MRI in Canada: Udunna Anazodo

INTERVIEW BY **AUDREY FAN**

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Udunna Anazodo is an Assistant Professor at Western University and an Imaging Scientist at the Lawson Health Research Institute. We were excited to catch up with Udunna as part of our interview series on Canadian scientists, find out what she's been working on, and to hear her perspectives on accessibility considerations for imaging technology in our global research community.

MRMH: What are your main research interests and how do they intersect with the MRM community?

Udunna: My main research interest is to understand what biological mechanisms drive functional changes in cognition in late life. These mechanisms include inflammation, oxidative stress, and vascular dysfunction. The idea is - can we make imaging tools that are sensitive enough to detect subtle changes in drivers of cognitive change?

I look at this as a mind-brain and body problem because these mechanisms are ubiquitous biological pathways activated in nearly all tissues in the body in response to stress, trauma, infection, or injury. This makes it important to understand how the mind is influenced by neurodegenerative changes but also systemically by how the body interacts with the environment (physical, psychosocial, cultural, etc.). I use a heart-brain connection and cardiovascular disease as a model to address this research question. In cardiovascular disease, I want to use imaging to understand the impact of major cardiovascular events, such as infarcts or heart attack, on the brain and how this influences cognitive function. Is the effect of a heart attack transient or can it actually lead to long-term changes in cognitive function? Can we image the brains and hearts of ischemic cardiac disease patients shortly after a cardiac event to better predict cognitive outcomes?

MRMH: As a field, we're only just starting to make imaging links between the body and the brain. How is your lab pursuing this?

Udunna: My lab started with imaging vascular dysfunction, which can be done well using contrast and non-contrast MRI. The next link is inflammation and we are interested in how it interacts with vascular dysfunction to influence cognitive function. We use an integrated PET/MRI scanner to simultaneously image inflammation using TSPO – translocator protein PET tracers and vascular dysfunction using MRI. The neat thing about TSPO PET tracers is that they were initially designed to penetrate into the brain to look for changes in microglia activity but they also bind to macrophages, so this allows us to link inflammation in the body to the brain.

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We're going to link inflammation to vascular dysfunction in the heart and brain of ischemic heart disease patients, focusing on blood-brain barrier dysfunction in the brain and ventricular function in the heart. We are also going to ask how this heart-brain interaction affects brain networks (BOLD fMRI) and how it contributes to cortical and macrostructure (DTI) degeneration. If we can put all these parameters and puzzle pieces from the brain and body together, then we might be able to un-

derstand why some parts of the brain are more vulnerable to systemic changes than others and why some individuals are prone to cognitive decline and dementia.

MRMH: Are you going to follow the same patients longitudinally?

Udunna: Yes, the ischemic heart disease patients will be followed and imaged twice, 6 months apart. I am fortunate to have access to one of the largest and well-coordinated cardiovascular rehabilitation programs in Canada, which runs in the same building as the PET/MRI, actually a floor below from the PET/MRI suite. I think we are probably the only group in the world with this setup and with also immediate access to a cyclotron and radiopharmacy lab to make TSPO imaging tracers.

Cardiac rehab is a 6-month multi-intervention program and includes things like exercise, diet counseling, and cognitive behavioral therapy for mood disorders, and it's offered to patients as the standard of care here in Canada. We've seen that cardiovascular rehab decreases your risk for reinfarction and may prevent stroke, so we know it is good for the heart. But I demonstrated during my PhD that it is also good for the brain and may even reverse cardiac disease effects on the brain like gray matter atrophy, macrostructure integrity loss and cerebrovascular dysfunction. This gives us an opportunity to see if cardiac rehab, particularly the exercise aspect of it, modulates the inflammatory load and vascular dysfunctions in the heart and brain. This is something that could make cardiac rehabilitation an even more important clinical intervention in management of cardiac disease.

MRMH: If you're given an opportunity to go to Ottawa and make a pitch, what would you advocate for related to imaging research?

Udunna: It's striking to ask these questions on a population level because a lot of these mind-brain-body issues are affected by our physical and social environment. These environments are constantly changing and changing more rapidly than our bodies can adapt to. We know air pollution is just as deadly as smoking - it is the new tobacco and has been linked to rising rates of heart disease and dementia, globally. But we don't fully know how these changes in our environment are acutely and chronically changing our bodies to impact our brain and mind.

Because these health impacts are driven by adverse changes in the environment, we can't rely on centralized imaging facilities to understand this question. We have to take the lab to where the people are, to where the largest burden of brain and other chronic diseases are – to the poorer low-to-middle income communities. There are communities in Canada, especially indigenous communities, that experience poor physical environments who don't have access to 1.5 or 3 Tesla MRIs. So, to understand how the body interacts with the environment, we have to bring the lab to the people by creating MRI technology including imaging sequences for low-field MR and portable scanners. So, I would encourage the government to invest in home-grown accessible imaging technology and research innovation in Canada and turn Canada into a global leader in production of high-value portable imaging technology.

MRMH: In your perspective, what are current barriers to make imaging more accessible?

Udunna: Cost is one, but lack of imaging expertise is equally an important barrier. I got firsthand experience seeing this when I visited Nigeria in January 2020 and went to a few hospitals and imaging centers, including those in key cities in Ibadan, Lagos, and Abuja.

The number of 1.5 T scanners in the region is growing, because they have figured out how to power the scanners continuously but also are increasingly able to secure financing to procure high field scanners. Now the biggest hurdle is finding the personnel to run these scanners, well trained radiologists to interpret the images, and imaging physicists that can help clinicians use MRI to solve relevant problems. As a community, we (the ISMRM) have an opportunity to provide advanced and multiparametric imaging capabilities to low-resourced regions as an alternative to PET or even CT. There are just 2 PET scanners in Africa, outside of South Africa and North Africa. Think about what this means for cancer care in the region. CT contrast, a staple in acute stroke imaging, for example, is not readily available in most African countries. I spoke to a neuroradiologist at Lagos University Teaching Hospital about imaging for epilepsy surgical planning and asked how they provide care in the absence of PET and sparse SPECT imaging for cases where standard anatomical MRI appear normal. She smiled and calmly said, if we don't see it on MRI, we don't operate, we can't do much beyond this. But non-structural lesions can be detected with sodium MRI, ASL perfusion imaging, and DTI,

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Udunna pictured in front of a 0.36 T Mindray Open bore MRI system at the University College Hospital In Ibadan, Nigeria.

Udunna with radiologists, radiographers and a nuclear medicine physician in front of the Access to Basic Medicine Center (ABC), in Ibadan Nigeria - one of the growing number of private diagnostic imaging centers in the region with a 1.5T MRI.

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just as PET and SPECT can. Research into optimizing these techniques can be enabled in these communities through collaboration within ISMRM. MRI can be a cost effective and high value tool for low-resourced areas, if we can enable colleagues in these communities to gain the skills and training, they need to create their own solutions.

MRMH: How are you trying to bridge this with your efforts on the Equity, Diversity, and Inclusion (EDI) committee in ISMRM?

Udunna: Through the EDI initiative at ISMRM, I am working to raise awareness on the MRI challenges in low-resourced regions and provide opportunities for ISMRM members to partner with local experts on the ground to increase MRI access. The ISMRM Virtual Meeting in February (ISMRM Spotlights Africa: Doing Much With Little) highlighted important targets for those interested in working on this problem. Training being one target, but another is networking and knowledge exchange. ISMRM can provide an inclusive space for collaboration and networking, which are both very important in advancing MRI research and clinical translation. I plan to continue working with the EDI committee to make it more feasible for trainees and MRI experts in low-resourced communities to attend and present at ISMRM meetings and training workshops. I hope we can have more of these region-specific spotlight series in the future. Maybe the next one will spotlight unique imaging challenges and opportunities in Latin America or the Middle East.

MRMH: What can individual ISMRM members contribute to research in low-income areas?

Udunna: Within the African continent, there's currently no good funding mechanism to fund health research or enable imaging technology development. When funding exists, a lot of it is diverted to what is typically thought of as "Africa's problems", such as infectious disease. However, looking ahead, the rise in stroke, cancer, and dementia burden will not be in Western countries, but rather is projected to be in low-to-middle income countries, including Africa. So how can an individual ISMRM member help with imaging research to address these complex health problems; 1) Train students from low-to-middle income countries and regions in your lab. A perfect example of this is Dr Johnes Obungoloch, who learnt to build low-field scanners at Penn State and now leads a dynamic biomedical engineering group at Mbarara University of Science and Technology in Uganda. For those interested in students from Nigeria, Ghana, Rwanda, Tanzania, Uganda, or Cameroon, I can help connect your lab to groups in the region. 2) Plan studies that include patients from these unique populations. There are local clinical experts in stroke, cancer, cardiac disease, and dementia in the region with no imaging expertise that ISMRM members can collaborate with. There are NIH funding programs that support this and local data collection helps increase local MRI capacity. Finally, 3) Develop MRI sequences and data analysis tools in an open-sourced and vendor-neutral manner, so these can be readily accessible.

MRMH: What are you looking forward to doing when we can travel again?

Udunna: Any time I travel, I tend to go to museums, especially museums of culture or art. I like thinking about what it is to be human, and how we've evolved as humans to get here. How do we as humans grapple with our changing environments (physical and social), and what were our human ancestors doing when the environment was different- more homogenous, or should I say more local, less global? I think that answers to some of these questions could be preserved in the works of arts and culture in these museums. I've been listening to Mike Duncan's podcasts on The History of Rome during the pandemic, but I am looking forward to going to museums again.

MRMH: Thanks for your time, that was a lot of fun.