knowledge of astronaut joint health and osteoarthritis. Now as a PhD student, I am a member of the June and Bothner labs where our focus is to study the metabolism of musculoskeletal tissues (bone, chondrocytes, synovial fluid) during times of health, disease (osteoarthritis) and injury. To further investigate diseases like osteoarthritis, I apply untargeted mass spectrometry-based metabolomics to identify and examine metabolic pathways and intermediates involved in disease progression.

How would you explain the main findings of your paper to non-scientific family and friends?

You may know someone with joint pain that may be osteoarthritis. This person might have had a knee or hip replacement, or you yourself may have this disease. While many experience this disease and its associated pain, metabolic changes underlying disease progression remain unclear. By researching the small molecules of cartilage, we can understand what is occurring at the metabolic level during disease progression. Here, we identified key players involved at this small level by exposing cartilage to simulated walking. With this information, we can better understand the relationship between osteoarthritis and joint loading.

What are the potential implications of these results for your field of research?

Osteoarthritis is the most prevalent joint disease worldwide, is the leading cause of disability, and costs the US at least $185 billion annually. Further, this disease has numerous risk factors including joint injury from overloading. To maintain healthy joints and promote cell growth and proliferation, mechanical loading is required. While this has been established, the mechanisms by which mechanical loading affect metabolism are unclear. Therefore, this study improves understanding of the mechanisms by which mechanical loading supports cartilage health. These findings open the door to drug development in the future.

What has surprised you the most while conducting your research?

While I have been utilizing metabolomics for a few years, the power of metabolomics still amazes me today. Metabolomics is the newest member of the 'omics' family, which includes genomics, proteomics, lipidomics, transcriptomics, and others. When I conduct an extraction to isolate metabolites, my end product is in a small tube which appears to have nothing in it. Using mass-spectrometry, the story comes to life. By isolating small intermediates (i.e. metabolites) that we cannot see with our eyes, we are able to learn so much about metabolic pathways like glycolysis and how pathways like it are influenced by various factors like disease.

What, in your opinion, are some of the greatest achievements in your field and how has this influenced your research?

The 2021 Nobel Prize in Physiology and Medicine awarded to David Julius and Ardem Patapoutian for their discovery and work on mechanical transducers has been one of the greatest achievements for many fields of science including musculoskeletal

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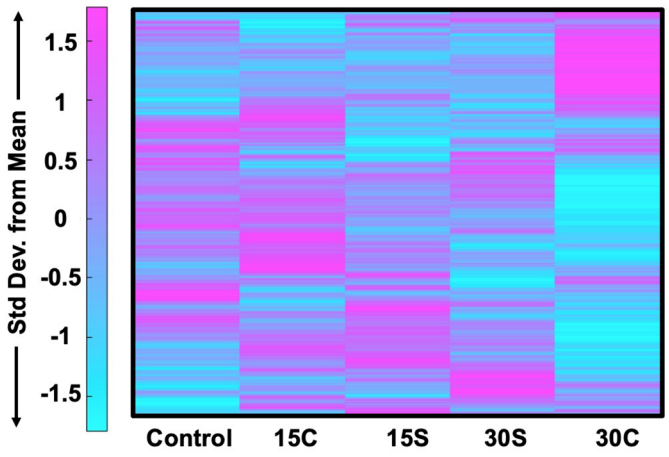

One way to view metabolomic data is by using heatmaps on platforms like MATLAB. Here, a median intensity heatmap of ∼1500 metabolite features from 30 different samples displays clusters of metabolite features that are unique to individual experimental groups. Next, metabolic pathways were identified, and biological relevance was determined. There's the saying "a picture is worth a thousand words", they must've been talking about metabolomics!

research. Their research focused on how one senses the world around them through thermal and mechanical sensation. By investigating this, they identified the transient receptor potential (TRP) and PIEZO ion channels as the MVPs in sensing and responding to stimulus. These findings are pivotal to many fields of research, can be applied to numerous models, and have already been extended to study the relationship of mechanical loading and the development of osteoarthritis.

"…only 18% of full professors in STEM related fields are women."

What changes do you think could improve the professional lives of early-career scientists?

To improve the professional lives of early-career scientists, the leaky pipeline of women in science and gender bias must be addressed. While the percentage of women obtaining their PhDs between 1969 and 2009 increased from 15% to 52%, women are still vastly underrepresented at the faculty level. Specifically, only 18% of full professors in STEM related fields are women. This is important to address because we tell young girls "You can be anything you want!" They are told to reach for the stars, pursue STEM, obtain a PhD, but once they achieve this, statistically, the odds are not in their favour. It is important for young women pursuing STEM to see successful female scientists in tenured positions paving the way at their universities.

What's next for you?

In the coming years, I aim to obtain my PhD from Montana State University in Biochemistry. During this time, I plan to continue studying osteoarthritis and its metabolism using mass spectrometry-based techniques. Following graduate school, I'd like to fuse my experience working for NASA as an undergraduate student combined with my mass spectrometry skills to pursue a career as a mass spectrometry instrument scientist for NASA. To infinity and beyond!

Reference

Welhaven, H. D., McCutchen, C. N. and June, R. K. (2022). Effects of mechanical stimulation on metabolomic profiles of SW1353 chondrocytes: shear and compression. *Bio. Open.* **11**, bio058895. doi:10.1242/bio.058895