**The Vestibular System and it’s Roles in Balance**

Mentions and Tips:

* What is the leading cause of preventable injury-related deaths in public places in the United States *(Graph)*
	+ SOURCE: <https://injuryfacts.nsc.org/home-and-community/deaths-in-public-places/introduction/>
* By 2030, the CDC projects…. *(Report paper – stat)*
	+ SOURCE: <https://khn.org/news/more-seniors-are-dying-in-falls-doctors-could-do-more-to-reduce-the-risk/>
* Fall Death Rates in the U.S…. *(Chart)*
	+ One out of five falls causes a serious injury such as broken bones or a head injury,4,5
	+ Each year, 3 million older people are treated in emergency departments for fall injuries.6
	+ Over 800,000 patients a year are hospitalized because of a fall injury, most often because of a head injury or hip fracture.6
	+ One out of five falls causes a serious injury such as broken bones or a head injury,4,5
	+ Each year, 3 million older people are treated in emergency departments for fall injuries.6
	+ Over 800,000 patients a year are hospitalized because of a fall injury, most often because of a head injury or hip fracture.6
		- SOURCE: <https://www.cdc.gov/falls/facts.html>

**Balance and Falls in the Older Adult**

By Charlotte Shupert, PhD, with contributions by Fay Horak, PhD, PT

Oregon Health & Science University, Portland, Oregon

One of the leading health concerns for people over the age of 60 is falling, which is often related to balance problems. Each year millions of adults fall and one in five of those falls leads to serious injury (CDC). 1,2 One of three adults 65 or older fall, but only 50% tell their doctor. The percent of people falling increases from 40% to 65% to 82% with each decade after age 65 years.

The consequences of falls can be substantial; between 12% and 67% of elderly adults who fracture a hip die within one year. Even if a bone is not fractured during a fall, falls cause pain and injury while reducing future mobility and quality of life. As a result, major scientific efforts are devoted to determining the causes of falling in older adults in an attempt to reduce this significant health hazard.

CAUSES OF IMBALANCE IN OLDER PEOPLE

Balance in walking and standing is dependent on many factors. Good balance requires reliable sensory input from the vision, vestibular system (the balance system of the inner ear), and proprioceptors (sensors of position and movement in the feet and legs). The elderly are prone to a variety of diseases that affect these systems, including: cataracts, glaucoma, diabetic retinopathy, and macular degeneration, which affect vision; peripheral neuropathy, which impairs proprioception in the feet and legs; and degeneration of the vestibular system.

Balance is also dependent on muscle strength, joint mobility, and healthy feet. A sedentary lifestyle, painful arthritis or diseases of bones and muscles can compromise strength, mobility, and the base of foot support.

Balance control also depends on healthy function across many brain areas. The brain needs to process and interpret sensory information, select appropriate balance strategies, and adapt and learn new strategies with practice. As we age, brain processing can slow down, which results in slower balance responses. People with cognitive problems also have balance problems, showing the importance of higher-level brain processing in balance control.

Because balance is a complex function, there is often no single identifiable cause of falls in an older person. However, older people with chronic dizziness or imbalance are two to three times more likely to fall in comparison with older people who do not experience these problems. 1 Experiencing a previous fall in the last year is the highest risk factor for a future fall.

DIZZINESS

Symptoms of a sense of lightheadedness or disorientation (dizziness) and/or a mild to violent spinning sensation (vertigo) can have a variety of causes: vestibular (inner ear) disorders, central nervous system disorders (such as stroke), cardiovascular problems (including low or high blood pressure), low blood sugar, infection, hyper-ventilation associated with anxiety attacks, medication side effects or interactions between drugs, or an inadequate or poorly balanced diet. Dizziness, or an abnormal sense of spatial orientation, should not be confused with disequilibrium or a sense of imbalance or unsteadiness. A thorough evaluation by a physician is usually necessary to help sort out these different possible causes of dizziness to arrive at a correct diagnosis. This task can be even more complicated when multiple problems are present. In such cases, the trouble in any one system may not be severe, but the combined effects may be enough to cause a serious problem with balance. For example, an elderly individual with age-related, mild degeneration in vestibular function may not complain of dizziness until they develop postural hypotension, or light- headiness when quickly moving from sitting to standing due to a new medication, low blood pressure or a cardiovascular problem. In fact, slow, age-related loss of vestibular function is usually not associated with dizziness, although it is associated with imbalance and falls. However, peripheral neuropathy resulting in poor positional sense in the feet and legs results in more severe balance problems and falls than vestibular problems, although a combination of both vestibular and proprioceptive deficits can have an even more profound effect on balance control.

THE AGING VESTIBULAR SYSTEM

Most people are familiar with the problems associated with the aging of senses such as vision and hearing. However, the vestibular system is another sensory system that gradually begins to lose function with age, potentially contributing to imbalance and falls. (See VeDA’s article titled Vestibular Function in the Older Adult for more information.) PRECAUTIONS Although the problem of imbalance in older persons can be complex, there are a few simple precautions that everyone can follow to help ensure an active old age. Balance in standing and walking is a skill that older adults can learn to maintain and/ or improve, and it is dependent on good general physical condition. Therefore, sound nutrition and health habits—including regular exercise, such as walking, strength training and participating in Tai Chi—can go a

BALANCE AND FALLS

In older people, a regular physical examination by a doctor familiar with the problems of aging, such as a geriatrician, can help identify and correct potential problems before a serious fall. Having a physician and pharmacist work to minimize the number of medications an older person is taking can help reduce potential side-effects and interactions causing dizziness and imbalance, and has been shown to reduce falls. Taking good care of the feet by wearing good shoes (see VeDA’s article on proper footwear) and maintaining healthy nails and skin is particularly important for good balance. In addition, making sure that the older person’s environment is safe (with good lighting, secure footing, clear walkways, handrails and anti-skid devices in bathrooms, etc.) can help prevent falls and their attendant injuries. A tendency to fall and symptoms of dizziness should never be dismissed as unavoidable consequences of aging but may be important signs of a condition that might be cured or controlled. The elderly have a higher risk of contracting many different kinds of diseases. As a result, the average older person is more likely to have a disease that interferes with balance than a younger person. The vestibular system should be ruled out as a source of these symptoms. The ability to move about freely is an important.

**FALL RISK FACTORS**

Risk Factors for Falls Risk\*

Fell in past year 5X

Weakness 4.4

Peripheral Neuropathy 3.0

Balance 2.9

Slow Gait 2.9

Cane 2.6

Vision Problems 2.5

Arthritis 2.4

ADL Deficit 2.3

Depression 2.2

Cognitive decline 1.8

Ages >80 1.7

> 5 medications 1.7

*\*Indicates the likeliness of falling, e.g. “5 times more likely.”*

SOURCE: <https://pubmed.ncbi.nlm.nih.gov/19358459/>

**Damage to inner ear system predicts fall risk among people with Alzheimer's disease**

MARCH 10, 2022

by Johns Hopkins University School of Medicine

Credit: Pixabay/CC0 Public Domain

A Johns Hopkins Medicine study of about 50 people with Alzheimer's disease has added to evidence that damage to the inner ear system that controls balance is a major factor in patients' well-documented higher risk of falling.

Overall, the researchers say, their study found that impairment of the vestibular system was linked to a 50% increase in the risk of falling for patients with Alzheimer's compared with patients who have Alzheimer's and normal vestibular function.

The study, published Feb. 14 in the Journal of Alzheimer's Disease, is believed to be one of the first to demonstrate the vestibular system as an important contributor to loss of balance and fall risk among the Alzheimer's population. Alzheimer's is a progressive neurological disease that destroys memory and other important mental functions. There is no cure, and although medications and management strategies can temporarily improve symptoms, falls contribute to substantial disability in patients, the investigators say.

"Falls are a major problem in people with Alzheimer's disease, who fall at twice the rate compared with healthy older adults, and this often leads to injury, nursing home placement and early mortality," says senior author Yuri Agrawal, M.D., professor of otolaryngology–head and neck surgery at the Johns Hopkins Medicine University School of Medicine. The new study, she says, was designed to better understand the root causes of the high fall rate and identify specific interventions to reduce it.

For the study, the research team recruited 48 people diagnosed with mild or moderate Alzheimer's who were seen at the Johns Hopkins Memory and Alzheimer's Treatment Center and the Johns Hopkins Alzheimer's Disease Research Center between March 2018 and January 2020. The mean age of participants was 65, and 27 were male. The team examined the link between vestibular impairment and falls in the patient cohort over a two-year period.

Impairment of the vestibular system, which consists of a group of canals and bony structures deep in the inner ear, is a common cause of dizziness, vertigo and balance issues, even in generally healthy people. Impairment causes these issues with higher frequency in older populations, so focusing on this system as a source of risk in patients with Alzheimer's made sense, investigators note.

Specifically, the researchers used devices that can track responses to eye and head movement to stimulate and mirror vestibular function. Subjects who had vestibular function impairment on these tests over time were 50% more likely to fall compared with individuals with normal vestibular function. Agrawal says that loss of vestibular function leads to an increased sway, causing unstable balance which in turn leads to more falls.

"We call the vestibular system the sixth hidden sense because it functions almost at a subconscious level. It's always 'on' and operates normally to keep us oriented as we move through space, sensing what's up and what's down and around us," Agrawal says. "The system automatically feeds that information to the brain as other sensory organs such as the eyes or ears do. But unlike closing one's eyes or plugging one's ears, people cannot willfully control it. So, when its impaired, people experience vertigo, a disorienting, inability to navigate the world."

Agrawal says most Alzheimer's research has understandably focused on reducing or preventing memory loss and other cognitive impairment, but suggests that additional attention to the vestibular system has the potential to improve the quality of life of people with Alzheimer's.

"Vestibular impairment is treatable with balance exercises performed under the care of a physical therapist," she says. "That could enhance the quality of life for both patients and caregivers."

The research team says a clinical trial is already underway to assess the value of vestibular therapy in preventing falls in Alzheimer's patients.

According to the Alzheimer's Association, more than six million people in the United States live with the disease, which is the sixth leading cause of death in the U.S.

SOURCE: <https://medicalxpress.com/news/2022-03-ear-fall-people-alzheimer-disease.html>

**What is Tinnitus?**

Demographics

Millions of Americans experience tinnitus. While anyone can develop tinnitus, some populations have a higher risk of exposure due to age, occupational hazards, and/or recreational activities. Manage Your Tinnitus

Discover the proven tools and therapies that can minimize the burden of your tinnitus and improve your quality of life.

Learn More

Over 45 million Americans struggle with tinnitus, making it one of the most common health conditions in the United States.

Each year, the U.S. Centers for Disease Control conducts its National Health and Nutritional Examinations Survey, a longitudinal study of the health of the American population. In the 2011-2012 Survey (the most recent year from which data is available) the CDC included several questions on tinnitus, to ascertain the full scope and severity of the condition on a population level. The survey discovered:

15% of all survey respondents experienced some form of tinnitus

67% of people reporting tinnitus had regular symptoms for over a year

26% of people reporting tinnitus had constant or near constant tinnitus

30% of people reporting tinnitus classified their condition as a “moderate” to “very big” problem in their life

Extrapolating these findings to the national population suggests that nearly 20 million people are dealing with burdensome tinnitus on a regular basis; and approximately 2 million people are struggling with severe, sometimes debilitating, tinnitus.

Demographic Trends with Tinnitus

Tinnitus is primarily caused by environmental and behavioral factors, with noise exposure and hearing loss being the main catalysts for the condition. There are very few known genetic-based catalysts for tinnitus. However, for a variety of reasons, certain demographic groups appear to be more susceptible to both acute and chronic tinnitus on the population level.

The following data is derived from Shargorodsky, Curhan, and Farwell’s 2010 analysis, Characteristics of Tinnitus among U.S. Adults, originally published in the American Journal of Medicine.

Males get tinnitus more often than females

This disparity may be attributable to males being more represented in the workforce, particularly in loud professions such as manufacturing, construction, and military service. Men are also more likely to participate in high hearing-risk behavior, such as hunting and motorsports.

Tinnitus is more common in older populations

The prevalence of tinnitus grows as people get older, peaking for the age 60-69 cohort. The increase is probably due to both age-related hearing loss and accumulative noise-induced hearing loss. It is unclear why incidents of tinnitus appear to decrease in cohorts older than 69.

Caucasians are more likely to have tinnitus

For an unknown reason, white, non-hispanics report a higher prevalence of tinnitus than other racial and ethnic groups.

High-Risk Groups

While anyone, at any time, can develop tinnitus, there are some groups that are more vulnerable to acquiring the condition. Below are some of the groups that are at particular risk of developing tinnitus.

Senior Citizens

The primary catalyst of tinnitus is hearing loss, and age-related hearing loss tends to accelerate after the age of 60. As such, seniors are particularly prone to developing tinnitus as they age. Research suggests that roughly 30% of seniors experience tinnitus symptoms.

Active Military Personnel and Veterans

Tinnitus is a huge (and growing) problem for America's military personnel. Exposure to gunfire, explosives and loud machinery puts active military personnel at a high risk of noise-induced hearing loss and subsequent tinnitus. The consequences of in-duty noise exposure can last a lifetime. Tinnitus is the leading service-related disability among U.S. veterans, with 9.7% of all vets receiving service-related disability compensation for the condition in 2012.

People Employed in Loud Workplace Environments

For nearly 30 years, noise-induced hearing loss has been one of the most prevalent occupational health problems in the United States. Workers involved in agriculture, mining, construction, manufacturing, and transportation are particularly at-risk because of their loud work environments; but tinnitus can be a significant problem in almost any workplace. By some estimates, more than 125,000 workers have suffered permanent hearing loss since 2004.

Musicians and Music Lovers

Professional musicians, who spend their working life playing loud, amplified music are in particular danger of developing tinnitus. (Many famous musicians acknowledge they have the condition.) Music enthusiasts are also in jeopardy, as listening to loud music, whether at live concerts or via recording, can contribute to noise induced hearing loss.

Motorsports and Hunting Enthusiasts

Proximity and repeated exposure to loud engines and firearms make these activities particularly risky for future development of tinnitus symptoms.

People with a Prior Behavioral Health Issues

Patients with a history of depression, anxiety, and obsessive-compulsive disorder may be particularly prone to experiencing burdensome tinnitus. While these behavioral health issues do not cause tinnitus, per se, they do exacerbate symptoms.

SOURCE: <https://www.ata.org/understanding-facts/demographics>

**What is Ménière’s?**

Ménière’s disease is another vestibular disorder that causes dizziness. Ménière’s disease produces a recurring set of symptoms as a result of abnormally large amounts of a fluid called endolymph collecting in the inner ear. These symptoms typically include spontaneous, violent vertigo, fluctuating hearing loss, ear fullness, and/or tinnitus. The incidence of Ménière’s disease (number of new cases per year) is difficult to assess. Estimates vary widely, in part because of the variability in diagnostic criteria across studies. The prevalence, however (all cases within a population), is generally known to increase with age.

SOURCE: <https://vestibular.org/sites/default/files/page_files/Balance%20and%20Aging.pdf>

**What is Vertigo?**

What is vertigo?

Vertigo is a sensation that the environment around you is spinning in circles. It can make you feel dizzy and off-balance. Vertigo isn’t a disease. Rather, it’s a symptom of varying conditions.

Are there different types of vertigo?

There are two main types of vertigo:

*Peripheral vertigo:* This happens when there’s a problem with the inner ear.

*Central vertigo:* This occurs when there’s an issue with the brain. Causes can include infection, brain tumors, traumatic brain injury or stroke.

What should I know about vertigo vs dizziness?

While both dizziness and vertigo are considered balance problems, the two symptoms are different. Dizziness is an overall feeling of being unbalanced. With vertigo, you have a sensation that you’re moving or that your surroundings are spinning.

Who does vertigo affect?

Vertigo attacks can happen at any age, but they’re more common in people over 65. Women are somewhat more likely to experience vertigo than men. Some people experience vertigo as a side effect of pregnancy.

How common is vertigo?

Vertigo is a common issue. Nearly 40% of Americans experience vertigo at least once during their lifetime.

How long does vertigo last?

On average, vertigo attacks last several seconds to several minutes. In severe cases, however, people can experience vertigo for hours, days, weeks or even months.

What does vertigo feel like?

Many people compare vertigo to motion sickness. It can make you feel like you’re spinning, rocking or tilting. Feelings of unbalance may worsen when you stand, walk, change positions or move your head.

Is vertigo a serious condition?

Vertigo can be scary but the condition itself isn’t considered serious. However, vertigo can be linked to other potentially serious health conditions. That’s why you should inform your healthcare provider if you experience recurrent or prolonged vertigo attacks.

**SYMPTOMS AND CAUSES**

Is vertigo hereditary?

While vertigo isn’t hereditary, it can be a symptom of a range of conditions — some of which run in families. Therefore, frequent vertigo attacks could involve genetic factors.

*What can trigger vertigo?*

A number of syndromes or conditions can result in vertigo.

These include:

Benign paroxysmal positional vertigo (BPPV): The most common cause of vertigo, BPPV is typically triggered by changed in your head’s position. People with BPPV often experience vertigo when lying down, sitting up or turning over in bed.

Meniere’s disease: This condition causes fluids to build up inside the ear, leading to vertigo attacks. Meniere’s disease may also be accompanied by tinnitus (ringing in the ears), fluctuating hearing loss or a feeling a fullness in the ears.

Labyrinthitis: If the inner ear labyrinth becomes inflamed or infected, it’s called labyrinthitis. The ear labyrinth houses the vestibulocochlear nerve, which transmits information to the brain regarding sound, position and head motion. People with labyrinthitis often experience headaches, ear pain, vision changes, tinnitus or hearing loss.

Vestibular neuritis: This inflammation of the vestibular nerve can cause vertigo. Vestibular neuritis is similar to labyrinthitis, but it doesn’t alter your hearing. People with this condition may experience vertigo and nausea or blurred vision.

Cholesteatoma: Repeated ear infections can cause a noncancerous skin growth to develop in the middle ear. This condition is referred to as cholesteatoma, and it can lead to dizziness, vertigo and hearing loss.

What else causes vertigo?

There are other factors that can lead to vertigo attacks. Here are some common vertigo causes:

Migraine headaches.

Certain medications.

Stroke.

Arrhythmia.

Diabetes.

Head injuries.

Prolonged bed rest.

Shingles in or near the ear.

Ear surgery.

Perilymphatic fistula (when inner ear fluid leaks into the middle ear).

Hyperventilation.

Low blood pressure (orthostatic hypotension) – a condition in which your blood pressure decreases when you stand up.

Ataxia, or muscle weakness.

Syphilis.

Otosclerosis (a bone growth problem affecting the middle ear).

Brain disease.

Multiple sclerosis (MS).

Acoustic neuroma.

What is migraine-associated vertigo?

Many people who have migraines also experience vertigo during episodes. Vertigo may occur before the onset of a headache, during a headache or — most commonly — during a headache-free period. It should be noted, though, that some people have vertigo as their main migraine symptom instead of a headache.

Can stress cause vertigo?

Stress itself doesn’t cause vertigo, but it can contribute to inner ear dysfunction. This can lead to vertigo attacks in some people. Approximately 5% of American adults experience vertigo when they’re anxious or stressed.

What are common vertigo symptoms?

As mentioned above, vertigo is a symptom of many different conditions. However, vertigo can also occur in combination with other symptoms, including:

Nausea and vomiting.

Balance problems.

Tinnitus.

Headaches.

Motion sickness.

A feeling of fullness in the ear.

Nystagmus, in which the eyes move side to side uncontrollably.

DIAGNOSIS AND TESTS

How is vertigo diagnosed?

Your healthcare provider will perform a physical examination and ask questions about your symptoms. They may also recommend one or more tests to confirm your diagnosis.

What tests will be done to diagnose vertigo?

Vertigo can be diagnosed with tests performed by your healthcare provider. These may include:

Fukuda-Unterberger’s test: You’ll be asked to march in place for 30 seconds with your eyes closed. If you rotate or lean to one side, it could mean that you have a problem with your inner ear labyrinth. This could result in vertigo.

Romberg’s test: For this assessment, you’ll be asked to close your eyes while standing with your feet together and your arms to your side. If you feel unbalanced or unsteady, it could mean that you have an issue with your central nervous system.

Head impulse test: For this test, your provider will gently move your head to each side while you focus on a stationary target (for example a spot on the wall or your provider’s nose). The clinician will be checking to see how the inner ear balance system is working to help control your eye movements while your head is in motion.

Vestibular test battery: This includes several different tests to help identify an inner ear problem. Goggles are placed over the eyes to monitor eye movement responses while moving your eyes to follow a target, moving your head and body, and even after warm and cool water are put into the ear canal.

In addition to the tests outlined above, your healthcare provider may request radiographs. These may include:

CT (computed tomography) scans.

Magnetic resonance imaging (MRI).

**MANAGEMENT AND TREATMENT**

Will vertigo go away on its own?

Vertigo goes away on its own in many cases. However, there are several treatments that can successfully manage vertigo.

What are common vertigo treatments?

The vertigo treatment that’s right for you depends on several factors, including the root cause. Some of the most notable vertigo treatments include:

Medication: Treating the underlying cause of your vertigo can help ease symptoms. For example, if vertigo is a byproduct of an infection, your healthcare provider can prescribe antibiotics. Steroids can help reduce inflammation. There are also medications to relieve other vertigo symptoms, such as nausea or motion sickness.

Vestibular rehabilitation: If vertigo is the result of an inner ear problem, this type of physical therapy may help reduce your symptoms. Vestibular rehabilitation helps strengthen your other senses so they can compensate for vertigo episodes.

Canalith repositioning procedure (CRP): If you have BPPV, canalith repositioning maneuvers help move calcium deposits into an inner ear chamber where they will be absorbed by your body.

Surgery: When vertigo is due to a serious underlying issue, such as a brain tumor or neck injury, surgery may be necessary.

Are there any home remedies for vertigo?

There isn’t enough evidence to prove that vertigo can be treated with alternative therapies. However, some people take herbal supplements to ease their symptoms. Popular herbal vertigo remedies include:

Turmeric.

Ginkgo biloba.

Cayenne.

Ginger root.

Gongjin-dan.

Be sure to talk to your healthcare provider before adding any herbal supplements to your diet. They can help you safely incorporate them into your regimen.

**PREVENTION**

How do I stop vertigo attacks?

*There are a few steps you can take to reduce your risk for vertigo. These include:*

Taking extra time to stand up, turn your head or perform other triggering movements.

Sleeping with your head elevated on two pillows.

Sitting down as soon as you feel dizzy.

Squatting instead of bending over when picking something up.

**LIVING WITH**

When should I see my healthcare provider?

If vertigo becomes severe or recurrent, it’s time to call your healthcare provider. There could be an underlying health condition that’s causing your symptoms.

**FREQUENTLY ASKED QUESTIONS**

Are vertigo and dizziness some of the symptoms of COVID-19?

Yes. COVID-19 can cause neurological symptoms, including dizziness and vertigo.

A note from Cleveland Clinic

Vertigo can come on suddenly without warning. Although vertigo attacks can feel scary, they go away quickly most of the time. If you’re experiencing severe or prolonged vertigo, your symptoms could be associated with another medical condition. Your healthcare provider can help you identify the root cause of your vertigo and determine personalized treatment options to help you get back to normal life.

Last reviewed by a Cleveland Clinic medical professional on 09/09/2021.

SOURCE: <https://my.clevelandclinic.org/health/diseases/21769-vertigo>