Teenagers with Tinnitus

Presenter: Brian J. Fligor, PhD, PASC

- [Kimberly] It's my pleasure to welcome back Dr. Brian Fligor. He's gonna present to us today with teenagers with tinnitus. Over to you, Dr. Fligor.

- Hi, thanks so much, Kimberly. Appreciate this. Christy, thank you for having me on here. You are all hearing me okay I take it? Great. So this is so near and dear to my heart. I'm a pediatric audiologist by background and training. I am, goodness, let's see, been in private practice now, I would say that my tinnitus caseload has been increasing, particularly since the pandemic hit. My caseload used to be probably, I'd say about 10 to 15 patients with tinnitus per week. And then it more than tripled when the pandemic came along. And then since then, I would say it's probably about three quarters of the work that I do. And while it's not the most common thing for us to see pediatric patients with tinnitus, when they do come through, the needs that they have are, you know, pretty significant.

And so this is why I'm just, I'm so pleased that you all are interested in this topic. We've got a lot of participants here today, so this is exciting. So we're gonna talk about teenagers with tinnitus today, and the specific things that we need to do to identify, evaluate, and then treat. So here's my disclosures. Please feel free, come back, take a look and follow up with me with any questions you may have. But otherwise I'm taking it away. So, learner outcomes here. Yes, I wanna make sure that you really do understand and identify what's going on with our teenagers, and how do we best help them, okay? So I'm sure all of us have either experienced tinnitus ourselves, currently are experiencing tinnitus, or know somebody who is.

I'll go into some of, like the background, geez, how many people in the United States, how many people worldwide actually have tinnitus, how many people are bothered by it, and then how many people are disabled by it? And then let's extrapolate it in with the teenage population. For those of you who have tinnitus or have what I would call reactive tinnitus, as in certain things cause your tinnitus to get worse, I'm gonna be

playing for you a sound clip that is my own tinnitus. This is the tinnitus that I hear. So fair warning that there's something here that you will experience that is part of what I experience hearing tinnitus, sound sensitivities, these are things that are experiential.

It's really hard to really know it and understand it unless you're able to step into that and be part of it yourself. So I am gonna ask you to be a little bit vulnerable today and allow yourself to be there, knowing that we are going to be able to exit back out again. We're gonna talk about how we might screen teenagers for bothersome tinnitus. There's actually a really pretty straightforward way to do this that's been validated in the literature. And I would encourage all of you who do interface and interact with teenagers to explore this. We're gonna talk a little bit specific to the issues that tinnitus brings for teenagers, because, boy, they're such an odd, interesting population.

And the way I describe it is you either love it or you hate it. I absolutely love working with my teenagers. That said, gotta be ready for 'em. There are treatments for tinnitus. We are going to talk about those treatments. If you walk away with nothing from today, walk away striking from your vocabulary, well, tinnitus is permanent, you just have to learn how to live with it. That is a phrase that not only is incorrect, but it also reduces the likelihood of a good outcome. So when we say things like that, that in fact are triggering and inflammatory, and are feeding the fear that is tinnitus, we're actually doing harm, not good. And so I want us to really think that through when we try to talk about what treatments for tinnitus exist.

We're gonna talk about pharmacological interventions for tinnitus, as in Prozac, Zoloft, Celexa, Lexapro, Gabapentin, benzodiazepines. We'll talk a little bit about those because a lot of the folks who are on our caseload, they do have behavioral health medications, helping them to manage general anxiety disorder, depression, obsessive compulsive disorders. If people who have other behavioral health challenges also have tinnitus, then they kind of feed each other. And there are ways that we can manage

one, and that can help manage the other. And then we'll just go back through and just make sure that we're all on the same page toward the end. All right, so I think of tinnitus as just the epitome of irony. This is a sound that you are trying to escape and can't escape because it's inside your head.

And so, because it's inside your head, it's actually not a sound, but your brain perceives it as a sound. It was defined actually by Pawel Jastreboff, who's a pioneer in this area, it's defined as a "Phantom ringing, buzzing, hissing noise in the ears or the head in the absence of an external source." Well, when people are bothered by their tinnitus, it's actually not hearing the tinnitus, the perception of the tinnitus, it's their reaction to it. Well, if we would stop hearing our tinnitus, we would stop reacting to it. But as long as we react to it, if it's bothersome, if it has us at a heightened state of attention, arousal, panic, then we're going to pay attention to it and therefore we're going to hear it.

So we have this really negative cycle of perception of the tinnitus, reacting to the tinnitus, which only reinforces our perception of the tinnitus, which only reinforces our reaction to it. But tinnitus itself, it's a sensation. It's a sensation like many other sensations we experience, how bright the light is, how loud, you know, sound in our environment is, the feeling of the shoes on our feet, the feeling of the chair pressed up against our back and against our backside. It's a sensation that's otherwise benign, except where tinnitus is concerned there's accidentally, the brain has created a network of neurons, a neural network if you will, a network of neurons that causes this cascade of self reinforcement of the actual sound, of the nerve firings.

And that projects down into the area of the brain where we assign threat to things. So when a loud sound goes off near us, an unexpected loud sound, we startle. That startle response, that's a reflex, and it causes our heart to race a little bit, our pupils to get bigger, they dilate. If it's really scary, you may even feel like, you know, your palms get

a little bit sweaty, maybe your mouth goes dry. That sensation of the sweaty palms, dry mouth, shortness of breath, eyes dilating, that's called an autonomic nervous system reaction. Autonomic nervous system reaction. It's panic, for lack of a better term. So our brain called that a threat, that that thing that happened was a threat.

Okay, well, what do we do with threats? We try to avoid them. When this network of neurons that is self-reinforcing this intrusive sound projects down into our limbic system where threat is assigned, you can't escape the threat. It's assigned a threat, therefore, it's a threat. Perception of the sound, reaction to it. And so what we're talking about here today is we are going to try to break this pattern of reacting to the perception of tinnitus. If we can modify our reaction to the tinnitus, then perception of the tinnitus can then be modified. I've never seen somebody stop hearing their tinnitus without first modulating reducing their reaction to it. So the moment you don't care about it anymore, then you're not gonna hear it.

So if you stop caring about your tinnitus, then the loudness of your tinnitus goes down, which of course when people see us, the first thing they want is, well, just make it go away. What they're asking is for the perception of their tinnitus to decrease so that their reaction can decrease. The problem is we have to reverse that. We have to reduce our reaction to it before we can reduce the perception. So scope of the problem. Now, this is according to American Tinnitus Association, and their numbers, perhaps they're slightly inflated because of course they're seeking grant money and seeking participation, but it seems pretty consistent around the world. Somewhere between 10 to 15% of people in developed countries have tinnitus.

That number may be higher in developing countries, and I'll get to why that is when we think about, well, what are some of the causes? So of that 10-15% of the US population having tinnitus, that's 50 million people, about 6% of people have what's thought of as bothersome, as in, I don't just hear it, but I wish I could get rid of it, I wish

I could make it go away. It negatively impacts my quality of life to some degree. Now, 1/10 of those people, so 0.6% of the US population has debilitating tinnitus, okay? So that's 2 million people have debilitating tenderness, as in they can't sleep, they can't work, they can't maintain and keep their positive outcome or their positive outlook on life.

So how often does this happen in kids? There's only a couple of studies that have really tried to narrow in on this. So you're gonna see some really wide percentages here, which is gonna be a bit of a challenge for us, but it's to the best we can do. So a paper published in 2016 was a meta analysis of lots, and lots, and lots of article, couple hundred of them, with 25 articles actually having all the data in them that they needed to do this review of, how often does bothersome tinnitus happen? So they found 6% to just shy of 42% of teens experienced tinnitus on a regular basis. Okay, so wide range, 6-42%. So there are 26.2 million teens in the United States, okay, so total out of our entire US population, 26.2 million teens.

And if 6-42% of them have tinnitus, then that means that it's a number of one and a half million to 11 million have it, okay? Rosing et al. reported then that of those that experience tinnitus, 0.6% have bothersome tinnitus, all the way up to 49.2% have bothersome tinnitus. So then extrapolating those numbers of 1.5 million to 11 million who have tinnitus, that means somewhere between 9,000 to 5.4 million teens have bothersome tinnitus, okay? Is it only 9,000, is it 5.5 half million? It's a wide range, it's not zero, it does exist, it does occur. The definition of bothersome, what's quote "bothersome" is why there was such a wide range. But we can rest assured that the numbers fall somewhere between 9,000 and 5.4 million teens have bothersome tinnitus.

A study that was out of, I believe this is Belgium, yes, this is outta Belgium, Gilles et al., 2013, surveyed 4,000 Belgian high school students and found that three quarters of

them had a noise-induced temporary tinnitus. So as in go to a concert and you leave and your ears are ringing. Go to a dance club, listen to your headphones. In Belgium, there's not a lot of firearms use, but in other countries there are. In the United States, there's a very high rate of firearms use. And firearms is the number one cause of noise-induced hearing loss outside of the workplace, therefore, with teenagers, we might also expect that firearms noise exposure may in fact also significantly contribute to tinnitus, whether it's temporary or then chronic/permanent.

Gilles et al. found that of their 4,000 Belgian high school students, just over 18% reported having ongoing tinnitus. And they attributed it to noise, specifically saying, after this is your tinnitus present, and has it been present for three months or longer? And 18.3% reported, yes, it is. So I'm just gonna play for you what I experienced when my tinnitus kicks up. And my tinnitus, it started when I was about 14 years old playing in garage bands, playing AC/DC covers, playing Van Halen covers, you know, and a few other, you know, of those songs that were of that era, the late 1980s, early 1990s. So you know, I'm gonna keep on talking as we go, but this is one of those things that I generally hear.

It's a lot of tones, there's like very high pitch tones, there's a lower frequency rumble that goes on. And whether or not I hear it depends on whether or not I'm focusing and attending or I'm not focusing and attending. But what makes tinnitus bothersome? See, look at that, it goes away, eventually. Whether or not tinnitus is bothersome is in very large part whether or not it's disrupting sleep. Either getting to sleep in the first place or being able to stay asleep. Because tinnitus can arouse somebody out of a deep sleep, or if as they go through their sleep cycle through the night, if they wake up, say they have to go use the bathroom, well, they come back and there it is, and they can't go back to sleep again.

So sleep disruption is truly the number one issue. But then there's also a sense of I can't escape, it's that loss of control, it's the persistence of the tinnitus. If there is anxiety or depression, or there is a chance for anxiety or depression to exist, then you're going to experience anxiety and depression with tinnitus. Slight aside, not quite anxiety, but the annoyance, the irritation, inability to relax, always being on edge. This is what's referred to as a heightened state of arousal. This is where someone may have like some ants in their pants or they're just feeling off. Tinnitus also leads to difficulty with concentration or even to the extent of causing confusion. These are significant issues related to having bothersome tinnitus.

As you note in my quiz, this is question number one, that you can find the answer on this slide. There we go, let's get past that. Well, here's a way to screen for bothersome tinnitus, okay? And this is anybody, even younger children, you can ask the same question. You know, do you often have ringing, buzzing, or hissing noises in your ear or in your head? If they say, well, yeah, I hear this, a buzz, a hiss, a high-pitched squeal, whatever it may be, you know, and is it there whether you close your ears off or not? Yeah, I always hear it, and either they hear it especially loud in the morning or at night, usually either when they're going to sleep or when they're first waking up.

When their room is the quietest, do you hear it? Yes. Well, all right, on a scale of zero to 10, where zero is it's really not there, and a 10 is the loudest sound you can imagine, how loud is their tinnitus? If they answer a four or higher, then that means their tinnitus is likely bothersome and it's worth evaluating further, okay? It is possible that a person with tinnitus has an undiagnosed hearing loss. Tinnitus is comorbid with hearing loss. It is very, very common. Hearing loss often causes tinnitus. Tinnitus doesn't cause hearing loss, but tinnitus exists when there is some damage in the ear. And perhaps that damage is something that is actually impacting their ability to hear and understand teachers, or peers, or parents.

Tinnitus is secondary to certain medications. Certain antibiotics will cause tinnitus. Certain pain medications can cause tinnitus, and certainly chemotherapeutic drugs. So any child who has undergone chemotherapy is at extremely high risk for having tinnitus. If there is a high frequency hearing loss due to ototoxic medications like chemotherapy, it is highly likely they also have tinnitus. Tinnitus is also a sign of concussion. And so in high school sports especially, there's been so much really good attention given to traumatic brain injury, to concussion safety, concussion protocols. Well, I'm a high school coach, or not a high school, sorry, I was my son's eighth grade tackle football coach. And yes, despite the fact that I manage and I deal with people with concussion, and traumatic brain injury, and auditory processing issues secondary to concussion, yes, I do let my son play a tackle sport.

My oldest child, my daughter, 15 year old, she plays soccer. And let me tell you, the rate of head injury in soccer is about the same as it is with tackle football. They don't have any pads in soccer. This is a thing, so being mindful of this. Typically when tinnitus is secondary to concussion, as the brain heals the tinnitus lessons, however, it can be there, and if post-concussion their tinnitus is present, screen them for bothersome tinnitus. If it's a four or a higher, refer on. And then finally, you know, I wouldn't call it my favorite, but this is the thing that kind of brought me kind of front and center in a place of teaching, and presentations, and educating, is over exposure to recreational sound.

I mentioned before about headphones, I mentioned about firearms use. You know, think of ATVs, think of water skiing, think of any of the other fun things that kids do, A lot of fun things that kids do, they're noisy. So this happens. So all of these are important, significant things that we need to attend to and screen for and evaluate. What does that further evaluation look like? Where do you send them? I would strongly advise you loop in their primary care physician, the pediatrician, but also indicate they need to see an audiologist, at a minimum for a hearing test, but preferably an

audiologist who identifies as working with and managing tinnitus, especially tinnitus in people under the age of 18.

Okay. So once we go beyond just this initial, on a scale of zero to 10, how loud is your tinnitus if it's there, you know, fairly often? When they see an audiologist, especially an audiologist who works in the realm of tinnitus, you know, we could advocate for some imaging studies to be done, such as functional MRI, there are PET scans, positron emission tomography, PET scans that can be done to detect tinnitus in the brain. The fun thing is if you say you have tinnitus and you go in for one of these esoteric imaging studies, you'll likely observe the tinnitus. Yes, it's there. Whether it's there or it's not there on an imaging test, that doesn't direct us for what to do about it.

So any kind of study that's done to evaluate the presence or absence of tinnitus is really just more of an academic exercise. What matters is how much does it bother them? So the way that we evaluate for bothersome tinnitus, it's not the hearing test itself, that's helpful, but it's not the whole thing. It's actually not even, hey, match the sound of your pitch to this other sound or match the loudness of your tinnitus. Those kinds of things, loudness matching, pitch matching, again, they're academically interesting, but they don't help to direct us toward treatment. What does help to direct us is having them fill out these validated questionnaires. The two that I like the most are called the Tinnitus Functional Index and the Tinnitus Handicap Inventory.

There's eight different tinnitus questionnaires that have been widely used for a long time, say like in the past 30 years. The Tinnitus Handicap Inventory is pretty common. Probably it's the most common until the Tinnitus Functional Index came along. And now this one, I do tend to lean more toward the Tinnitus Functional Index But that said, when I see a patient for an evaluation for tinnitus, I actually have them fill out both, the Tinnitus Functional Index and the Tinnitus Handicap Inventory. Both of these are 25 item questionnaires. They've been validated, studied, internal consistency is very high,

reliability is very high, and retest reliability is very high with these, so that you can find out, well, where are they at a baseline.

And then after some period of treatment, you can re-administer the questionnaire and see where are they and see whether or not things have gotten better. So on the Tinnitus Functional Index specifically, the scale is a zero to 100, and it assesses seven different sub-domains, like sleep, concentration, quality of life, emotional, sub-domain, hearing. If a person scores from a zero to a 25, that's considered low priority, as in if they do have tinnitus, it's generally speaking, not something that's causing them significant disruption or significant decrease in quality of life. I generally help people to understand that, yep, a lot of people have this, it's there, and it's just a matter of the brain being aware of its own circuit noise.

Circuit noise is like the hum of fluorescent lights, whether it's there or not there, it doesn't really matter. And so if it's something that is not interfering with their ability to concentrate or interfere with sleep, just put it into that context. And a lot of people have it, and it's just one of those things where your brain is aware of some of its own internal noises. If they score between a 54 and a 72, that's up there with what's considered a very big problem, "Big problem." It's bothersome, it's interfering, it's something that necessitates intervention. Between that 26 and 53, case by case, sometimes it really does necessitate some interventions. Sometimes it involves some therapies, you know, cognitive behavioral therapy, helping them to identify ways to establish control.

But doesn't typically require ongoing services from a tinnitus specialist. If their score is up in that 73 to 100 range, that is in what would be considered catastrophic, that matters, that is a stop everything, let's get them evaluated by, at a minimum audiologist, ear, nose, and throat physician, and either a psychologist or psychiatrist, because we really need to hit this with a team approach. So the Tinnitus Handicap Inventory is also a zero to 100 point scale, with the higher number being more severe.

The categories are similar, although it doesn't have seven different sub-domains. And in this case, any score that's over 38, that does require some intervention. And the higher the number, the faster and the more intense the intervention needs to be.

The three fables of the teenage brain, this is something that comes from the 1960s, a guy named Elkind. And hmm, such brilliant stuff. The three fables are that a teenager thinks that they are special, that something that happens to them has never happened to anyone else. They think that they are always on display, that they are subject of an imaginary audience, that everything they do or say is being observed by others. And there's a third, is that they are invincible. That they will not experience the negative consequences of their own actions. Those three things together create a recipe for disaster when a teenager has tinnitus, that they catastrophize their tinnitus, and that this is something that nobody else has ever had, that they have ever experienced.

That their suffering is on display for everybody and everything. And the opportunity that, well, they can crank their headphones up or they don't have to be careful with their hearing, that they're invincible and that this isn't going to happen to them, until it does. So those three fables of the teenage brain, this is where the executive function has not yet kicked in. When the executive function does kick in, we have a lessening of those three fables. So let's think then about how the presence or absence of tinnitus and whether the tinnitus is bothersome, how this interfaces with the teenage brain. And the teenage brain, it's frustrating, it's joyful, it's fantastic. And for any and all of you who have a teenager in your life who brings you joy, frustration, pain, and whatever, I think you know what I'm talking about, this is a special, special population.

They need our assistance. So the teenage brain is undergoing massive organizational changes. Their cognitive development is, they're not human, they're animals with human qualities sometimes. The appetite, their ability to maintain memory, their emotional contexts, those are pretty mature, they're pretty intense. And I say mature as

in the emotions that they feel are fully formed, they're sophisticated. There's a difference between sad and happy. No, there's fine detail between, you know, anxious versus nervous. There are fine distinctions between these two, so it's more discreet, unlike in a much younger child. Memory is exquisitely good. My goodness, we ask them to memorize so many math facts, and memorize so many vocabulary words, and rules in history. So all of that stuff, it's there.

If anything, I think that their memory is actually better than those of us who are in our middle age and older. If any of you have ever seen a group of teenage boys fall upon someone's kitchen, you know what I mean by the appetite. It's a feeding frenzy, like a bunch of sharks or wolves. It is impressive. All of these things, like their memory, their emotion, the appetite, this is managed by the limbic system. What's also been referred to kind of jokingly as the lizard brain, as in this is all lizards have, they have a brain that is an amygdala, a hippocampus, and their thalamus, with a little bit of extra stuff around the outside of it.

These are the primitive areas of the brain, these are the parts of the brain that help us to maintain our alertness, our arousal, our focus, but it's subconscious. And we don't have a lot of good access in there from the logic centers of our brain, the parts of our brain that help us make good decisions and help us to not do something that we shouldn't do, okay? Those things that we try to make good decisions and do things that we should and don't do things that we shouldn't do, and things that help us organize ourselves and manage our time, this comes from the development of our prefrontal cortex, which is where our executive function exists, okay?

For children who have ADHD, ADD, children who have other atypical cognitive development or they're neurodivergent, their executive function has some challenges to it. Well, every teenager has challenges to their executive function, 'cause it's not fully formed yet. The fact that their prefrontal cortex lags behind the limbic center and other

areas of the brain, the more subconscious areas, creates a real challenge for those of us who do work with teenagers. Let's add into this the fact that they're in puberty, they've hit puberty or they're about to hit puberty, and so we have significant shifts in their hormones, which influences concentration, influences memory, influences their highs and their lows. They're not yet able to apply the inhibitory activity of the executive function, okay?

Prefrontal cortex, so much of what it does is it inhibits thoughts, it inhibits actions, it inhibits mistakes that we might otherwise make. Well, hormones are flowing along, affecting our limbic system without the executive function there to put the brakes on things. We also know that in teenagers, especially as they hit puberty, their sleep patterns change quite a lot. So they start going to sleep later on, they're more alert at like nine o'clock, 10 o'clock, 11 o'clock at night, right about the time that I'm like, that's it, I'm hanging it up, I'm done for today. You know, my 15 year old is wide awake and revving to go. Come 5:30 AM, 6:00 AM, you know, I'm getting going, I'm drinking my coffee, off I go.

My 15 year old, if she could sleep until 11:00 AM, she would, and she does on the weekends. So our school schedules tend to be focused around us adults, and a 7:15 AM start time. And if you've got a teenager with tinnitus who already just naturally is programmed to go to sleep later at night and wake up later in the morning, but now you've got tinnitus that is interfering with their ability to achieve sleep, even though they're going to sleep late at night, you're talking about a recipe for sleep deprivation hitting quickly. It's no wonder, you know, one, we already have extremely high rates of anxiety and depression within teenagers, let's add into this the hormonal shifts, let's add into this the changing sleep patterns, the opportunity for sleep deprivation, anxiety and depression are just basically guaranteed.

And so if, again, it's one of these things where I say, hey, if you walk away with nothing else, consider that presence of tinnitus, presence of bothersome tinnitus is almost guaranteed of them having anxiety and/or depression. So 22 years ago when I finished my CFY at Boston Children's Hospital and I saw a 14 year old violinist, she's an exceptionally good violinist, had been playing since she was about four years old. She had tinnitus in her left ear and her pediatrician said, "You know, I'm gonna have you go see this other person, this ENT." And the ENT saw them and told her parents and told her, "Well, it is on one side, so you know, it could be a tumor."

How many tumors on the auditory nerve do you think happen in the general population? It's this thing called an acoustic neuroma. It is exquisitely rare. Best numbers we have is about 1 in 40,000. So 1 in 40,000, that's pretty rare. Bothersome tinnitus happens somewhere between 9,000 kids in the United States to 5.4 million in the United States. A lot fewer than that have an acoustic neuroma, like a lot fewer than that do. So one, the well-intended physician said, "Well, it could be a tumor." You think that that's gonna give them any sense of comfort? No, it's gonna scare the heck out of 'em. And after they did imaging studies, which if you go in for an MRI and you're not a big fan of enclosed spaces, and oh, by the way, we're looking for a tumor here, I think that that whole experience is gonna be, and I'm not overstating this, I think that the medical workup for tinnitus is trauma.

Of course, the tinnitus is gonna get worse as a result. And then one of the worst things that a child, especially, or any of us could be told is, all right, well, there's nothing we can do for this, you'll just have to learn how to live with it. That's the message that patients with tinnitus receive. And I used to say, well, it's not all together false, but it's not true either. I actually would just say, no, that's not true. You don't have to just learn how to live with it anymore than if we go to our physician and say, I've got ongoing headaches, I get like three or four of 'em every week, and they're so bad I throw up.

Or when I get a headache like this, the room starts spinning. Or when it gets like this, I can't open my eyes, I have to just lay down in a really, really dark space. Okay, so those are the hallmarks of migraine. No, you don't just have to learn how to live with a migraine. There's therapies for people with migraine. Now, is there a cure for migraine? No, there's not a cure for migraine. But there are good therapies to help a person have more migraine free days. There are good proven therapies to help people have less tinnitus intrusiveness, less tinnitus bothersomeness, and have improved quality of life. So tinnitus intervention, it is a management, it's not a cure, okay?

Well, you know what else we don't have a cure for? We don't have a cure for migraines. We don't have a cure for fibromyalgia. We don't have a cure for nearsightedness. You know, we don't have a cure for multiple sclerosis. I could go on, and on, and on. I could list out a ton of different diagnoses for which there is not a cure, but there is effective managements. So I introduced this at the beginning of the talk, that there is tinnitus, which is perception of a phantom noise that's a sensation that, all things being equal, it's actually it's a benign sensation. Whether it's there or it's not there does not indicate a problem the vast majority of the time.

The vast majority of the time we do not have a tumor, we do not have an autoimmune disorder. If there is hearing loss, we identify the hearing loss and we manage it. If it comes from having an ear infection, for instance, that is something that can be managed with antibiotics, or with PE tubes, or whatever, okay? So you manage that. But if it's hearing loss that's secondary to, you know, ototoxicity, anoxia at birth, genetics, yeah, there's management for that in those cases. But the vast majority of time there is not some "active disease process," there's not some underlying medical condition to treat. It's something where it's a benign sensation that has accidentally triggered the limbic system to react to it.

So rather than focus on habituating their perception of the tinnitus, we're going to focus on habituation of their reaction to it. And one of the first things we do to achieve that is to demystify what this is and what this is not. When we succeed in causing habituation of reaction, we can count on at least a 20% reduction in symptoms, and that 20% reduction correlates with clinically significant improvement, as in they still hear their tinnitus, but they're not nearly as bothered by it. They're sleeping better, they're concentrating better, just life is better. So clinically significant improvement is at least a 20% reduction. So if their Tinnitus Functional Index is a 50 at the start of therapy, at the start of interventions, then success would mean that at the outcome their score is a 40 or less.

I certainly say let's target for a complete cure, whether or not there's complete cure is hard to say, but you can count on at least a 20% reduction. We'll talk a little bit about what those therapies are and what the success rate are of them. But bear in mind that, you know, our primary goal here, while it would be nice for us to have the tinnitus not exist, that would be habituation of perception of the tinnitus. What we are focused more on here is habituation of their reaction to it. And certainly, if we can get their reaction to lessen, then there are things that the brain does, such as top-down inhibition, that can cause a person to not really notice their tinnitus so much, and that is habituation of perception.

Nope. So what are the interventions? Well, the interventions, historically we've been looking at connecting them with a therapist, as well enhancing their environmental sounds, and depending on the level that we need to go to, connecting them with an audiologist who is certified in Tinnitus Retraining Therapy, which is combination of the first two. So connecting with a licensed mental health counselor who can evaluate them for anxiety and depression, enroll them in cognitive therapy, cognitive behavioral therapy, mindfulness, and coping strategies to help manage their generalized anxiety. Demystifying what the tinnitus is and what the tinnitus is not is part of this overall

cognitive therapy. Sound enhancement, so this is increasing their background noise. So if I had an audience that I could look out on, I would ask you all for a show of hands, how many of you love silence?

Some of you are going to say, yeah, no, I absolutely love silence, I crave silence. And then I'm gonna do a follow up question and I'm gonna say, all right, how many of you actually love quiet but don't necessarily love silence? That's gonna change things just a little bit, you know, how many people say. Some people absolutely love silence, they crave it, they love the sound booth, they go into an audiology sound booth, and it's like, oh, this is delightful. A lot of people though, you put 'em in a sound booth, you have 'em sit there and it's very unnerving, it's a weird sensation, like, this is weird, there's no sound, it's like deadened. Even worse, you go into an anechoic chamber this is where there's these wedges of foam all over the walls, and it deadens all echoes.

And so that's a really weird sensation of having no echoes and such a silent space. Well, I would argue that it's actually not silence, for the most part, that we seek out, we seek out quiet. And silence and quiet are two different things. Quiet is a state of mind, silence is just an absence of acoustic signal in your space. And what tinnitus has done, it has robbed us of quiet. Yes, silence is not there, but silence is lack of acoustic sound in your environment. So we actually don't necessarily crave silence, but we do crave quiet. You know, for those of you who equate silence and quiet together, good for you. But I would also argue that it is possible to achieve a sense of quiet without it being absolutely silent.

So for instance, if a person were to identify a vaguely pleasant but easy to ignore sound. I'm gonna say that again, a vaguely pleasant but easy to ignore sound and have that just exist in their environment. That's not silence, but that is promoting a sense of quiet. So for me, one of my favorite sounds is the sound of rain on the roof of my house. If I go to sleep and it's a rainstorm, and it's just like a pretty good, you know,

amount of rain coming down, I sleep so unbelievably well. It's this lovely calming sensation. Well, guess what? I have that sound on my smartphone right there ready to go. And I pop in either hearing aids with Bluetooth streaming or I'll pop in a pair of Apple AirPods and just have that right there for me to redefine quiet.

Because if my tinnitus is kicking up and I'm being robbed of quiet, I can stream this sound either up in my earphones or through a speaker in my space. When I travel, and traveling I do get stressed out, and stress increases tinnitus, it's one for one. If I feel stressed from the travel, when I go to sleep, I may struggle to fall asleep in a strange, you know, space like at a hotel, and I have that masking sound streaming out of my phone. These are things that we can do to regain a sense of control. And it's that regaining a sense of control that gives us such a wonderful outcome. Tinnitus Retraining Therapy is a combination of that sound enhancement, with adjustment counseling, and developing coping strategies.

When we do this, that actually gives the brain an opportunity to create helpful neural networks that kind of pull apart this network that is the tinnitus. The neurons that are self-reinforcing, hearing the tinnitus, delivering that fear signal down to the limbic system, if we have those connect to the area around it, so other neurons that are not part of that tinnitus network, what we are then doing is we're creating different neuro networks. This is the concept of neuroplasticity. We have modified the structure of the neurons of the brain and we have lessened the opportunity for the tinnitus to be there and to be present, or at a minimum lessened how much it's projecting down into the limbic system, causing that fear reaction.

So let's do a quick example of this. So here's my tinnitus again, I'm gonna start it. Okay, I'm gonna pause that there. Well, here's one of the sounds that I've incorporated. So I use this app called ReSound Relief. Nothing special about it other than there's a lot of controls to it. It's a free app, it is made by one of the six hearing aid

manufacturers, but no, they don't advertise to you, so at least there's that. I have no financial or other interest in it other than I just like it and it works really well for me. So this is what I program in. So in this, it's this one soundscape that I created called Rain, Oceans, Monks.

And it's actually, it's a heavy rainstorm, it's ocean waves crashing, and it's monks chanting. Why monks chanting is something that helps me and that I really enjoy? I don't know, it just does. So it's a couple of water sounds with that. So now what I'm gonna play is I'm gonna play my tinnitus, but with that Rain, Ocean, Monks going on at the same time. So what I did was I have the sound of the app lower than the sound of my tinnitus right now. See that? Lower than the level of my tinnitus. And so you could hear the tinnitus through it, you could hear it over it. However, it took the edge off of it. And if I needed to, I could keep going up and up until my tinnitus was completely covered up and masked.

If I play that sound and just have it keep going, and going, and going, and going in my environment, I eventually tune it out as in I don't really hear it so much anymore. That's called habituation. So if I habituate to that vaguely pleasant and easy to ignore sound, that Rain, Ocean, Monks, if I habituate to that sound, then the tinnitus goes right along with it. Oh, let's go past there. Okay, so there is another therapy that was just released, literally, like I'm talking March of 2023. This is a device that does sound enhancement, so masking. But it also does an electrical stimulation on the tongue, and it's the combination of the tongue stimulation as well as the auditory stimulation that is bimodal, so both pathways, that has been shown in some clinical trials to significantly reduce the bothersomeness of tinnitus.

It facilitates that neuroplasticity in ways that other devices or other therapies have not. Now it is cleared for adults only. Any use of it under the age of 18, it's considered off-label. I have been fitting it now since March 1, I'm sorry, not March 1, May 1.

There's only 15 clinics in the United States that actually is partnered with the manufacturer. This is based in Dublin. They're onto something here. I started evaluating this technology around 2021. I was interested in it, but I was very skeptical, because I've seen a few different things out there like dietary supplements or other tinnitus therapy devices that had not been FDA cleared. And this is the first one that I feel has some promise. It is not a cure, it is just another tool in the tool chest.

Now there's no prescription or non-prescription medications, no dietary supplements, vitamins, minerals, essential oils, any alternative medicines. None of them have been evaluated by the Food and Drug Administration as being safe and efficacious for the treatment of tinnitus, okay? So any medications that a person has for their tinnitus, it is to treat the sequelae of the tinnitus, their anxiety, their depression, and their sleeplessness. That doesn't treat the tinnitus. Vitamin B complexes, Lipo-Flavonoid, magnesium, potassium, none of those influence tinnitus, despite what any kind of claims there may be in the marketing. So the comorbidities of tinnitus being anxiety, depression, negative repetitive thoughts, that's where the obsessive compulsive indulging of this comes in. So for these, certainly in teenagers, this is where you need to get a really good prescriber, a child psychiatrist to manage this.

I would not feel terribly comfortable about a primary care physician managing, unless they are really knowledgeable in it and comfortable taking on the responsibility, given that there is some risk of increased suicidal thoughts and actions in children who do try some medications. As I've understood from psychiatrists and psychologists that I've worked with, while Prozac has been around the longest and is very often recommended, it's also an activating type of selective serotonin re-uptake inhibitor, SSRI. But Prozac and some others tend to be activating, whereas Zoloft and Lexapro are more of an inhibitory response. And so therefore those tend to be a better option when you can consider these, that if you're thinking between using Prozac versus Zoloft, if the person has tinnitus, Zoloft might be a better option.

People certainly can use benzodiazepines like Klonopin, Valium, Xanax. Strongly recommend that they be managed by a child psychiatrist because of the possibility of it being habit forming. And with this type of medication, the more you take it, the higher the dose you need, because your body develops a resistance to it. Neurontin, also known as gabapentin, this is something that's good for nerve pain. It doesn't affect tinnitus. I don't recommend gabapentin for tinnitus. Melatonin, it's an over-the-counter dietary supplement that can help promote sleep. Maybe it works, hard to say. Trazodone is a medication that is for sleep challenges. A lot of patients that I take care of, they are on Trazodone. Again, gotta be really careful with medications and make sure that whoever is managing them is monitoring them carefully.

So in summary, tinnitus is just ironic. It's the reaction to it, it's not the perception of it, despite the perception of it is driving the reaction. There is a high prevalence of this. It's a challenging combination of the physiological, some damage has happened, whether it's measurable on an audiogram or not, versus the psychological, the pain. So this is auditory pain that we're dealing with. It happens often enough that it warrants all teenagers be screened for bothersome tinnitus. And it's not hard to do, two questions, more often than not, do you have a ringing, buzzing, hissing noise in your ears or in your head? If the answer is yes, on a scale of zero to 10, where would you put it?

10 being the loudest sound you can imagine, zero being really not there. If they say four or higher, that warrant's sending them on for further evaluation. The diagnosis of it is through a hearing test, counseling them for hearing loss preventions, headphone use. Love my headphones, I use 'em. I don't recommend discharge headphone use, but I do recommend safe use of it. And that's where you get in with somebody who's really thoughtful about this. Doing validated tinnitus questionnaires like Tinnitus Functional Index. Management is around behavioral health, Tinnitus Retraining Therapy, the sound enhancement. And then psycho-pharmacology for the comorbid

conditions. And I can think of no other condition that can affect teenagers as tinnitus where it really requires so much teamwork across all these disciplines between the speech-language pathologist, the audiologist, primary care physician, and that licensed mental health counselor.

So on that note, I didn't give us a tremendous amount of time, but I would love to open this up for some questions, and I'll give every bit of time that I can here. Kevin asked, "Would you say the environmental noise masking was responsible more for reducing the perception of the tinnitus or promoting habituation of a reaction to the tinnitus?" Let's see, the best way I think for describing this is first it reduces the perception of the tinnitus by giving the auditory system and the thalamus, which is your attention center, other things in that same pathway to observe, other things to be aware of. And when you do, and the tinnitus isn't the only thing getting the focus, then you're able to experience a lessening of, like it's not as discreet.

And as you experience something being less discreet, then your reaction to it can lessen. It gives the opportunity for habituating your reaction. Hope that answered that. That's my best description of it. Others. Natalie says, "Seems very parallel to pain management." Absolutely, Natalie, you're 100% correct. I described this as auditory pain And after the Boston Marathon bombing in, goodness, April of 2013, I was part of the survivor's network where there was a lot of chronic pain, as well as chronic tinnitus, and a lot of interface between the two. And so very much, it is. Others. Anyone else able to chime in with a question here or there? Christy or Kimberly? Any thoughts, any chiming in you'd like to do?

- [Christy] Thanks so much Dr. Fligor. I don't see any other questions in the queue, but we'll leave it open for another minute or so. And I wanna say just thank you so much for coming on and giving us your expertise and your thoughts. This is a really important

topic and I think a lot of what you spoke to can be applied to all ages of tinnitus. So I know that this particular talk was, you know,

- Yeah.

- geared towards the teenagers, which is, you know, technically pediatrics. But I definitely feel that this has been a very beneficial, clinically applicable course. We do have one more that came in here.

- Yeah,

- He said, "Could you try to explain TRT a little bit more, Dr. Fligor? With your time that you have left?"

- Yep. Tinnitus Retraining Therapy is this concept where the auditory cortex has created a neural network that is the tinnitus. It is kind of self-reinforcing. You hear the tinnitus, you focus on it, it causes more neurons to be participating in that network of activation that the brain identifies as a sound. It's a little bit weird, but that is what tinnitus is. Tinnitus Retraining Therapy is that we provide sound enhancement to activate that auditory cortex so that it's not just the tinnitus activating the cortex itself. As we provide more stimulation there, we help a person to say, so do you hear anything else? Do you understand more about, you know, other sounds in your environment? We demystify the tinnitus, we explain, well, so the tinnitus, it's not doing any damage, it's just some noise that's existing along the wires that go from the ear up to the brain, just as a lot of other wires go from the ear up to the brain.

And so you're aware of that, but it turns out that if you put just about anybody in an absolutely silent space, like a sound booth, and ask them to listen for a sound, they'll actually hear tinnitus. So a lot of people do have this. So that's just a flavor of how we

demystify and then describe, well, how was your day? How are you feeling with, as it relates to, just stuff in general? So in light of that, what I would say is it helps a person to change their reactions to it and lessen the likelihood of them panicking. And when they lessen their panic, it gives them back some of that sense of control, and that positivity begets more positivity.

Okay, Megan had asked, "Do you generally recommend doing sound therapy through hearing aids as a first step or after using other sound sources like the teenager's, you know, phone, headphones if that's unsuccessful?" So lovely question. I don't put people into hearing aids quickly. There's a lot of other devices that can be used to stream, you know, sound from your smartphone, between headphones, you know, or something else that's in their environment, like a speaker. That said, if we do need them to have constant, like 24/7, or you know, basically like all night long sound enhancement, then we do need to use a device that is comfortable enough to use for a good 12 to 14 hours a day. And hearing aids are actually a good option.

They don't have to be set in order to provide any boost to soft sound. But they do provide boost for, let me think about this one a little bit. Provide enhancement through the streaming. Kevin asked, "Is the goal of cognitive behavioral therapy to promote the habituation of how one reacts to the sensation of tinnitus?" Yes, flat out. That is the goal of CBT is to promote habituation. Habituation occurs because new networks that are of neurons that help a person, essentially it's like developing a new skill, it's like learning to play an instrument, it's like memorizing the rules of a game or getting really good at playing chess for instance. That is a skill that's developed and the way that our brain maps it is through a neural network.

Cognitive behavioral therapy to promote habituation of tinnitus is literally a skill that is developed in concert between a good therapist and the patient who are both engaged in helping to develop a skillset around the tinnitus being less threatening to them. And

when they do, the reaction lessons. Sarah noted that she likes Bose Sleepbuds for night. Yes, absolutely. I wholeheartedly agree with that one, about the Bose Sleepbuds. They're a little on the expensive side, and the Bose Sleepbuds app is a closed system, you can't just stream anything. The sounds that they have in their library are pretty good, but you can't really modify them other than just louder or softer. And so the one thing that I have against the Bose Sleepbuds is that it's not universal, you can't just stream like the ReSound Relief app, for instance.

I know that we're over time, but if there's anything else folks want to touch on or questions that they have, you know, please speak now, if not, I'm available, I'll just reach out to the AudiologyOnline and speech-language pathology online folks to pass questions along, and I'll get back to you.