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Dizzy?
A Vestibular Rehabilitation Guide

THE VESTIBULAR SYSTEM: GIVING YOU A HEAD START IN YOUR "DIZZINESS" JOURNEY

Contents

Introduction

Are you feeling "Dizzy"?

Dizziness is a term used to describe a wide range of symptoms that may include feeling off balance, faint, woozy, foggy, light-headed, the sensation of spinning or moving (vertigo), feeling disconnected, disoriented, feeling visually "off", and the list can go on. Many individuals also find it difficult to describe the sensation they feel. It can be especially hard to explain something to someone when no one else can see it. This can even lead people to question whether they're feeling "dizzy" or just crazy! Well, this resource is here to tell you… you're NOT crazy, and help might be just around the corner.

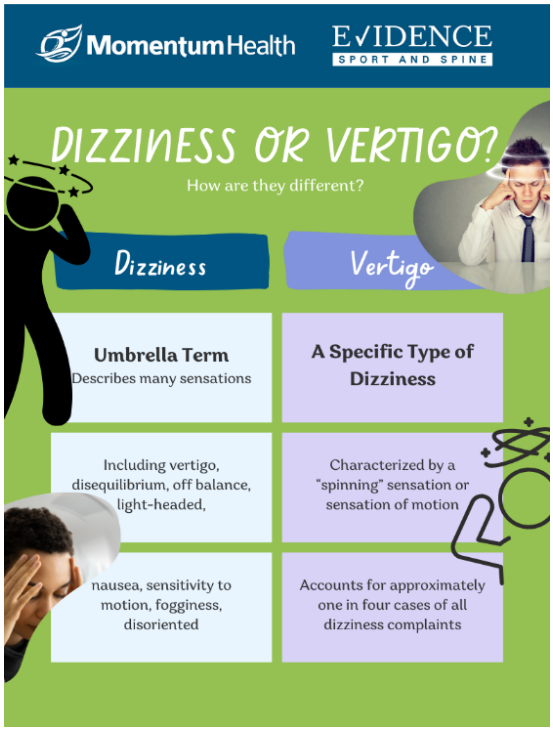
Let's start by answering a few quick questions to help get you on the right path.

Do you experience dizziness while laying down, rolling over in bed, looking up or down, quickly turning your head to check your surroundings, or navigating a grocery store? Are you often off-balance when you close your eyes, move too quickly, or even while standing still? How about a persistent feeling of unsteadiness or the sensation of swaying as you walk? If you answered yes to any of these questions, it's possible that you may be dealing with a *vestibular disorder.* It is important to always consult with your doctor first to rule out any potentially serious underlying conditions. However, if the root cause is related to the inner ear, Vestibular Rehabilitation could play a key role in your path to recovery.

Dizziness vs. Vertigo

Dizziness is a general term that is used to describe many sensations as mentioned above, which includes vertigo.

Vertigo is a specific type of dizziness that is characterized by a "spinning" sensation or sensation of motion, and accounts for approximately one in four cases of all dizziness complaints [1].



Does it matter how you describe your dizziness?

While it's still beneficial to think about and do your best to describe what it is you're feeling to your health care provider, *it does not have a lot of weight in figuring out a cause.* So, no need to stress on this part! You will be asked many other questions related to your symptoms that will help put the puzzle pieces together.

Who gets "Dizzy"?

Balance and dizziness problems may occur suddenly, without warning, or may result from trauma (e.g. car accident, falls), inner ear infections, medication, tumors, aging, brain-related issues, or other underlying medical conditions. These disorders can be triggered by movements or events that were previously not problematic and can be debilitating if left untreated.

In other words, the short response to the question "who gets dizzy?" is that anyone can!

Many patients visit multiple healthcare practitioners over months or even years before they receive an accurate diagnosis, delaying treatment and slowing recovery.

Being your own advocate is important!

Dizziness can be a complicated and frustrating symptom for both patients and healthcare providers. The challenge comes from the various ways people express it and the various causes. This can make diagnosing and deciding on the right medical management challenging. However, being well prepared with important information for your medical appointment not only speeds up the process, but also empowers you to be an effective advocate for your health. This E-book aims to provide you with a head start in doing just that.

Who should you see?

Although some vestibular disorders can be quickly diagnosed and sometimes treated by your doctor or other health care provider, some require the assessment and expertise from multiple health care professionals and specialists, including a physiotherapist with training and experience in vestibular conditions, called a vestibular therapist. A thorough *vestibular assessment by a skilled vestibular therapist can play an important role in figuring out a cause and guiding further referrals if needed.* You do not need a specific doctor referral to see a vestibular therapist, and appointments are generally available quickly, making this a great starting point. Working together with the right team of experts is essential for achieving the best possible recovery.

Why is it important to seek help sooner than later?

Fall risk!

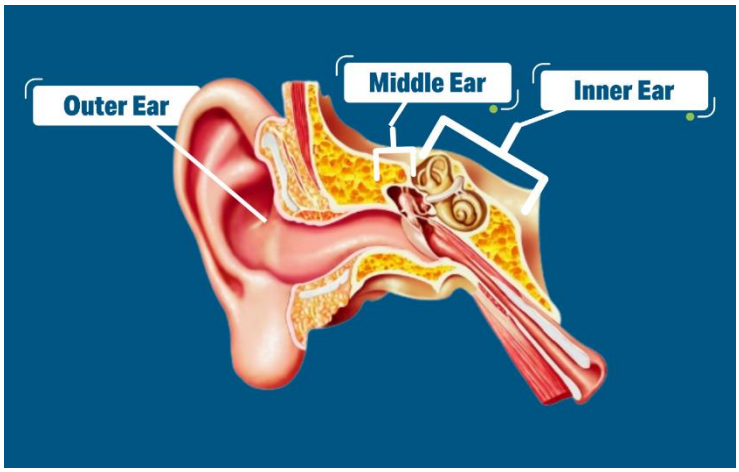
- People who are dizzy have an increased fall risk, particularly falls resulting in fractures and other injuries with associated disability and risk of death. [7]
- Adults with an inner-ear dysfunction are up to 12 times more likely to have a serious fall. [7,8]

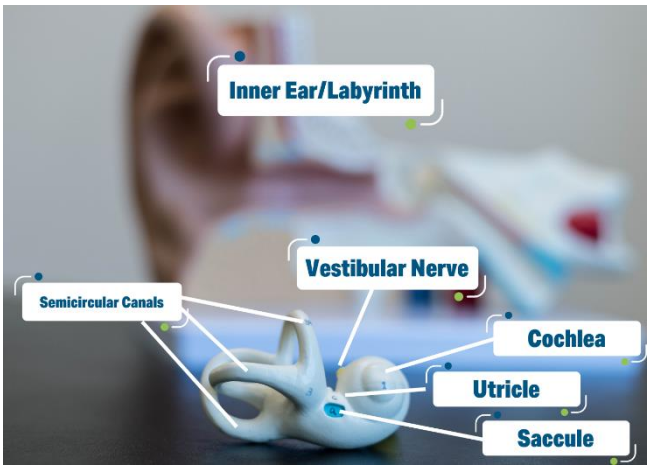
Quality of Life!

- An estimated 33% of all adults with chronic imbalance experience problems performing activities of daily living such as bathing, dressing and eating,[9] as well as the ability to participate in school, work, extra-curricular activities, social activities, and travel.
- Children with vestibular disorders can face impairments of motor development and balance and learning challenges at school. [9]
- Vestibular disorders are often linked to cognitive, emotional, and social stress and can leave a person feeling very isolated and alone in their suffering as well as lead to anxiety, depression, and/or an overall decline in mental health status.

Timing matters!

- Starting treatment early for a vestibular disorder can help reduce the risk of symptoms turning chronic and impacting your quality of life.
- Timely physiotherapy referrals may be beneficial in helping reduce the fall risk among adults with varying diagnosis of dizziness.
- A typical approach may be to avoid the things that trigger dizziness with a “learn to live with it mentality, however this may in fact slow recovery.





Chapter 1: Introduction to the Vestibular System

What is the "Vestibular System"?

The vestibular system includes parts of the inner ear and brain that help control balance and eye movement. It consists of a tiny membranous structure called the labyrinth that is encased in the temporal bone of the skull and is comprised of a complex network of 3 semi-circular canals filled with fluid, 2 otolithic organs called the utricle and saccule, and sensory cells that respond to changes in head movement and position. There is also a vestibular nerve that relays this information about head motion and position to the brain. The vestibular system connects the inner ear, the eyes, and the brain through one of the fastest reflexes in the human body called, the vestibular-ocular reflex (VOR). This VOR is considered one of the most important reflexes for everyday movements because it allows images observed in the world to remain clear and stable when the head is in motion. This is an important reflex to remember when we start talking about what can go wrong.

Let's look at an example of how this works.

- *Hold your thumb out in front of you or focus your eyes on a target in front of you. Now turn your head side to side just a small distance while keeping your eyes focused on that target. Now increase your speed and go as fast as you can without your target going blurry. Does the target stay clear? Do you feel dizzy?*

The image should stay clear, and it should not trigger any large amount of dizziness. This is the work of the vestibular-ocular reflex (VOR). When we move our head, our eye muscles are triggered instantly to create an eye movement opposite to that of our head movement and at the same speed to keep the image clear. For proper functioning, this signal needs to be the same on both sides, so the brain knows the information coming in is accurate.

Without the VOR, when walking down the street, it would be nearly impossible to read signs or even recognize faces and make it difficult to walk straight.

Chapter 2: What is a Vestibular Disorder?

A "Vestibular Disorder" is a condition that affects the vestibular system (parts of the inner ear and brain that help control balance and eye movement), and can result in a range of symptoms that may include, but not limited to:

- Vertigo
- Dizziness
- Imbalance
- Nausea
- Difficulty with coordination and vision
- Motion sensitivity
- Hearing loss and/or tinnitus (ringing in the ears)
- Clumsiness and frequent falls
- Brain fog
- Change in cognitive "sharpness"
- Feeling emotionally disconnected from people or surroundings

Someone can have a peripheral vestibular disorder (affecting parts of the inner ear), a central vestibular disorder (affecting parts of the brain), or just to make things more complicated, can have a combination of both. Vestibular disorders can result from or be worsened by injuries, genetic or environmental conditions, underlying neurological conditions, or occur for unknown reasons. Common causes include inner ear infections, head injuries, certain medications, and aging.

Chapter 3: How is a Vestibular Disorder Diagnosed?

There are more than 25 known vestibular disorders, and many of them share common symptoms and traits. Diagnosis therefore requires a combination of history taking, assessing symptoms and clinical presentation, and specific clinical tests.

It's important to know that vestibular disorders cannot be diagnosed by simply looking into the ear, because the inner ear is too deep to see. However, the eyes serve as a valuable window to the vestibular system due to the connection with the eyes, the inner ear and the brain. For example, **Nystagmus,** a rapid and involuntary eye movement, can be present with a range of conditions. The pattern of nystagmus observed can

play a critical role in diagnosing certain types of dizziness. For instance, the nystagmus from an inner ear problem that is not sensing motion well, will follow a specific pattern that is different from the nystagmus observed from a problem related to the central vestibular system involving the brain. Nystagmus can sometimes be observed in room light, but not always. The use of special equipment that can record this eye movement, called Video Frenzel Goggles, is critical in detecting certain conditions and improving diagnostic accuracy. These goggles are talked about in more detail in the next chapter.

Some vestibular disorders can be quickly diagnosed by your doctor or other health care provider, while some require the assessment and expertise from multiple health care professionals and specialists.

Chapter 4: Video Frenzel Goggles: What are they and how do they assist in diagnosis?

The video Frenzel Goggles use a high-resolution camera to record eye movements during tests. Worn by the patient, these goggles offer clinicians a magnified view of the eyes in a dark environment, allowing them to identify and analyze subtle eye movements like nystagmus. In well-lit conditions, the eyes can focus on a target and mask certain types of nystagmus. By blocking out vision with the goggles, clinicians can better observe nystagmus that my otherwise go unnoticed.

> *In summary, Video Frenzel goggles are a non-invasive and safe diagnostic tool that provide valuable information for the assessment and management of vestibular and balance disorders.*

A Vestibular Therapist or physiotherapist who utilizes the Video Frenzel Goggles can serve as a valuable starting point in determining if further tests or referrals, in collaboration with your medical doctor, are necessary.

Chapter 5: Is there treatment for a Vestibular Disorder?

The short answer is YES! In most cases

While damage to the vestibular system can be temporary or permanent, there are vestibular rehabilitation exercises that can teach your brain how to rely on other senses, such as vision and body sense, to compensate for any deficits. This means that symptoms and functional problems associated with vestibular disorders are not necessarily permanent and can be greatly diminished or even eliminated altogether. There is strong research that shows the brain can change with rehabilitation! This is called compensation.

So, what is Vestibular Rehabilitation?

Vestibular rehabilitation includes various exercises and techniques to help restore balance and alleviate symptoms. These exercises can involve moving your head and eyes, challenging your balance, and exercises that gradually expose you to movements or environments that trigger mild to moderate symptoms to desensitize your response. If your problem involves loose crystals, a condition called BPPV, then treatment may also involve a series of repositioning maneuvers and can often be resolved within several treatments with a physiotherapist.

In summary, the goal of vestibular rehabilitation is to help your brain fully compensate, to improve your ability to function in daily activities and reduce the risk of falls or other accidents.

A skilled vestibular therapist will begin with a thorough evaluation of your vestibular system to determine its functioning. Based on this assessment, they will develop a personalized treatment plan that considers the severity of your symptoms and your individual response to therapy. ***The research shows that an individualized plan is more effective than a general plan of exercises.*** This plan will specify the appropriate duration and frequency of treatment required to effectively address your condition and will be based on the underlying cause.

Chapter 6: A Vestibular Assessment: What to expect

A vestibular assessment typically lasts an hour. It always begins with your vestibular therapist asking you questions about your condition. This is followed with an examination that includes a series of clinical tests to look for signs of a vestibular disorder and screen for more serious conditions. For some of these tests, you will wear the Video Frenzel Goggles that block out the light for a few minutes. Here are a few tests that are typically included:

- *Balance and walking tests*
- *Evaluating eye movements and looking for nystagmus*
- *Head Impulse Test*
- *Dynamic Visual Acuity*
- *Positional tests* (Dix-hallpike and Roll test)

Additional tests:

These tests are not performed in a typical vestibular assessment and require special referrals. They may be considered depending on the patient's history and examination findings. These may include: hearing tests, laboratory tests, caloric testing, Video Head Impulse Test (vHIT), rotary chair or Vestibular evoked myogenic potentials (VEMPs).

Other tests may be done by your doctor or medical specialist such as blood work, heart rate and blood pressure monitoring, imaging such as CT or MRI scans and medication review.

What if all tests are normal?

When comprehensive vestibular testing is all normal, this too provides valuable information as it can then potentially rule out a primary vestibular disorder. Other conditions, including vestibular migraine, dizziness related to anxiety, dizziness from heart conditions or blood pressure/heart rate abnormalities, as well as conditions such as persistent postural perceptual dizziness often have normal results on vestibular assessments at the bedside and in the laboratory. In these cases, vestibular tests may assist the clinician in avoiding unnecessary management strategies or treatments (I.e. Vestibular-suppressant medication or vestibular rehabilitation for patients with no vestibular disturbance).

Summary of vestibular testing:

For individuals experiencing dizziness, beginning with a comprehensive vestibular assessment conducted by a trained therapist using Video Frenzel goggles can typically identify vestibular issues on one or both sides. The assessment can also screen for other problems not related to the vestibular system, that may require additional referrals. Laboratory vestibular tests are not included in the routine examinations conducted by vestibular therapists or medical doctors and are done in specialty clinics. However, they can be recommended as a referral if necessary and can enhance diagnostic accuracy in some cases.

Chapter 7: Common Vestibular Disorders

There are 25 known vestibular disorders. We will be focusing on the more common ones.

Benign Paroxysmal Positional Vertigo (BPPV)

BPPV is the most common vestibular disorder, characterized by brief episodes of vertigo triggered by changes in head position. It occurs when tiny calcium crystals in the inner ear become dislodged and disrupt the normal fluid flow in the semicircular canals, sending incorrect signals to the brain. Symptoms include spinning sensations when moving the head, especially when lying down, rolling over, or bending over. Diagnosis involves a physical examination and specific maneuvers like the Dix-Hallpike test, which can provoke vertigo and nystagmus (rapid eye movement). BPPV is treatable through a series of head-positioning maneuvers, such as the Epley maneuver, which helps move the crystals back into their proper position. While BPPV can resolve on its own, treatment can be life-changing for those affected, although recurrence rates are high.

Vestibular Neuritis

Vestibular Neuritis is caused by inflammation of the vestibular nerve, disrupting balance and spatial orientation. This leads to

vertigo, dizziness, nausea, and difficulty walking. Symptoms can last from hours to days, with lingering effects potentially persisting for weeks or months. The condition is often linked to viral infections but can also result from bacterial infections, head injury, or certain medications. Diagnosis is based on the patient's history, physical exam, and sometimes specialized equipment like Video Frenzel Goggles. Treatment involves vestibular rehabilitation exercises to help the brain compensate for the balance deficit, with medication used to manage acute symptoms.

Labyrinthitis

Labyrinthitis is an inflammation of the labyrinth in the inner ear, affecting both balance and hearing. It shares similarities with Vestibular Neuritis but is distinguished by symptoms like hearing loss, tinnitus, and a feeling of fullness in the ear. Labyrinthitis can be caused by infections, head trauma, or other factors. Treatment is similar to that of Vestibular Neuritis, focusing on managing symptoms and promoting recovery through rehabilitation exercises.

Vestibular Migraines (VM)

Vestibular Migraines are episodes of dizziness or balance issues linked to migraines. They are the most common cause of episodic vertigo in adults and children. Symptoms include spontaneous dizziness, motion intolerance, and sensitivity to light and noise, among others. VM is underdiagnosed, and its exact cause is unclear but is believed to be related to changes in blood flow and nerve activity in the brain. Diagnosis involves a specialist familiar with the condition, and treatment focuses on managing triggers, lifestyle changes, and vestibular rehabilitation for lingering symptoms.

Meniere's Disease (MD)

Meniere's Disease is a progressive condition affecting the inner ear, leading to sudden attacks of vertigo, tinnitus, hearing loss, and a feeling of pressure in the ear. The cause is thought to be related to an abnormal buildup of fluid in the inner ear. Diagnosis is challenging due to the lack of a definitive test and the similarity of symptoms to other conditions. Treatment aims to reduce vertigo attacks and manage hearing loss and tinnitus through lifestyle changes, medication, and sometimes surgery.

Persistent Postural Perceptual Dizziness (PPPD)

PPPD is a chronic vestibular disorder characterized by persistent dizziness, unsteadiness, and non-spinning vertigo lasting for three months or more. Symptoms are often worse when standing, moving, or in busy places. PPPD often follows an initial vestibular disorder but persists beyond the expected recovery period. Treatment includes vestibular rehabilitation, cognitive-behavioral therapy, and sometimes medication, focusing on reducing dizziness symptoms and improving quality of life.

The neck!

Even though this is not a vestibular disorder, it is important to acknowledge the neck's role in certain types of dizziness. The neck can be the main cause, termed *cervicogenic dizziness,* or be a contributing factor. It is important to understand that one can experience multiple types of dizziness and causes at the same time.

Although this field of research is still evolving, assessing the neck and offering advice on posture and tension relief in targeted areas could be considered as a treatment option.

Concussions or mild Traumatic Brain Injury (mTBI) and Persisting Post Concussion Symptoms

Dizziness is a common symptom after a concussion, and for several reasons. Some of these reasons may involve injury to the vestibular system (which affects the inner ear and its communication with the brain), the visual system (and its communication with the brain), the autonomic system (responsible for functions like heart rate and digestion, managed autonomically by the body), as well as the neck and other causes.

Dizziness after a concussion will sometimes resolve on its own within the first few days, while other times the dizziness may persist.

A comprehensive concussion evaluation considers a range of factors contributing to symptoms. It may involve a vestibular assessment, but the various parts of the exam may vary based on the persons individual symptoms and concerns, as well as include other screening tests.

Assessing and treating post-concussion symptoms requires teamwork, with referrals to specialists as necessary and effective communication among the health care professionals involved.

These are both topics of their own that require separate attention and discussion

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Chapter 8: Living With a Vestibular Dysfunction

Coping with vestibular dysfunction can be challenging and isolating, but there are several strategies that can help. A few lifestyle changes can help manage symptoms and improve quality of life. These include but are not limited to the following:

- Proper sleep and hydration are important to help the body function properly and reduce symptoms of dizziness and fatigue.
- Stress and anxiety can exacerbate symptoms of vestibular dysfunction, so learning stress-management techniques and seeking emotional support as well as counselling can be helpful.
- Regular exercise and balance training can help reduce symptoms. It is important to always ensure you can safely perform an exercise and have a spotter when needed. If in doubt, speak with your healthcare provider before starting.
- Finding support from friends, family and support groups can provide emotional support and practical assistance.
- Maintaining a positive outlook and finding purpose despite vestibular dysfunction may involve pursuing hobbies and

interests, volunteering, or focusing on other areas of life that bring joy and fulfillment. In other words, if you love it… do it!

Chapter 9: Conclusion

Vestibular dysfunction can be a challenging and debilitating condition, but with the right diagnosis, treatment, and lifestyle modifications, it is possible to manage symptoms and improve quality of life. The "Vestibular Journey" is exactly that, a journey that is unique to each person living with a vestibular disorder and therefore needs to be managed in a compassionate, holistic, person-centered way.

We hope this e-book serves as a valuable starting point for those looking to expand their knowledge of vestibular dysfunctions and find direction, whether it be for you or for a loved one. Nevertheless, it is crucial to always seek personalized advice and treatment from a qualified healthcare professional. Here at Evidence Sport and Spine and Momentum Health, we are here to serve you and guide you to the right practitioner. Remember, we are here to assist you every step of the way in your journey to recovery!

About the Authors

Tanielle Garcia, Physiotherapist PT, MPT, BKin(Hons) ***BOOK ONLINE AT EVIDENCE SPORT AND SPINE SOUTH***

Tanielle Garcia graduated with a Masters of Physical Therapy in 2010 from the University of Saskatchewan. She completed her undergraduate Honours degree in Kinesiology in 2008 from the University of Regina while playing on the university women's hockey team. She moved to Calgary in 2010, and after a couple of years in practice started to gain a special interest in concussion and vestibular rehabilitation, which has now grown to be her primary caseload. Tanielle has completed numerous vestibular and concussion courses over the years, including the Vestibular Rehabilitation certification program (Emory University) in 2016, and is currently completing her Advanced Vestibular Rehabilitation certification (University of Pittsburgh). She has been fortunate to mentor under and work with leading experts in the field, including Dr. Kathryn Schneider. Tanielle also works as a research clinician at the University of Calgary under the work of Dr. Kathryn Schneider in the areas of sport related concussions and more recently dizziness related to the cervical spine.

Tanielle had a unique opportunity early in her career to travel to Botswana Africa as a volunteer therapist with a non-profit organization providing care to those in remote and underserved regions. During this time, she implemented a fall prevention program for those at risk and taught a "Straighten Up" program to students, promoting improved posture at school.

Tanielle has a passion for treating the "dizzy" patient and getting to the root cause, as well as presenting and teaching on this topic. In her spare time, she enjoys spending time with her family, coaching her son's hockey team, and playing ball hockey with her husband.

Kathryn Schneider, Clinical Specialist in Musculoskeletal Physiotherapy, PT, PhD, DSc, BKin(hons), BHScPT, cGIMS ***BOOK ONLINE AT EVIDENCE SPORT AND SPINE NORTH***

Kathryn Schneider is a physiotherapist in Calgary, Alberta and graduated from McMaster University with a Bachelor of Health Sciences in Physiotherapy in 1998. She has completed her Fellow of the Canadian Academy of Manipulative Physiotherapists (2004), certification in Gunn IMS (2002) and a certification program in Vestibular Rehabilitation (Emory University), an Advances In Vestibular Rehabilitation (Duke University), and a Doctor of Science degree (DSc) (Andrew's University) (2008) with her research focusing on dizziness and cervical spine dysfunction. She completed her PhD at the University of Calgary studying the effects of multimodal physiotherapy and vestibular rehabilitation in athletes who have sustained sport-related concussions. Kathryn has presented at numerous conferences, clinical rounds and has instructed courses on vestibular rehabilitation, whiplash and cervical spine pain. She was a member of the expert panel of the International Consensus on Concussion in Sport 2012 and 2017 and as the lead in 2022. Kathryn was selected by Avenue Magazine as one of Calgary's Top 40 Under 40.

References

1. Edlow, J. A., Carpenter, C., Akhter, M., Khoujah, D., Marcolini, E., Meurer, W. J., ... Bellolio, F. (2023, May). Guidelines for reasonable and appropriate care in the emergency department 3 (GRACE-3): Acute dizziness and vertigo in the emergency department. *Academic Emergency Medicine*, 30(5), 442-486. doi: 10.1111/acem.14728. PMID: 37166022

2. Casani, A. P., Gufoni, M., & Capobianco, S. (2021). Current Insights into Treating Vertigo in Older Adults. Drugs & Aging, 38(8), 655–670. https://doi.org/10.1007/s40266-021-00877-z

3. National Institute on Deafness and Other Communication Disorders. (2016, January 27). More than 1 in 20 U.S. children have dizziness and balance problems: First large-scale, nationally representative survey finds issues slightly more common in girls, non-Hispanic white children. NIDCD. Retrieved from https://www.nidcd.nih.gov/news/2016/more-1-20-us-children-have-dizziness-and-balance-problems

4. Saber Tehrani AS, Coughlan D, Hsieh YH, Mantokoudis G, Korley FK, Kerber KA, et al. Rising annual costs of dizziness presentations to U.S. emergency departments.Acad Emerg Med. 2013; *20*:689–696. doi: 10.1111/acem.12168.

5. Neuhauser HK 2016. The epidemiology of dizziness and vertigo. Aminoff MJ, Boller F, Swaab DF Eds. Handbook of clinical neurology vol. 137 3rd Series. 67-82. Amsterdam: Elsevier 1

6. Saber Tehrani, A. S., Kattah, J. C., Kerber, K. A., Gold, D. R., Zee, D. S., Urrutia, V. C., & Newman-Toker, D. E. (2018). Diagnosing Stroke in Acute Dizziness and Vertigo: Pitfalls and Pearls. *Stroke, 49*(4), 788–795. https://doi.org/10.1161/STROKEAHA.117.016979

7. Marmor, S., Karaca-Mandic, P., & Adams, M. E. (2023). Use of Physical Therapy and Subsequent Falls Among Patients with Dizziness in the US. *JAMA Otolaryngology-Head and Neck Surgery, Volume(Issue)*, Page range. DOI:10.1001/jamaoto.2023.2840. Published online September 14, 2023.

8. Johns Hopkins Medicine. *Survey suggests higher risk of falls due to dizziness in middle-aged and older Americans*. 2009. Available from: http://bit.ly/2uwgs0z. Accessed Aug. 22, 2023

9. Vestibular Disorders Association. Facts, figures & trivia. September 2013. Available from: http://bit.ly/2UmsfgN

10. Sfakianaki I, Binos P, Karkos P, Dimas GG, Psillas G. Risk Factors for Recurrence of Benign Paroxysmal Positional Vertigo. A Clinical Review. J Clin Med. 2021 Sep 24;10(19):4372. doi: 10.3390/jcm10194372. PMID: 34640391; PMCID: PMC8509726.

11. Bukurov, B., Nenezic, D., Pot, D., et al. (2023). Adoption of clinical practice guidelines in cases of benign paroxysmal positional vertigo. *European Archives of Oto-Rhino-Laryngology*, 280, 4477–4483. https://doi.org/10.1007/s00405-023-07981-3

12. Choi, M. S., Shin, S. O., Yeon, J. Y., Choi, Y. S., Kim, J., & Park, S. K. (2013). Title of the article. *Korean Journal of Audiology, 17*(1), 13-17. doi: 10.7874/kja/2013.17.1.13. PMCID: PMC3936518. PMID: 24653897.

13. Dieterich, M., Obermann, M., & Celebisoy, N. (2016). Vestibular migraine: the most frequent entity of episodic vertigo. *Journal of Neurology, 263* (Suppl 1), S82-S89. DOI: 10.1007/s00415-015-7905-2.

14. Balci, B., & Akdal, G. (2022). Outcome of vestibular rehabilitation in vestibular migraine. *Journal of Neurology, 269*(12), 6246-6253. https://doi.org/10.1007/s00415-022-11250-4

15. Lempert, T., Olesen, J., Furman, J., Waterston, J., Seemungal, B., Carey, J., Bisdorff, A., Versino, M., Evers, S., & Newman-Toker, D. (2012). Vestibular migraine. Diagnostic criteria. *Journal of Vestibular Research, 22*(4), 167-172. DOI: 10.3233/VES-2012-0453

16. Sulin Zhang, Dan Liu, E. Tian, J Wang, Zhaoqi Guo & Weijia Kong (2022): Central vestibular dysfunction: don't forget vestibular rehabilitation, Expert Review of Neurotherapeutics, DOI: 10.1080/14737175.2022.2106129

17. Hall CD, Herdman SJ, Whitney SL, Anson ER, Carender WJ, Hoppes CW, Cass SP, Christy JB, Cohen HS, Fife TD, Furman JM, Shepard NT, Clendaniel RA, Dishman JD, Goebel JA, Meldrum D, Ryan C, Wallace RL, Woodward NJ. Vestibular Rehabilitation for Peripheral Vestibular Hypofunction: An Updated Clinical Practice Guideline From the Academy of Neurologic Physical Therapy of the American Physical Therapy Association. J Neurol Phys Ther. 2022 Apr 1;46(2):118-177. doi: 10.1097/NPT.0000000000000382. PMID: 34864777; PMCID: PMC8920012.

18. Basura GJ, Adams ME, Monfared A, Schwartz SR, Antonelli PJ, Burkard R, Bush ML, Bykowski J, Colandrea M, Derebery J, Kelly EA, Kerber KA, Koopman CF, Kuch AA, Marcolini E, McKinnon BJ, Ruckenstein MJ, Valenzuela CV, Vosooney A, Walsh SA, Nnacheta LC, Dhepyasuwan N, Buchanan EM. Clinical Practice Guideline: Ménière's Disease. Otolaryngol Head Neck Surg. 2020 Apr;162(2_suppl):S1-S55. doi: 10.1177/0194599820909438. PMID: 32267799.

19. Lopez-Escamez, J. A., Carey, J., Chung, W.-H., Goebel, J. A., Magnusson, M., Mandalà, M., Newman-Toker, D. E., Strupp, M., Suzuki, M., Trabalzini, F., & Bisdorff, A. (2015). Diagnostic Criteria for Menieres. *Journal of Vestibular Research, 25(1)*, 1-7. DOI: 10.3233/VES-150549.

20. Nada EH, Ibraheem OA, Hassaan MR. Vestibular rehabilitation therapy outcomes in patients with persistent postural-perceptual dizziness. *Ann Otol Rhinol Laryngol*. 2019; 128:323-329

21. Sarna, B., Risbud, A., Lee, A., Muhonen, E., Abouzari, M., & Djalilian, H. R. (2021). Migraine Features in Patients with Persistent Postural Perceptual Dizziness Annals of Otology, Rhinology & Laryngology, 139(12), 1326-1331. https://doi.org/10.1177/00034894211007233.

22. Staab, J. P., Eckhardt-Henn, A., Hori, A., Jacob, R., Strupp, M., Brandt, T., & Bronstein, A. (2017). Diagnostic criteria for persistent postural-perceptual dizziness (PPPD): Consensus document of the committee for the Classification of Vestibular Disorders of the Bárány Society. *Journal of Vestibular Research, 27*, 191–208. DOI: 10.3233/VES-170622.
