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Pre-diabetes, diabetes and hearing issues

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Introduction

Diabetes mellitus (DM) is characterized by hyperglycemia resulting from anomalous insulin secretion and/or insulin action. DM's typical target organs include eyes, kidneys, heart and the inner ear. Although complications from diabetes mellitus (DM) are more well-known regarding eye health in general, and specifically diabetic retinopathy, glaucoma and cataracts, relatively little attention has been paid to diabetes and hearing health.

In 2024, the Centers for Disease Control (CDC)[1] reported 38.4 million people (11.6% of the U.S. population) had diabetes and an additional 97.6 million people (38% of the U.S. population) have pre-diabetes. For those ages 65 years and older, 49% have pre-diabetes.

The CDC (May 2024) states high and low blood sugar may damage the auditory nerves. They report people with diabetes have twice the rate of hearing loss found in people without diabetes and even people with "pre-diabetes" have a 1/3rd higher rate of hearing loss than do people who are not pre-diabetic. Das, Sumit, Ahsan et al[2] report people with DM have a higher rate of idiopathic sudden sensorineural hearing loss than those without DM.

The CDC reports that because hearing loss occurs very slowly over time, it is difficult for individuals to detect hearing changes.

However, there are signs, symptoms, and observations which may indicate hearing loss such as friends and family mentioning the possibility of hearing loss, asking people for repeats, difficulty understanding what others say (i.e., "I can hear but I cannot understand"), difficulty understanding speech in noisy locations such as restaurants, cocktail parties, family gatherings, perceiving that people mumble, turning the TV volume too loud, using closed-captions and more.

As proposed by Axelsson (1978),[3]the term diabetes-related hearing loss (DRHL) will be used to encapsulate the suspected damage from diabetes regarding hearing loss, listening difficulty, tinnitus and other auditory manifestations of diabetes.

Although controversial, extra high frequency hearing thresholds may indicate DRHL earlier than standard audiometric frequencies. Das, Sumit, Ahsan et al.[2] presented a binary logistic regression analysis indicating a 5-fold increase in the chances of an extra-high frequency hearing impairment in DM subjects and evidence that high frequency thresholds may serve as a sensitive marker for DRHL. Although an exact mechanism, or causation pathway, remains unclear for specific individuals, Deng, Chen and Hu[4] report DM threatens human health and the incidence of DM is increasing.

Multiple studies indicate DM damages blood vessels, spiral ganglion neurons, afferent nerve fibers, the organ of Corti, and may impact the stria vascularis through thickening of the basement membranes of the inner ear and multiple animal and human studies suggest the duration and severity of DM is associated with the incidence and severity of DRHL. Waissbluth & Delano[5] report Type 2 diabetes mellitus may cause hearing loss via microangiopathy, as well as neuropathy, and/or oxidative stress, and/or mitochondrial dysfunction, all of which may impact the cochlea as well as the auditory pathways.

Ears and eyes and diabetes

Deng, Chen and Hu (2023)[4] report that of all co-morbidities of DM, the hazard ratio (HR) with retinopathy was the highest.

Alizadeh (2022)[6] reported the degree of diabetic retinopathy (mild-to-moderate versus severe) was positively associated with the prevalence of hearing loss. As the degree of retinopathy became more severe, hearing loss became more common.

Al-Abed, Hakoom, Teimat et al[7] reported a cross-sectional analysis from 118 patients with diabetes mellitus type 2. Of those, 57% were male with an average age of 61 years old. 59% had hypertension. Approximately three-quarters (77%) of their subjects did not report hearing problems, 23% did report hearing problems and some 80% of the patients did not report difficulty comprehending speech. However their hearing assessments revealed only 29% had normal hearing, 41% had mild sensorineural hearing loss (SNHL), 23% had moderate SNHL, and 8% had severe SNHL.

Pre-diabetes and diabetes hearing assessment recommendation

Although the American Diabetes Association Standards of Care (ADA, 2025)[8] laudably recommends "screening people with diabetes for hearing disability at the initial diabetes related visit…" the term "screening" is clinically problematic.

The definition of "hearing screening" varies across professionals and organizations. As such, when addressing the auditory abilities, biomarkers and needs of people with DM, it is important to request a comprehensive audiometric evaluation with speech-in-noise assessment and extended high frequencies and a communication and listening assessment.

This author (DLB)[9] does not recommend a "hearing screening" when frank diagnostic information is sought. Beck (2022) reported difficulty hearing in noise often drives older adults to seek help, but most hearing screenings assess loudness thresholds for a few pure tones only, which are almost always inconclusive.

In the last 75 years audiology has progressed beyond simple threshold-based pure-tone screenings. Multiple measures such as complete loudness thresholds across the human hearing spectrum (20 to 20,000Hz), word recognition in quiet, word recognition in noise, listening and communication self-assessments, otoacoustic emissions, tympanograms, ipsilateral and contralateral acoustic reflexes and more, are needed for a fully informed audiologic diagnosis and treatment plan. Simply assessing a few pure tones is not informative enough to diagnose or treat and is not recommended.

In popular discourse, "hearing" and "listening" are used as synonyms. They are not synonyms. Hearing is perceiving or detecting sound, listening is comprehending sound or applying meaning to sound.

Unfortunately, the term "hearing screening" is ill-defined and ambiguous and often does not include specific assessments such as extended high frequency testing, speech-in-noise assessment, otoacoustic emissions, acoustic reflexes, etc., which may indicate auditory anomalies which are easily diagnosed and treated, but are not part of a "hearing screening." Unfortunately, as is true in most medical disciplines, we cannot find what we do not look for. In general, and especially for people with pre-diabetes, diabetes, and other symptomatic people, hearing screenings may unintentionally squander time and resources and offer, by definition, incomplete information leading to an often incomplete or incorrect (i.e., less informed) diagnosis and treatment plan.

Threshold-based screenings provide only a partial overview of the patient's auditory system and may fail to reveal the primary underlying problem. As an analogy, imagine simply acquiring the blood pressure of a patient with cardiovascular disease to determine if they need a coronary artery bypass.

Importantly and problematic for those undergoing a "hearing screening" is that hearing clarity and speech-in-noise ability are not measured via hearing screenings and hearing screenings do not measure hearing above 8000 Hz, which is where the most probable early auditory damage from DRHL is likely to occur.

Complicating the situation is a tendency for people not to notice mild-to-moderate hearing loss as they age. Similar to Al-Abed, Hakoom, Teimat et al reported above, Sukarai[7,10] reported 696 older adults and found two-thirds of them had mild hearing loss and a fifth had moderate hearing loss. None of them knew they had hearing loss and none of them recognized degradation of their hearing ability. Beck & Danhauer (2019) reported 26 million people with normal/typical thresholds from 250 to 8000 Hz (USA) who report hearing difficulty and difficulty understanding speech in noise. Papesh, Fowler et al (2023) reported similar findings (23 million veterans) regarding Functional Hearing Impairment. As reported (above) many people are unaware of their hearing loss and many people pass hearing screenings despite hearing and listening problems. Hearing loss generally occurs slowly and is often not noticed, and hearing screenings are simply not sensitive enough to be used or recommended for these purposes.

Discussion

Clearly people with diabetes and pre-diabetes are at increased risk for auditory problems, however, the exact mechanism is not yet clear. Although well intentioned "hearing screenings" have been previously recommended, this author (DLB) contends that hearing screenings are not sensitive enough and are not likely to demonstrate the often-present and often-missed auditory problems associated with diabetes and pre-diabetes. However, these same signs and symptoms would almost certainly be detected via a comprehensive audiometric assessment inclusive of extended high frequencies, otoacoustic emissions, ipsi and contralateral acoustic reflexes, speech-in-noise assessment, communication and listening assessment, all of which are based on well-established Best Practice protocols from the American Academy of Audiology, the American Speech Language Hearing Association and the International Hearing Society.

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Conflicts of interest

Dr Beck is Senior Director of Audiology at Essilor Luxottica Inc, manufacturer of Nuance Audio Glasses and other hearing and vision products.

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