

Hearing impairment – an under-recognized complication of diabetes?

Kathleen Bainbridge

Diabetes-related sensorineural hearing impairment affects people's ability to hear and understand sounds. Although evidence from as early as the mid-19th century linked diabetes with hearing loss, a degree of controversy has surrounded this association. However, recent research findings suggest that impaired hearing is not only very common among older and middle-aged people with diabetes but affects young people with diabetes to a greater degree than those without the condition. Kathleen Bainbridge looks at research carried out in this field to date and makes a call for further attention to be given this under-recognized diabetes complication.

A relationship between diabetes and hearing impairment was first suggested in 1857 in a person who was in the early stages of diabetic coma.¹ However, conflicting scientific evidence has prevented this relationship from gaining much attention among research scientists and has not been accepted generally among diabetes healthcare providers.

While a number of small, clinical studies have provided limited evidence to support an association, epidemiological evidence from large-scale, population-based research, such as the Framingham Cohort Study and the Hispanic Health and Nutrition Examination Study, both carried out in the USA, did not confirm an effect of diabetes on hearing.^{2,3}

Only the Epidemiology of Hearing Loss Study, a community-based investigation, also conducted in the USA, detected a 40% increased rate of impaired hearing among adults with diabetes compared to people without the condition.⁴ Other studies to identify such a link were conducted in industrial and military settings, and could not rule out that the effect of



Although they have apparently normal hearing, people with type 1 diabetes may have undetected cochlear dysfunction.

diabetes was limited to people who were already predisposed to hearing loss due to an exposure to noise.^{5,6}

“**Hearing loss is more common in people with diabetes than among people without the condition.**”

Recent evidence

Recently, a large epidemiological investigation demonstrated that hearing impairment is more common in people with diabetes than among people without the condition.⁷ This analysis was conducted using audiometric data (measurements of range and

sensitivity of hearing) that were collected as part of the National Health and Nutrition Examination Study (NHANES), a national health survey that provided a representative sample of people aged between 20 and 69 years living in the USA. The study evaluated hearing impairment at two ranges of frequency, two levels of severity, and impairment in people’s worse ear and better ear.

Damage at a range of frequencies

The authors concluded that 68% of people with diabetes had some high-frequency hearing impairment, compared to 31% of people without diabetes. This finding is consistent with

the belief that diabetes tends to affect hearing in the higher frequencies. However, the researchers also documented that 28% of people with diabetes had some hearing impairment in the low and middle frequencies, compared to 9% of those without diabetes – a two- to three-fold-increased occurrence of hearing impairment (even after statistically adjusting for the effects of age, race, sex, education, and poverty level).

Additional analyses indicated that the greater occurrence of hearing impairment is not limited to those who may be predisposed to the condition – smokers, people who reported

leisure-time or occupational noise exposure, and those who were taking medications that are known to affect hearing levels.

Hearing loss in younger people

Further analyses demonstrated a stronger link between diabetes and hearing impairment in younger people than in older people. This might explain why previous population-based studies that recruited older people demonstrated either null findings, as was the case for the Framingham study, or only a moderate association, as in the Epidemiology of Hearing Loss Study. With a variety of competing causes that accumulate over a lifetime contributing to age-related hearing impairment, detecting an association with diabetes may be more difficult among older people.

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Blood glucose levels

Fortunately, fasting blood glucose values were available for a random group of participants in NHANES. The authors noted a graded prevalence in hearing impairment according to blood glucose status: a greater proportion of people with impaired fasting glucose had hearing loss than did those whose fasting blood glucose was normal. Also, a greater proportion of people with diabetes had impaired hearing than did those with impaired fasting glucose. From these observations, we might hypothesize

that blood glucose levels play a role in the causal pathway to diabetes-related hearing impairment.

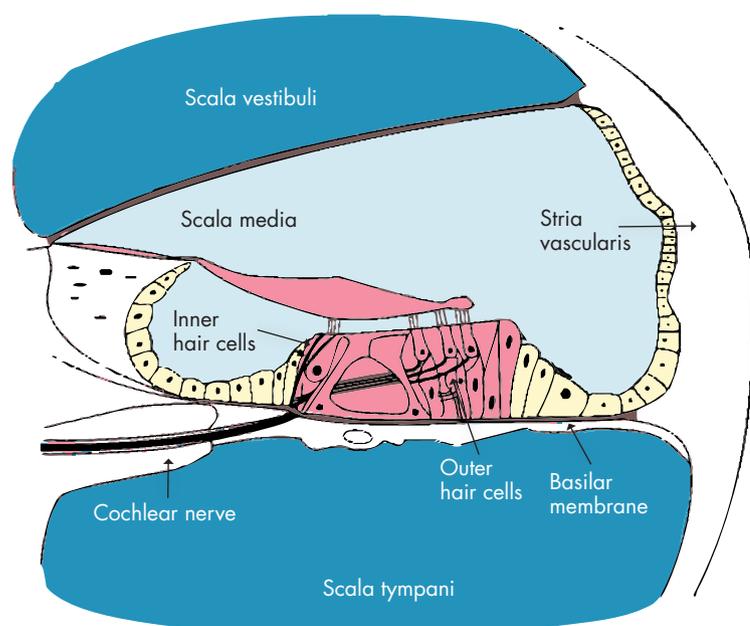
Pathophysiological explanation

The pathophysiological explanation for diabetes-related hearing loss is still speculative. The origins of a range of diabetes complications, including retinopathy, kidney disease, and peripheral arterial disease, lie in the body's blood vessels. Neuropathic complications affect the function of the peripheral nerves, as well as the autonomic control of people's heart rate, vascular dynamics, digestion, peristalsis, and bladder function. The pathological changes that accompany diabetes could cause injury to the blood vessels or the neural system of the inner ear, resulting in sensorineural hearing impairment.

Determining the actual damage that is responsible for diabetes-related hearing impairment is made more difficult because we cannot see the cochlea – the structure inside the inner ear which is responsible for the transfer of sounds (auditory stimuli), via the cochlear nerve, to the auditory cortex of the brain. Recent developments in the measurement of the sounds that are generated from within the inner ear (otoacoustic emissions) do, however, allow us to evaluate the outer hair cells inside the cochlea.

Lower otoacoustic emissions in response to auditory stimuli in people with type 1 diabetes of long duration (an average of 18 years) indicate undetected cochlear dysfunction – although these people appear to have normal hearing.⁸ Microscopic evidence of vascular or neurological

Cross-section of the cochlea



involvement (obtained post-mortem) includes sclerosis of the internal auditory artery, thicker vessel walls of the stria vascularis and of the basilar membrane, damage to the outer sheath (demyelination) of the cochlear nerve, and atrophy of the spiral ganglion (linking the cochlear nerve and the brain).⁹ The loss of outer hair cells has also been observed in both people with type 1 diabetes and people with type 2 diabetes.

“**Epidemiological evidence of an association between diabetes and hearing impairment is just emerging.**”

Need for more research

Epidemiological evidence of an association between diabetes and hearing impairment is just emerging and needs to be confirmed in other well-designed population-based studies. Most evidence has arisen from cross-sectional analyses where the ascertainment of diabetes and hearing impairment has been done at the same point in time. Prospective studies designed to test whether hearing impairment has an earlier onset among people with diabetes than among people without diabetes would establish any temporal relationship, and advance the argument that diabetes precedes and contributes to the hearing impairment.

Examining whether hearing impairment is correlated with other diabetes complications, such as kidney disease, retinopathy and/or neuropathy, may suggest a greater likelihood of either vascular or neurological causes. Demonstrating

whether other characteristics of diabetes (such as the type of diabetes and its duration, and levels of blood glucose control) are related to the prevalence or severity of hearing impairment would suggest certain groups of people with diabetes who may be most at risk for hearing impairment.

“**Given the high proportions of hearing loss in people with diabetes, healthcare providers might consider referring for audiometric testing.**”

Possible clinical recommendations

Scientific evidence is emerging to suggest that impaired hearing is very common among people with diabetes. The US data suggest that among people with diabetes between the ages of 50 and 69 years, over 70% have high-frequency hearing impairment and a third have low- to mid-frequency hearing impairment. With such high proportions of hearing impairment, healthcare providers might consider providing referrals for audiometric testing. People with damaged hearing might benefit from hearing aids.

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