

Dr. Saleh applies knowledge of neurophysiology and neuroimaging to advance rehabilitation research – Ep 36

[Listen to the podcast here:](#)

- JOAN BANKS-SMITH 00:07 [music] Welcome to a Fast Takes - Women in Science podcast honoring the International Day of Women and Girls in Science. This is your host, Joan Banks-Smith.
- BANKS-SMITH 00:17 In this episode, I had the opportunity to speak with Dr. Soha Saleh, a research scientist in our Center for Mobility and Rehabilitation Engineering Research. We talked about her desire to help people through her rehabilitation research, participants that motivate her, and how proud she is of her team of researchers. Let's listen in.
- BANKS-SMITH 00:40 Welcome to our show, Dr. Saleh.
- SOHA SALEH 00:41 Thank you.
- BANKS-SMITH 00:42 Why did you choose to become a scientist?
- SALEH 00:44 I studied biomedical engineering first. So my undergrad was in computer and communication engineering with minor in biomedical. I like biomedical field because it uses technology and apply it to the field of medicine and science. And then in my PhD studies, I focused on neuroimaging and neurorehabilitation. The main focus for me was on rehabilitation and rehabilitation engineering because I felt that has direct impact on people. We interact in rehabilitation, we interact with patients. The technology we use or the methodologies we apply, it directly impact their lives. So I just love that part. And then I think it's my curiosity. I didn't want a more routine job in science. We have different questions every day, and we come up with new projects and new ideas to follow these questions and find more information. So I chose to be a scientist mainly because I'm curious about different questions in the field of neurorehabilitation, and I'm interested in contributing to a new [inaudible] [into?] this field, then.
- BANKS-SMITH 01:56 As a young person, did you always envision yourself being an engineer?
- SALEH 02:00 Very young, I wanted to go to do medicine, and then when I started school, I felt like the field of medicine, I can't contribute much. I learned about biomedical engineering, and I felt that I'm good in math and good in science, and I can contribute better if I studied biomedical engineering instead of studying medicine. I started with college, and the more I got involved, I liked it more and more. So I forgot about medicine and continued with biomedical engineering.
- BANKS-SMITH 02:33 Let's move forward to your current career. You've been working at the foundation for a while. You've done some studies using treadmills and MS, but now you've been working in the area of stroke and robotic exoskeletons for lower-limb. Can you talk about that a little bit and what your day looks like?
- SALEH 02:53 Actually, in my PhD studies, I start working in stroke. So my research started on stroke. It was more on upper extremity rehabilitation at NJIT, where we studied the effect of intensive robot-assisted upper extremity rehabilitation. And my focus was on the effect of that on the brain using neuroimaging. At Kessler, I contributed to many

Dr. Saleh applies knowledge of neurophysiology and neuroimaging to advance rehabilitation research – Ep 36 studies, and because we do more upper extremity and lower extremity, my work shifted more toward focusing on lower extremity and helping individuals with disabilities with walking.

SALEH 03:33

So with the treadmill you mentioned, we use not a regular treadmill but more like an instrumented treadmill that's equipped with virtual reality and augmented reality feedback to look at the brain and how the brain process information during walking and avoiding obstacles. And we tested that on healthy individuals and persons with multiple sclerosis, both cognitive and mobility deficits. For the robotic exoskeleton, I'm collaborating with Dr. Karen Nolan at Kessler Foundation, who is an expert in lower extremity rehabilitation and exoskeleton. Both together got funding for an R01, a study looking at early-on rehabilitation of walking using exoskeleton and how that could help renormalize brain activation and brain connectivity for stroke. So we are recruiting from the Kessler Institute for Rehabilitation inpatients, and we are testing them using technologies like functional MRI, structural MRI, EEG, EMG, looking at brain connectivity, brain-to-muscle connectivity, and we are testing them at different time points before they start rehabilitation and then after and at six months to see if early-stage stroke improve the chances of recovery. I'm also collaborating with Dr. Forrest, also looking at powered exoskeletons and how that changes how the brain process the information. We're looking at, also, brain connectivity and brain-to-muscle connectivity during walking in the exoskeleton and walking without the exoskeleton. And in that project, we are testing this on able-bodied and also in individuals with spinal cord injury.

SALEH 05:20

So as you can see, I'm working on different population but mainly using the same technology of functional MRI, EEG. Also, we're using functional near-infrared spectroscopy, the fNIRs, to look at brain activation and to look at brain-to-muscle connectivity, mainly to understand how the brain makes the intention to move, the intention to walk, how that changes in individuals with disabilities, whether it's multiple sclerosis or stroke or spinal cord injury, and how that changes with therapy that we are providing in the center.

BANKS-SMITH 05:54

Do you currently have any preliminary outcomes regarding any of the work that you're doing with these two studies?

SALEH 06:01

With the study of multiple sclerosis, we published that one paper that showed that walking and avoiding obstacles recruit different areas in the brain in persons with multiple sclerosis compared to healthy controls. I'm working on another publication now, also showing that when we look at the connectivity between different brain regions, there is a different networks or connections in persons with MS compared to the healthy controls when they are walking and avoiding obstacles on the treadmill. With the study on stroke, we have preliminary data. We see improvements in the rehabilitation outcomes in terms of improved walking, improvement in balance, but in terms of the neuroimaging and the electrophysiology data, we don't have enough data to make any conclusions. Similarly, with the study of spinal cord injury, we have a small sample still, so we cannot give any conclusions. But what we are seeing is when individuals walk in the robot, there is an importance to the intention to movement. If they put more mental effort to have more intention to move, the activation in the brain is different than when they move passively in the robot. What

Dr. Saleh applies knowledge of neurophysiology and neuroimaging to advance rehabilitation research – Ep 36

we're trying to show is that, okay, we are using robotics and rehabilitation, but also, we're trying to maximize the cognitive effort that the individual does in the robot so we can improve the involvement, how much the brain is involved, to maximize recovery outcomes.

BANKS-SMITH 07:41

What are the hardest parts related to this work?

SALEH 07:43

The most challenging part in my work, personally, is the data. As I mentioned to you, that we are collecting data in different populations, different individuals with very heterogeneous background, right, in terms of the disease or the onset of the disease or the time since injury if we're talking about brain injury. And then we are collecting electrophysiology data during movement, during activity. So we study more EEG and fNIR signals during walking, during obstacle avoidance while they are wearing the exoskeleton. So all that give us a very interesting data to work on. For me, my lab is mostly busy most of the time working on data, working on improving our methodologies, working on improving our analysis approach to get useful information from that data without all these artifacts and all this noise that we are also picking up using this technology. That complicate my work a little bit because I take longer to publish this data than in other research work where the analysis could be simpler and then the outcomes. The other scientists, they can get their outcomes quicker than I can do because it takes me longer to work on this data and make sure that the results I'm seeing are correct, are real, and not biased by all these factors that are in there.

BANKS-SMITH 09:11

In talking about these studies, is there any one particular participant that stands out, that has helped motivate you in the work that you do?

SALEH 09:20

I can give you multiple examples. But I really cannot forget a person who has memory issues. At the first few times when I met him, when he was enrolled in my study-- it's a study that we just completed on bimanual coordination training for individuals with traumatic brain injury. So when we recruited him and when he came for the first few visits, every time, he asked me about my name because he has memory problems because of the injury. And then when he finished the study, on his last day, he got a dollar bill, and he created a frame of a person using that dollar bill, and he gave it to me as a gift. And he told me, "I give that to every person who makes impact in my life. And I want you to keep this." So I have this in my office, and I will keep it forever. I like that we share these experiences with patients and individuals. Sometimes, our studies don't help them. We tell them, "We are experimenting," right? So we creating this intervention that we hope that help them in a way or another. Sometimes, it does, sometimes, it doesn't, but I think the fact that we are trying and we have these experiences with them-- most patients - I don't want to generalize and say all - the majority, appreciate that, and we make an impact in their lives, and they make-- and make impact in our life. Right? This gesture that this person did maybe will keep me longer and longer in this field because it will motivate me and tell me that we're making a difference.

BANKS-SMITH 10:53

That's really what it's all about, making a difference in people's lives.

SALEH 10:57

Yes. Absolutely.

Dr. Saleh applies knowledge of neurophysiology and neuroimaging to advance rehabilitation research – Ep 36

- BANKS-SMITH 10:59 We're going to just shift gears here a little. If you are completely free to choose a scientific topic to work on, what would it be?
- SALEH 11:07 The topics I'm studying or I'm working on are my choice. So if I have the choice to change anything, maybe I will not change much. But there is one scientific topic or population that I would try, probably, to explore, not in the near future but maybe later when I have more time, is the Parkinson population. So the rehabilitation of individuals with Parkinson-- this is outside my field of research right now, but I did some research on this, and I believe there is a huge need to work on the rehabilitation of individuals with Parkinson Disease, because I think right now, they rely more on medications to delay the symptoms or to manage the symptoms, but rehabilitation can make significant impact. And in the future, maybe this is a field that I would explore.
- BANKS-SMITH 12:05 In 10 years, what do you hope to have accomplished in the terms of your work?
- SALEH 12:10 What I want to see in 10 years, that what I accomplished in terms of research and publications and new findings, that they impacted the clinical practice and they led to improvements in the protocols that are being used in hospitals or in clinics, to have direct impact on patients in their daily life.
- BANKS-SMITH 12:29 That's certainly what we strive for at the foundation, and your work, obviously, really helps contribute to that. What do you think is your biggest accomplishment to date?
- SALEH 12:41 I'm proud, of course, of the grant funding I acquired in my career. I mean, I've been at the foundation for five years. I got funding for several projects from the Department of Health at New Jersey State, the New Jersey Commission Brain Injury Research, and the New Jersey Commission on Spinal Cord Injury Research, and I also got funding for a large R01 study from the NIH. But I think personally, I'm proud of my team. I'm proud that I have a lab with very productive, very smart engineers. They help me in all these projects, and I can't do much without them. As a young investigator who finished my PhD nine years ago, I'm proud that at this stage, I have a lab that's well funded, and I have a team who I'm proud of them, and I hope that day after day, we grow larger and larger. We have more members come in that can help us do better work.
- BANKS-SMITH 13:41 The bottom line is that it takes a team. We can't do it all ourselves. So to have a team that works well together, makes a difference in people's lives is what we're striving for. What advice would you give to young girls and women who are looking to get into the world of science?
- SALEH 14:03 Maybe what I would tell them is what I told someone years ago when I decided to study biomedical engineering. And I remember someone asked me, "Is that for you? Are you sure? As a woman?" And I told him, without much thinking, now I remember - much thinking, I said, "I know what I want to do, and any place I want to get into, I step my foot and enter." And then I felt, "Oh, maybe I was so strong, the way I answered him." But then I felt, "Okay, this is the reality. Don't think that there is anything you cannot do. You want to do this, you're not lacking anything." Okay? Tell yourself, "Oh, I'm not good for this." If you like it, go and work on it and get it done.

Dr. Saleh applies knowledge of neurophysiology and neuroimaging to advance rehabilitation research – Ep 36

And anywhere you want to go, any goal you want to achieve, just go and do it. You can. You can do it. Nobody is better than you if you want to do it.

- BANKS-SMITH 15:09 That's right. It takes hard work, determination, and not allowing people to say no. You got to keep moving forward, especially as a female.
- SALEH 15:19 Exactly. Exactly.
- BANKS-SMITH 15:21 I have always said if you want to do something bad enough, you'll figure a way to get there.
- SALEH 15:26 Yes.
- BANKS-SMITH 15:27 Thank you so much, Soha, [music] for talking about the work that you do here at the foundation and what motivates you to do your work.
- SALEH 15:36 Thank you so much, Joan.
- BANKS-SMITH 15:38 Tuned into our podcast series lately? Join our listeners in 90 countries who enjoy learning about the work of Kessler Foundation. Follow us on Facebook, Twitter, and Instagram.
- Listen to us on Apple Podcasts, Spotify, SoundCloud, or wherever you get your podcasts. Be sure to subscribe to our SoundCloud channel, Kessler Foundation, for more research updates.
- BANKS-SMITH 16:03 Learn more about Dr. Saleh, the Center for Mobility and Rehabilitation Engineering Research, and me, your host, Joan Banks-Smith. Links are in the program notes.
- This podcast was recorded on Wednesday, January 5th, 2022 remotely and was edited and produced by me, Joan Banks-Smith, creative producer for Kessler Foundation.