Vanderbilt Audiology Journal Club: Hearing Aids in the 'Real World'

Presenter: Todd Ricketts, PhD; Erin Margaret Picou, AuD, PhD, CCC-A

It's my pleasure to welcome back for our annual Vanderbilt University series with audiology online. Today we have presenting Doctor Erin Picou and Doctor Todd Ricketts. If you'd like to learn more about either presenter, you can read their bio on the course registration page at this time. I'll hand the mic over to you, Doctor Picou. All right, thank you, Christy.

Thank you, everybody, for logging in and tuning in and being here today. And thank you, Christy and audiology online for the opportunity to do this. Journal club. This is one of my favorite things to do because it gives us the opportunity to go into the literature and see what's been published in the last year in terms of hearing aids and what I think is interesting and what maybe you may or may not find interesting. So this year we did that.

We went into literature, read a bunch of articles about hearing aids, and came up with this theme of hearing aids in the real world. It's generally a loose theme, but I'll talk about the particular articles in just a minute. Before we do that, we do need to disclose that Doctor Ricketts and I receive funding from a variety of industry and federal sources, and we're both employed by Vanderbilt University Medical center in Nashville. And so because today is a journal club, all of our learner outcomes are related to journal club like things. So by the end of this hour, I hope that you will be able to list the key journal articles that we talk about in the topic of hearing aid benefits in the real world.

For each of those articles, I hope that you'll be able to describe the purpose, general methodologies, and results of those studies and then explain some key clinical takeaway points from the articles that we talk about. As I mentioned, that we have this very loose theme of hearing aids in the real world. And specifically, we're going to talk about three closely related topics. One of them is literally hearing aids in the real world.

So we're going to look at a study that looks at hearing aids and how they function in the real world.

I'm also going to talk about some studies that look at emotion and real world listening situations. And then I'm going to turn the mic over to doctor Ricketts, who's going to talk about cognition, hearing loss, and hearing aids, because I feel like we would be remiss if we left if we didn't talk about hearing aids and cognition this year. So without further ado, let me get into the first article. This article is called auditory environments and hearing aid feature activation among younger and older listeners in an urban and rural area was published by Jorgensen and colleagues in Ear and Hearing. In the study, the purpose was to investigate potential differences in auditory environments and hearing aid feature activation between urban and rural locations, as well as the role of age and hearing loss in these differences.

So, as the title might suggest, and so specifically, thinking about how hearing aids are functioning and performing in urban and rural listening environments for younger and older listeners. So why are they interested in this? Well, there's been some research that's come out in the last couple of years that suggests that hearing aid users are generally in quiet listening environments. So I've got a list of three studies here that have all been published previously, which suggests that hearing aid users are rarely in noisy environments, the signal to noise ratios are almost always positive, and most of the time they're listening in speech in quiet, which suggests that some of our noise related hearing aid algorithms might not be particularly beneficial. But the authors of the current study that I'm talking about point out that all of these previous studies were all done in relatively rural academic centers, so they didn't really capture the kinds of urban listening environments that might be important and where features might be beneficial.

So, we also know that only 19% of the United States population lives in a rural setting, at least according to the 2010 census. So, that is, although the United States is 97% rural, only 20% of the population of the United States lives in rural settings. So these rural settings, the findings in these rural settings might not generalize to urban settings.

So, as you might expect, there are some differences between urban and rural settings. So, urban settings tend to be louder. They tend to be characterized by noises that are manmade, industrial, car noises, those sorts of things. People who live in urban settings tend to have larger social networks, and those social networks tend to be comprised more of friends. In contrast, rural settings tend to be quieter.

The sounds that are in the background might be. Are more likely to be related to nature sounds. People who live in rural settings might also have solar, sorry, smaller social networks. And those social networks are more likely to be comprised of family rather than a large number of friends. But the authors point out that this distinction between urban and rural might not be the only thing that's interesting, and there might be some interactions between age.

So, this group of authors, in particular, has studied the kinds of listening environments that older listeners are in compared to younger listeners. And in the past, they found that younger people tend to be more socially active, tend to have larger social networks, and be exposed to and around higher levels of background noises, whereas people who are older, tend to have smaller social networks, maybe more meaningful social relationships, and be around less noise.

So if there are differences between urban and rural settings and between older and younger listeners, we might expect then that the hearing aids would behave differently in these kinds of different listening situations. And hearing aids behaving differently might affect our clinical recommendations and our clinical expectations, and they might

also make us reinterpret some of the findings that have been reported in the literature and really thinking about where the studies were conducted. So whether they were urban or rural, because that might affect, for example, whether or not we think advanced hearing aid features could be beneficial or not. So those are some pretty big research questions that could be influenced by the setting. So, these authors collected data in participants daily lives.

So, these data came from two different kinds of sources. So one is hearing measurements. So they measured, for example, sound pressure level and whether or not the features were activated. And the specific features are directional microphones and digital noise reduction. So these are all acoustic hearing aid based measures.

And they also had people complete surveys on a smartphone. So they did an ecological, momentary assessment in which the participants self reported what they were listening to, and they made subjective ratings of background noise level. So they had 46 participants, approximately equally distributed into four groups. And these groups varied based on age, whether they were younger or older, and then also where they lived. So they did.

Did they live in a rural or an urban environment? Now, the younger listeners also had normal hearing, and the older group had hearing loss. Those living in the rural setting lived in or around Iowa City, Iowa, and those living in an urban setting lived in or around Berkeley, California. All of the participants reported being active and having active listening situations. So the older participants were, for the most part, retired, but were active outside the home.

And the younger participants were working professionals or students who were also active outside the home. So they fit everybody with Starkey Halo receiver in the canal hearing aids with 24 channels, and they connected these hearing aids to smartphones

so they could, in real time, extract information from the hearing aid. The hearing aids for the participants with normal hearing were fit to have zero gain. So there's just zero decibels insertion gain, and they're functioning like sensors. Whereas the hearing aids for the participants with hearing loss were fit to match the participants own hearing aid settings.

So they've matched the gain targets of the participants own hearing aids because they were all established hearing aid users. But for the participants with hearing loss, the hearing aids also acted as sensors. So from the hearing aids, they're extracting information periodically, so it would be too data and power consumptive. It's too heavy to collect data all of the time. So they would ping the hearing aid approximately every ten minutes to just get those acoustic data.

Approximately every 40 minutes. Those acoustic data would be paired with subjective ratings. So they would ping the participant to open the smartphone and answer questions subjectively. So we've got lots and lots of data, both subjective and objective. The hearing aid, as I mentioned, is collecting sound pressure level estimates, sound classification.

So what does the hearing aid think that the environment is? Is it quiet, speech, noise, music machine or wind? And then whether or not the features were activated. So were the directional microphones active, and was the hearing aid doing any kind of gain reduction in response to noise?

So that's the hearing aid bit. The EMA bit, as I mentioned, is approximately every 40 minutes. It wasn't self initiated, so it was timed. So participants were pinged and then answer their questions. The questions were, were you actively listening most of that time?

Yes or no? What was your active listening situation? So was it live conversation, electronic conversation? Was it speech and music, live speech and music, media, like a recorded thing or where you're listening to environmental sounds? And then overall, how loud were the background sounds?

Very loud, loud, medium soft or very soft. So what they found, they have lots and lots of data. So over 8000 snapshots of so little pieces of information from real life listening situations, 2600 of those were EMA associated. So we've got subjective ratings that can be paired with the hearing aid data. And on average, the participants completed those EMA surveys eight times a day.

So lots and lots of data. In general, they found that the participants who live in young urban, the young participants who lived in urban environments had higher noise levels than both of the older groups. So they were listening and communicating in louder noise levels than the older groups. Whether or not the older groups were in urban or rural situations, most of the time people were listening in quiet. However, 30% of the time they were listening in speech, and 48% of the time noise was present.

And there was no difference between groups and the environments they're listening to. So all groups, regardless of age and setting, had the same approximate distribution of the kinds of environments the hearing aids thought they were in. The features were more likely to be active for the young urban group than the other groups. And this tracks with the background noise level. So the directional microphones and the noise reductions were more likely to be active in those for those participants in the young urban setting.

And it was basically driven by input level in terms of the EMA surveys, they said, like I said, the group spent similar times in the same kinds of listening environments. So they spent similar times in conversation on a device like a phone, similar times in live music

and listening to recorded music. And there were no differences in the groups between the ratings of noise. So very few surveys had loud or loud, and most of the surveys were moderate or soft background noise levels. And it didn't matter if you were young or old or in an urban or rural setting.

So these data suggest that there's some mixed support for the idea that age and location affect auditory environments. So, in general, the young urban dwelling group had more demanding and diverse and louder auditory environments than the older groups, and their features were more likely to be active there. But we didn't see that group difference, that urban and rural group difference for the older listeners, it was only for the younger listeners. But even though the evidence is mixed and didn't exactly fit with what you might expect, we do see, these data do suggest that demographics and setting can affect the acoustics, auditory demand, and feature activation, which suggests that some of the where the study is done matters, and we might expect different benefits and feature activations for younger listeners who are in urban settings. These data also provide additional support for some of the literature that's already been published.

That suggests that older listeners have less demanding auditory environments and less diversity in their listening environments. So they're just less background noise and less conversational demands. So does this matter clinically? Yeah, of course it does. That's why I'm talking about it.

But I will also say that the interpretation of these findings is limited, or, I'm sorry, complicated, because the young participants didn't have hearing loss. So we don't really know. The question about young listeners in urban environments who have hearing loss isn't yet answered, so there's more work to be done in that case. And then, as you might expect, there's also some things in the study that limit the generalizability of the findings. We just.

In the study, they measured just two settings, Iowa City and Berkeley, California. So the degree to which those two settings best reflect urban and rural population centers is questionable. They also only measured people's EMA and hearing aids over the course of one week, and the population was relatively heterogeneous. All this to say, there's some limitations in the study, but it does suggest that the hearing aid features and the kinds of listening environments that we might expect our patients to be in will vary as a function of age and urban setting. If you combine those two things.

Okay, so that brings me to the second study I want to talk about, which is also thinking about real world benefits, hearing aids, but specifically positive emotions. So, the title of this study is focusing on positive listening experience improves hearing aid outcomes in experienced hearing aid users. This study was published in the International Journal of Audiology by a group of authors who work for WS audiology. So, the purpose of this study was to look at whether or not positive listening experiences can improve hearing aid outcomes and experienced hearing aid users. So we know that not all hearing aid owners use their hearing aids regularly.

So there's somewhere between 20 and 30% of hearing aid owners don't use their hearing aids regularly, and that's not good for hearing aid owners. So they have hearing aids, they could benefit from hearing aids, and they're not using them. So one of the factors that drives hearing aid acceptance in hearing aid use is hearing aid benefit and satisfaction. So if we could figure out ways to improve hearing aid benefit and hearing aid satisfaction, we might be able to increase hearing acceptance and use so that people who own hearing aids can use them and benefit from them.

We also know that there are some things that can affect hearing aid benefit and satisfaction that aren't only technology or fitting or match to target. We know that counseling can affect hearing aid benefits and also speech and noise performance. So

these are three examples that the author mentioned of studies where people were told that the hearing aid is new, or the hearing aid is digital, or the hearing aid is really going to help them. In all of these cases, the words that the clinicians used affected outcomes. So we see that calling a hearing aid new can improve speech and noise performance for, for people, as compared to calling a hearing aid conventional, even if it's the same hearing aid.

So, all of these studies suggest that the way we talk about hearing aids and the way we talk about hearing aids to patients can affect not only their perception of what's going to happen, but also their actual speech in noise scores, and therefore, it could also affect their performance in the real world and how they feel about their hearing aids and hearing aid benefit and satisfaction. So this kind of positive thinking and this positive focus could be really beneficial for overcoming the negativity bias. So, we know that negative events and bad things are subjectively more potent and salient than positive things of a similar magnitude. So we remember the things that didn't go well or aren't really positive or great much more clearly than we remember things that were positive. So if we can draw attention to the positive things and make them more salient, maybe we can change the way or nudge the way that people feel and think about hearing aids.

We might be able to overcome this negativity bias. This suggests that in addition to great hearing aids that have fabulous features and are fit well and comfortable and have great venting and acoustics, we might be able to combine those really nice hearing aid things with some counseling where counseling itself could be an intervention, and counseling can affect outcomes and speech and noise performance. And if we can affect benefit and satisfaction, we might be able to improve hearing aid use and acceptance. So they did a randomized, single blind, parallel arm study, and all participants were told the same study purpose. So they were told that the study

purpose was to learn more about hearing aid users experience with hearing aids so that we can better understand behavior and needs of hearing aid users.

So everybody was told the same thing, and the participants were assigned to one of two groups, a control group and a positive focus group. And the positive focus group did a little something extra, but everybody was blind to the real study purpose. All of the participants were experienced hearing users who had sensory neural hearing loss and smartphone app experience. So what they did several visits, some EMA stuff, sort of complicated. I've tried to visually represent it here, but everybody did at baseline.

So they were randomized into the control or positive focus groups. They did some personality measures. They rated their satisfaction with their own hearing aids completed in Iowa, and then they did EMA with their own hearing aids on their smartphone at home. They came into the clinic or the research lab. They had their hearing checked.

They did a cozy with the researcher, they had their study hearing aids fit. They went home for three weeks, and they did EMA after a two week adjustment period. And everybody did EMA during, after that adjustment period. The positive focus group also had a little something extra that I'll talk about in a second. And then they came back, they did a second cozy and an exit interview.

So the EMA questionnaires, which they were doing in these, in these between visit things happen every 2 hours from 09:00 a.m. To 09:00 p.m. And they asked about location, listening task, hearing difficulty, and there was a single hearing aid satisfaction question, the cozy, which happened at those visits with the patient, with the researchers. If you're not familiar with the COSI, it's the client oriented scale of improvement. And the patient and the provider work together to identify the five most

critical situations where the patient wants help, and then they rate how well they're doing.

And after the hearing aids, they rate how much the hearing aids helped. So the hearing aids they were fit with were receiver in the canal widex moment hearing aids. They didn't have any special programs, and they were all instructed not to use the app to make changes to the hearing aids. So they were just, um, fit, and they were using the app for the other study procedures. So, as I mentioned, the positive focus group did a little something extra.

So, in the positive focus group was doing the EMA stuff as I just described. But then they also had this additional instruction. And the instruction was, I am very interested to hear about situations where the study hearing aids are helping you. Please use the app to report every time you notice you encounter a positive listening experience. These type of situations could be great communication at a party, hearing the sounds of crickets in a forest, or other situations where your hearing is noticeably good.

The positive focus group reports were always self initiated, so they weren't pinged to or prompted to complete this questionnaire. But instead, when they noticed something good, they were supposed to talk about it. And they were not asked to report negative experiences, only the positive ones. So it's a focus on the positive things. So they found that the positive focus group reported an average of 38 positive listening experiences over three weeks.

These are four examples of things that people mentioned, and these are quotes from the article. So somebody mentioned watching tv with others. They could hear everything. Somebody else noticed that they were eating lunch with several people. And with the hearing aids, the separation of sounds was good.

This person commented on the traffic in the rain, and then the last one said, the forest sounds completely different. Interesting. So these are all the kinds of things that were mentioned in that positive focus group where they're really thinking about the way that hearing aids are helping them in the real world.

So after all of that, they came back and looked at satisfaction and these different outcome measures, and they found that the positive focus group had higher satisfaction ratings on the single item EMA score. And then also their cozy benefit scores were higher, and their ayahuasca satisfaction scores were higher. So the hearing aids were the same, everybody was fit the same way, everybody did the same EMA stuff. And the positive focus group, the only additional intervention is this focus on positive things in the places where the hearing aids are helping. In addition, there was this relationship between participants who submitted more positive experience.

They also had a higher benefit ratings on the cozy. So the more things they noticed, the higher their benefit scores were. So why is this important? I just really love this finding because it suggests that there are things that we can be doing clinically, these non audiologic, non technical things that can influence hearing aid outcomes. It suggests that asking people to reflect on their positive experiences can have a positive effect on hearing outcomes.

And it happens really relatively quickly. Remember, they only had these hearing aids for three weeks, and they were only asked to do this positive focus bit for one week. These data together support this collaborative, iterative approach to follow up visits, where we can just not only ask people how they're doing, but also prompt them to think about the. The ways that the hearing aids are helping and explicitly helping, not just asking for what's not going well. Does it matter clinically?

I think so. We do need to see how this translates into real, I'm sorry, not real world, real long term hearing aid benefit and satisfaction and use rates.

But I think that this, you don't necessarily need the app to do this. This could be something that is done in a clinical setting with a conversation. You could do it with a pen and penalty pen and paper, or a diary, or you could do it with your notes app on your smartphone, or patients can do it with their notes app on their smartphone. And I think that this has the real potential to have a domino effect, too. So if we can have people focus on the things that are going well and things they really like about hearing aids and overcome that negativity bias, then when they talk to their friends about how much they like their hearing aids, it could help their friends overcome some kind of negativity bias if they have.

I'm sorry, friends with hearing loss. Also if they have a negativity bias. So I think that this has the potential to really improve not only hearing aid acceptance of owners, but maybe also hearing aid adoption rates.

Okay, so the last study I want to talk about is still sitting in this emotion world, but from a different perspective. So, in this study, this is a qualitative investigation of the hearing and hearing related emotional states experienced by adults with hearing loss. Sorry.

So, this study was published in the International Journal of Audiology, and they wanted to know what hearing aid related emotions are experienced by adults with hearing loss in everyday, real world situations. What impact does hearing aid use have on emotion in the hearing aid wearers? And to what extent does the experience of hearing aid related emotions vary between adults with hearing loss? So, just to back up a little bit, an emotion is an instinctive or intuitive feeling deriving from one's circumstances, mood, or relationships. And an emotion is different from a mood.

So a mood is sort of like a non specific, kind of general, slow acting thing, whereas an emotion is like a quick response to something that's happening. We know that people experience emotions daily, and these emotions can affect their daily living situations. So, hearing aids, I'm sorry. Emotions can guide hearing aid satisfaction, hearing aid uptake, and general overall well being. So, understanding the emotions that people experience related to hearing loss and hearing aids can help us guide our interventions and think about well being and hearing outcomes.

We know that hearing loss and emotion are related. So we've seen in the past that people who have hearing loss have this reduced range of emotional responses to sounds. We know that people who have hearing loss report feeling frustration and isolation during conversations. They also report feeling anxiety, embarrassment. They're in an increased risk of depression and anxiety.

So there are a lot of these negative emotions that come with hearing loss. But hearing aids can have positive effects. So pleasant feelings increase relative to unaided when people are using hearing aids. Although hearing aids can also cause negative emotions. So there are reports of negative feelings towards devices like stigma and just practical difficulties dealing with the hearing aids.

So why does it matter? Like I said, if we can understand the emotional experience of people who have hearing loss and wear hearing aids, that can help us guide our interventions and also our studies to figure out the whole listening experience and also set expectations for patients and modify and improve and work towards optimizing hearing aid outcomes.

So in the study, they use semi structured interviews. So they use a set of predetermined questions that could guide the interviewer. So using a predetermined set of questions and a semi structured interview, it lets the participants have flexibility

to derail the conversation a little bit, but also has this guide for things that they do want to talk about. And the interviews were conducted remotely.

They had 17 adults with hearing loss who had a wide range of experiences, so they ranged from 44 to 74 years old. They had a range of PTA's mix of genders. Some wore hearing aids and some didn't.

In the interviews, they had some background information, just sort of like get them warmed up. And then they ask them questions about what they do, what kind of experiences, I'm sorry, what kind of emotions they experience, and what effects hearing loss and hearing aid use have on their social, leisure work and daily chores. And then they ask about coordination of emotion. So how well do they think that they portray their emotion? And how well do they think they understand the emotions of others?

So this figure is showing the summary of emotions that people reported feeling related to hearing loss on the left and reported to hearing aids on the right. And these are emotional words that came up in the interviews that are plotted as a function of valence and arousal, where valence is pleasant, sorry, high is pleasant, one is unpleasant, and then arousal is exciting to calming. So nine is very exciting and one is very calming. What we see is related to emotions that are related to hearing loss. We see lots and lots of unpleasant and highly arousing emotions.

So they feel, because of their hearing loss, they feel stressed, angry, scared, overwhelmed, anxious, really bad things. There's just one feeling that's in the positive domain, which is acceptance, and so they've accepted their hearing loss. But generally we see lots of negative and unpleasant emotions related to hearing loss. Conversely, related to hearing late hearing aids, we see this kind of bimodal thing. So we see some

unpleasant emotions, like they feel annoyed or embarrassed or shamed because of their hearing aids.

But the hearing aids also make them feel comfortable, relaxed, confident. So we see negative emotional experiences related to hearing loss, primarily, and then some positive things related to hearing aids.

So they also they took the transcripts of the semi structured interviews and summarized some factors that can affect emotion related to hearing loss and hearing aids. This is a summary of five themes that they came up with, and in their article they have some really nice quotes from patients and or, I'm sorry, participants and explanations about how each of these things might affect the emotional experience related to hearing loss or hearing aids. And I won't read them all, but I encourage you, if you are interested in the kinds of things that people are reporting, to go look at this article. It is open access, so you'll be able to see it no matter what your institution affiliation is. The link is here, but there are a couple of things that I want to point out.

A couple of things I want to mention. One, the negative emotions associated with hearing loss were more likely to come up for people who had particular personality traits, specifically perfectionism. They're also more likely to come up for people whose hearing loss is relatively new. So rather than being like congenital or really early onset, people who had more recent onset of hearing loss loss were more likely to report negative emotions with hearing loss.

And people who don't. When they didn't have control over the listening situations, they were much more likely to have negative emotions. So if they had jobs where they couldn't control the situation, or they were forced to go to social environments where they weren't going to be able to manipulate the environmental surroundings, or they, yeah, they weren't going to have any control, they were going to have more likely to

have negative emotions related to hearing loss oh, and the last thing I want to say about this is that when people were in conversations with family and friends, they were more likely to feel relaxed and not be as affected by their hearing loss than if they were talking to strangers or acquaintances or peers.

So why is this important? Well, it suggests what you might already feel intuitively, that hearing loss causes negative hearing related emotions due to situational factors like annoyance, worry, frustration, and that hearing aid use allows for the experience of some positive emotions, enjoyment, happiness, relaxation. But there is also some frustration or irritation that comes with hearing aid use. This is important because it helps us to understand the emotional experiences of adults who have hearing loss and hearing aid users. And knowing and understanding their perspective and their lived experience can help us improve our clinical assessment and counseling.

There's also some evidence and in here to suggest support for the inclusion of significant others. So if we're talking not just to the patient, but also people who are important to them, that can make them feel more comfortable and have more positive emotional experiences. And I mentioned this, I've already talked about this list, but negative emotional experiences were less likely to happen if they were in conversations with people who they felt comfortable, if they've had long, more long standing hearing loss, and if they had more control over the situation.

Does this matter clinically? Yeah, I think, at least for me, this feels natural. And it's nice to see some studies related to the lived experience of people who have hearing loss and who wear hearing aids. The only things that I'll say about the generalizability is that it does reflect the perspective of only 17 adults who are living in the UK. And they were all samples sampled during the pandemic.

And it was because of that, the sample was generally limited to tech savvy patients. But I think that. I hate to end on that note. I do think that understanding the positive and negative emotions associated with living with hearing loss and using hearing aids are important. And this study really helps us to get a broad perspective of these adults who are living with hearing loss and hearing aids.

So with that, I will pass the microphone over to doctor Ricketts, who's going to talk about cognition.

Thanks so much, Doctor Piku. I wanted to spend a little bit of time considering some issues around cognition and hearing loss. As I'm sure all of you are aware, this has been one of the hot topics in the research over the last few years, and in particular has really received a lot of press around it. And so because of that, I wanted to spend a little bit more time providing a little background and a little terminology, and I apologize to those of you that are already aware of this, but I think it's good that we kind of try to all get on the same page when we're talking about some of these issues. Um, one of the reasons is that there has been some concern with some of the publications that have been out, and there's been some glossing over of some of the information.

And so this is an article that was published about a year ago that had a lot of press around it, and basically concluded that up to 8% of dementia cases could be prevented with proper hearing loss management. And this was based on an analysis of the UK Biobank cohort and published in the Lancet. However, this is an article that the Lancet then retracted without explanation. And so I think it is one where we really have to question the validity of the conclusions. And essentially, because it's a retracted article, just count them.

And so I think that it is important that we're careful to not overhyping results, and I also think it's important to explore new information regarding previously published studies.

Research is not a single article, as you all know. It is really important to look at a group of research and several studies before we draw any kind of firm conclusions. So let's talk a little bit about the terminology around this, because I know that even those of us that do research in this area might not do population research in the same way that we're talking about with some of these studies, with cognition and hearing loss.

Just a little refresher for those of you that might not have thought about this for a long time. I'm sure many of you already know this, but prevalence is really looking at the total number of cases versus the total population. So it really answers the question, you know, what percentage of individuals in a particular group have a disease or disorder that can be contrasted with incidence? That's the number of new cases in a defined population during a specified time. For example, the incidence was four cases per 100,000 people last year.

But really, oftentimes what our patients want to know is, what are my chances? This is really harder to estimate, but it's commonly referred to as a lifetime risk. It's important to note that this isn't the same as prevalence or incidence. And one of the reasons that it's harder to estimate is it really does relate to how long people live. And so lifetime risk is interacted with lifespan.

Regardless of the information, whether it's prevalence, incidence, lifetime risk, the information usually comes from studies and reflects estimates. So you often see a range rather than a single number when we're talking about prevalence, incidence, or lifetime risk.

So when we talk about cognitive decline, specifically Alzheimer's and related dementias, prevalence certainly goes up with age. And when we're looking at individuals that are 65 and older, the prevalence is right around one in ten. It's about 11% or so, depending on the study that you're looking at. One of the things that's

important to note about Alzheimer's and related dementias is they're generally considered to be delayed and compressed. What I mean by that is they occur later in life, and the disease progression is really relatively quick comparatively to some disease processes.

But there is certainly a lot of individual and group variability. When we compare this with age related hearing loss, one of the things that we see is the prevalence is quite a bit higher at more like three in ten in individuals that are 65 and older. And certainly, again, those that live longer will be in a group with higher prevalence. Unlike Alzheimer's and cognitive disorders, age related hearing loss is really considered to be progressive in nature. That is comparatively to dementia.

It's acquired at a mild level and at a younger age, and then it gets worse with increasing agents. Let's contrast that with lifetime risk. Lifetime risk of dementia really differs quite a bit between women and men, and it's in the neighborhood of 30% or so with a lifetime risk. And of course, there's a greater risk as you live to be older, and about 35% to 40% of individuals that are 90 or older will have some form of dementia, depending on the study results that you look at. When you compare that, though, with a lifetime risk of hearing loss, it is much higher.

We're talking more like two thirds of individuals have a risk of hearing loss, and about 90% of individuals that are 80 or older will have some form of hearing loss. When we put those two data sets together, we can conclude that the majority of older individuals that will experience cognitive decline will also experience hearing loss. And oftentimes, those that experience cognitive decline will experience hearing loss first. That isn't always true, but that's more commonly true. And that has really led to some of the questions and ideas around.

Well, if hearing loss does occur first, is there treatment for hearing loss that might have some sort of protective effect relative to cognitive decline? That was the question really asked in the large study that I want to review from the achieve group, where they're really looking at hearing intervention versus health education in its ability to reduce cognitive decline in older adults here in the US.

Really, the specific question they asked was, what is the potential for a three year change in global cognition before and after an intervention? The way that they're looking at cognitive decline is really a comprehensive neurocognitive battery. Really another way to frame that question is whether a comprehensive hearing healthcare program that includes hearing AIDS, is that associated some sort of protective effect for cognitive decline?

When we look at this, I think there's a couple of other important factors and things to think about, especially if we're considering this and thinking about it for our patients. When we look at the risk factors for dementia and cognitive decline, it is important, I think, to recognize that age and genetics are really the big ones, and so they are really the biggest risk factors, along with a few other non modifiable risk factors. But the interest in hearing loss revolves around the fact that it's a potentially modifiable factor. And so maybe up to 40% of the risk for cognitive decline are potentially modifiable factors. And since those might be a addressable, I think that's where there's the real interest.

Of course, people can't do much about their genetics and they're going to age, and that's why there's the interest in things that might be modifiable.

I also think it's important that we think about why this question is important. One of the things that I think patients sometimes get hung up on, and we may exacerbate that

problem, is what it means for them. I think when we look at potential modifiable risk, they really might have little or no effect for an individual person.

But we do know that even small delays in disease onset or disease progression can have really very significant effects on public health cost and public health policy. I think that's one of the reasons why this type of study is so important. There are a lot of potential modifiable risk for dementia that I list on the right, but hearing impairment is certainly one that has received a lot of attention because it appears to be one that is one of the larger ones.

It's also interesting, I think, to consider why treating hearing loss might protect against cognitive decline. Certainly I don't have time to go into any of the details related to these theories, but there are basically three general classifications of theories. Two possibilities are that hearing loss forces the brain to work harder when listening. That potentially affects mental processes that are crucial for functions like memory and thinking, what's generally referred to as the information degradation type of theory. And there's also related to this, that sensory deprivation changes the brain's integrity, and there are structural changes or structural effects to the brain by treating hearing loss.

So, kind of boiling this down into one of the hypotheses, treating hearing loss reduces listening efforts, and therefore, it could reduce the negative impact that effort has on cognition. Another group of possibilities is that hearing loss contributes to social isolation, which has been associated with increased dementia risk. That is, treating hearing loss reduces social isolation and therefore could indirectly reduce cognitive decline by limiting another risk factor. And so I think that one of the ideas around this is, rather than protecting against cognitive decline, treating hearing loss could still have positive effects by offsetting some of the symptoms or manifestations of cognitive decline.

So what they did in this study is a randomized, controlled trial of almost 1000 adults in between 70 and 84 years of age. All participants had untreated hearing loss and no cognitive impairment. They were randomly assigned to receive one of two treatments, a comprehensive audiological care counseling and hearing aids arm, or an individualized health education session, which served as the control group. One of the things I want to acknowledge for those of you that haven't read these studies, the comprehensive audiological care and counseling, this group really did a lot of work at really identifying best practices and serving patients with best practices related to hearing aid intervention and hearing intervention. And so it wasn't just, you know, put a hearing aid on people and see how they do.

It was really a comprehensive audiologic care versus a fairly comprehensive health education set session.

So what they found, importantly, the general study finding was that there was no significantly different difference between the hearing aid intervention and hearing health education control group. In terms of outcomes, the study failed to show any protective effect in the general group. However, importantly, this study included two different groups of people that were somewhat different in their risk for cognitive decline. The overwhelmingly large group, about three quarters of the people, were healthy volunteers that were really considered to be quite health conscious. It's speculated that these individuals were in better than average health and were in the position to take better than average care of themselves.

In comparison, about a quarter of the individuals were really higher risk individuals. They had more risk factors for cognitive decline, they had lower baseline cognitive scores, and they were generally less healthy. And so when we look at all the participants, they were really dominated by that healthy group. And cognitive scores before and after the intervention were not actually different for either the hearing aid or

the no hearing aid interventions. In other words, when you look at the group as a whole, there wasn't any cognitive decline over the three year period.

One potential interpretation of this study was it wasn't really possible for there to be a protective effect because no cognitive decline actually occurred. One of the things that's important, I think, is that this study will continue to look at a longer time window for those healthy volunteers to see if a protective effect does occur over time, as cognitive decline actually happens in that group. I think it's also interesting to look at the high risk group in isolation.

Participants in the high risk group who received audiologic care, including hearing aids, had no average decline in global cognition. However, the control group here, those that received the health education intervention, and no hearing aids, did have an average decline in cognition. And so there was a potential protective effect evident in this high risk group only. And I plotted these data on the figure on the right hand side. This is sd units, which is what the study used, which is their way of plotting standardized global cognition.

And what I'm showing is the benefit that hearing aids provided comparatively to no treatment in the orange box. Now, while this is a positive number, I want to remind you that it's a positive number, because those without hearing aids actually went down and those with hearing aids stayed about the same. You can see, by comparison, the healthy group did not show a significant difference between the intervention group and the non intervention group.

Another thing that I think sometimes gets overshadowed by all the focus on cognition is there's another reason I think the study findings are really important. And this study and many other studies have shown that hearing Aids really do have benefits for all, regardless of their cognitive status, whether that's improved communication, even in

noisy settings, whether it's self perceived benefits in listening and hearing, reduced listening effort and fatigue, improved social connectedness, or even decreased tinnitus. All of our patients, as a group, on average, are getting lots of hearing aid benefits, regardless of their cognitive status and regardless of whether there's a protective effect.

Another way that I think that we can kind of think about this is what the study results don't say. And I think that's really important for our patients. And I noticed that Katherine Palmer came to a very similar conclusion when she presented this study at AAA, a review of the study at AAA just a few weeks ago. And that is, the study doesn't show that not using hearing aids will lead to dementia. And conversely, it doesn't show that using hearing aids will prevent dementia.

That is not a result of the study, even in the high risk group. I think that several individuals, including Kathy Piku Fuller, have written articles and focused on the idea of really the importance of sending a positive message to patients without overhyping or scaring them about the fact that hearing aids have lots of positive benefits, and regardless of what this might mean in terms of a protective effect for a population, it might not mean very much to an individual patient in terms of a protective effect.

A related clinical question that's also a pretty hot topic that I couldn't help myself from mentioning is the idea of using cognitive screeners. I think a lot of people have a question of whether we should screen patients using cognitive screeners as audiologists, and can we determine a cognitive diagnosis from cognitive screening results? Should we use cognitive screening results for hearing aid counseling? I think those are all open questions, and I wouldn't be so bold as to answer them in any sort of definitive way, because I think some of these things are related to opinion. But I think that we could kind of ask ourselves a little quiz.

Consider that maybe we've read a lot about audiologists using the MOCA or other cognitive screeners for the MOCA. Based on the data we know, the cutoff for normal is either 25, or if you want to use a more conservative study estimate, 23. Consider a case where we have two older patients, one who scores a 22 and one who scores a 15. Think about what we know based on this. Is it the case that both of these patients are experiencing mild cognitive impairment?

Is it the case that the patient scoring 15 has a moderate cognitive impairment, and it is quite a bit more significant than this one scoring 22 has a mild cognitive impairment? Is it the case that one or both of these patients will require atypical audiologic intervention due to a cognitive impairment, or is the answer d, which, in fact it is, that the MOC is a screener, and it's aimed at determining the potential need for cognitive testing. It's not diagnostic. In fact, some professional organizations, including psychologists, suggest it should not be used at all in individuals who are asymptomatic for cognitive deficits. Why might they suggest that it shouldn't be used in these asymptomatic individuals?

Well, one reason is there's a pretty high false positive rate for the MOCA, and it's actually highest in the 70 to 79 year old group. That's an age range which it's common to have hearing loss, and it's a little early for cognitive decline. It's the very age group that might be most interested in whether cognitive decline is occurring, and it's the age group where you might have the highest false positive rate. Another concern that I have, and I'm not trying to be an alarmist here, but I kind of think about this for myself when I'm talking to or thinking about patients think about a patient who believes a screening result is diagnostic, no matter what you tell them, and maybe in this case, the patient scores very poorly and this leads to a suicidal ideation. I personally am not prepared to counsel around those issues, and I think that's another reason where I think we at least have to lean towards some caution when we're using screeners, given the diagnostic nature of their results.

All right, skipping over to a very different topic, and this is factors associated with hearing aid outcomes, including social networks, self reported mental health and service delivery models published out of a group out of South Africa. And they are really asking whether there are unexamined patient factors that contribute to hearing aid outcomes. We know there's lots of studies out there that have been previously shown to contribute to hearing aid outcomes, some audiologic, some related to purchase price, hearing aid problems, word recognition scores. And this is really an important question because it could lead to interventions that further improve hearing aid outcomes or limit failures in hearing aids. And I think it's particularly important when we're thinking about individualizing care for patients.

We are looking all, many people right now are looking at trying to optimize service delivery for patients. Not every person needs a comprehensive care package, but if we want to improve low hearing aid adoption rates, we really need to answer questions like this. This was an online survey of almost 400 individuals. They asked questions on patient demographics, audiologic variables, general health, social factors, hearing aid outcomes, and they use the IOI haw, or the international outcome Inventory for hearing aids as their hearing aid outcome. What they found is that bigger social networks were positive for all, but the makeup of the social network mattered.

That is, people that had social networks that included people with hearing aids, the impact was positive. But people that had social networks that were primarily large groups of people without hearing aids was associated with more negative outcomes or lower outcomes. People that had better self reported mental health, that were working, that had a good quality of life, or more self reported hearing difficulty, all were associated with better hearing outcomes. One of the things that I also thought was interesting is that the service delivery model that is, private or university clinic had poor outcomes compared to big box realtor.

So why is this important? So social circles matter. And the difference between hearing aid users and non hearing aid users highlights the continued importance of addressing hearing aid stigma. We also, I think, have more support that service delivery models and costs likely affect hearing aid outcomes. One of the things that this study doesn't disentangle the reality is the university clinics, comparatively to the big box stores.

There's quite a big difference in cost. And so people certainly like service, but they like low cost, too. And so finding that balance for individuals might be a really key point when we're considering individualization. And then finally, I think, and some of Doctor Picou's articles also touched on this, there's emerging evidence that more positive people, those with higher expectations, better self perceived quality of life, go along with those individuals that perceive more difficulty in having better outcomes. And that what this boils down to is perception and not just audiometric hearing loss matters when we're looking at outcomes for hearing aids.

So when we're looking across all of these studies, just in summary, real quickly, Doctor Picou reviewed these three studies. Jorgensen et al. Demonstrated that demographics and settings can affect acoustics, auditory demand, and feature activation. And older adults have less diverse and demanding listening environments than younger adults. The Lulu studies indicated that hearing aid outcomes were significantly better in the group of hearing aid users who focused on positive hearing aid experiences.

That a control group, and I think it really opens up an interesting question for future research. Holman et al. In 2023 demonstrated that adults have negative emotions toward hearing loss and positive emotions towards hearing aids. The achieved study demonstrated that the relationship between hearing aid use and cognition may be individualized and may come down to an individual's person's experiences with cognitive decline. I think more importantly, it showed that hearing aids, as part of a

hearing healthcare, have benefits for all users in addition to any potential cognitive benefits.

Then finally, I think that Jiang study in 2023 concluded that Biobank data support hearing aid use decreased cognitive decline, but that was really invalidated by the retraction and invalidated our ability to make that claim. And so it's always important to explore new information regarding previously published studies.

I know we're reaching the ends, but I want to thank you all and entertain any questions.

Thank you so much, Doctor Ricketts and Doctor Picou. We'll go ahead and open up the queue for any comments or questions. We have a nice comment here from Kendra. Kendra says thank you to the both of you for this presentation.

Doctor, there's been some, there's been some conversation in the Q and a about sample sizes and concern for, you know, the studies that I presented had some pretty small sample sizes. So if, well, I guess we might be out of time, but if you want to comment on the kinds of sample sizes that we've talked about today, certainly, and I very briefly touched on this at the end, I think that a lot of the studies that we review and a lot of studies that are published, they're not necessarily. And I think that we do have to be careful. And I think that Doctor Picou, in limitations on every one of her studies, talked about small sample size and that these aren't conclusive. Right.

Sometimes it's, this is, hey, maybe this is something interesting to look at. Maybe this is a research area that we need to explore more. And sometimes we're introducing research where we're not trying to make, I think, as a field, definitive conclusions. Even when we look at the very large studies, like the achieve study, in no way conclusive, right? A piece or a bit of information.

And I think we absolutely temper that with sample size and a number of studies, which has been one of the reasons why there's been more meta analysis, there's been more looking at groups of studies when we're trying to draw conclusions. I think that's an important point as we look at sample size and we look at studies in general. Trying to summarize this, it's popular now to summarize a study with a single line or a single sound bite, but that is so underrepresenting what a study might actually be saying.

Thank you, Doctor Ricketts. It looks like that is all the questions in our queue, and we're going to go ahead and conclude today's presentation. I want to thank you to Vanderbilt University for hosting this series annually, as well as Dr. Ricketts and Dr. Piku for coming on year after year and sharing their knowledge.

Thank you so much everyone. We hope you enjoyed the course.