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ACCEPTABILITY OF MOTION SICKNESS GOGGLES FOR BALANCE REHABILITAION

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ABSTRACT

This study assessed the acceptability of Motion Sickness Goggles as a balance rehabilitation tool among licensed physical therapists. Guided by the Cognitive Load Theory, a quantitative descriptive research design was used. Data were collected from 30 licensed physical therapists with at least two years of experience in balance rehabilitation using a researcher-made survey questionnaire. Statistical tools included frequency, percentage, and weighted mean, with a 5-point Likert scale for interpretation. Results showed that the most commonly used tools in balance rehabilitation were the wobble board (23.30%), vestibular ball (21.36%), and BOSU ball (13.59%). The most frequent challenge encountered was lack of equipment (39.58%). Motion Sickness Goggles obtained an overall weighted mean of 3.82, interpreted as Moderately Acceptable. Among the dimensions, ease of use (4.00) and durability (3.97)were rated highest, while appearance (3.70) and usability (3.60) received lower but still acceptable ratings. Findings indicate that Motion Sickness Goggles have potential as an adjunctive tool, though improvements in design and clinical application are recommended.

Keywords: Motion Sickness Goggles, Balance Rehabilitation, Physical Therapy, Acceptability

INTRODUCTION

Physical therapy for balance rehabilitation is one of the critical factors in helping develop patients' strength, improve coordination, and prevent falls. Falls are a common cause of injury, particularly among older adults. According to the Centers for Disease Control and Prevention (CDC) falls are the leading cause of fatal and non-fatal injuries. Physical Therapists help to improve an individual's balance. Physical Therapists use a range of techniques to help patients to improve balance such as Tai Chi and Pilates exercises, strength training, and also gait and balance training (Wu, 2024). Senior citizens and other persons with balance issues are more vulnerable to falls, which can result in injuries and fatalities. The majority of "conventional" balancing exercises focus on keeping balance while moving or adopting static positions. (Devasahayam et al., 2022).

Balance rehabilitation is a distinct branch of physical therapy dedicated to evaluating, diagnosing, and treating individuals who struggle with balance and stability. This form of rehabilitation emphasizes enhancing a patient's capacity to carry out daily activities safely and independently, ultimately improving their overall quality of life (Heffernan, et al., 2021). Balance rehabilitation is an exercise-focused program aimed at diagnosing and addressing the root causes of dizziness, vertigo, and various balance issues. One type of exercise that has been shown to significantly improve control of balance is reactive balance training “RBT”. Reactive Balance Training is an interesting form of exercise that allows people to purposely lose their equilibrium by utilizing repetitive balance perturbations in a safe environment. Individuals who complete RBT report fewer falls in their daily life and greater control over their striding and reach-to-grab behaviors. (Jagroop et al., 2021). Exercise games that use virtual reality (VR) are becoming more and more popular in the rehabilitation of patients with neurological diseases as an additional therapy to increase training intensity. The intensity is greatly influenced by the patient's motivation. Offering challenging exercises and diversity in your training can increase motivation. (Hilfiker et al., 2022). As in the study of Hitchfilker et al. (2022), most of the prevalent problems in AR/VR are the user's privacy and security, which more non-invasive motion sickness goggles could compensate. Moreover, Bautista et. al. (2022) stated that to increase the acceptance of these technologies, researchers focus on other challenges including latency, affordability, health concerns, perceived usability limitations, and ethical considerations.

In addition to the current balance training technologies, an innovative tool in motion sickness emerged. Motion sickness goggles are primarily used to alleviate the symptoms of motion sickness. According to Joy (2020), when your vehicle moves, the liquid in the motion sickness goggles shifts, creating an artificial horizon in your field of vision. This is designed to help your brain process information correctly, reducing stress and motion sickness. A study found that looking at the horizon from a ship helped people sway less (Mayo et al. 2011; Hemmerich, W., et al. 2020). This suggests that the horizon can help prevent motion sickness, as (Stoffregen and Smart, 1998; Smart et al., 2002; Hemmerich, W., et al. 2020) have shown a link between increased swaying and higher levels of motion sickness and visual-induced motion sickness. The idea behind motion sickness goggles is aligned with the concept of motion sickness as it is stated as a bodily response caused by conflicts between different senses, like optical, vestibular, and muscular systems. According to Kumar, G.P., et. Al. (2020), motion sickness exists due to the disagreement between visually perceived movement and the vestibular system's senses. The vestibular system helps us stay balanced by sensing changes in movement and adjusting our head's position using muscle control (Kumar, G.P., et. Al. 2020), as it plays an important role in space orientation (Illich Zabolotnyi, D., & Serhiivna Mishchanchuk, N., 2020). In addition, a study by Al-Sharif, D., et. Al. (2022), stated that vestibular and autonomic systems are both responsible for postural control and spatial orientation in complex environments. These concepts prompted the researchers to investigate the use of motion sickness goggles in balance rehabilitation.

The researchers aim to determine the level of acceptability of Motion Sickness Goggles among Physical Therapists in balance rehabilitation. This exploration will primarily focus on subjective aspects, including the challenges, common tools in balance rehabilitation, ease of use, durability, appearance, usability, and overall acceptability through survey. With an emphasis on these aspects, our study aims to contribute valuable insights from physical therapists into the practicality and user satisfaction of incorporating motion sickness goggles in balance rehabilitation.

LITERATURE REVIEW

Motion Sickness and Balance

Motion sickness (MS) is still a problem related to transportation. Motion sickness is said to be a response to the conflict between visually perceived movement and the vestibular's system senses. Kumar et al. (2020) discussed different theories behind the cause of motion sickness; namely, sensory conflict theory, poison theory, postural instability theory, and movement program theory. As cited by Kumar et al. (2020), the theory behind MS and the most accepted one is the sensory conflict theory. According to this theory that was proposed by Reason and Brand, the conflicts between various sensory organs provoke MS. These sensory disturbances destabilize and inhibit the stability of the connection between the visual, vestibular, and proprioception. However, Stoffgregen and Ricio proposed a different analysis, they proposed the postural instability theory. They simply state that prolonged postural instability or loss of control is the cause of motion sickness. In the concept of balance, Cleveland Clinic (2023) states that a sense of balance depends on the stable flow of inputs among the ears, eyes, tissues, and brain. Disruption of this flow will result in loss of a sense of balance. The interaction of visual, vestibular, and somatosensory systems to process information will produce motor output that is termed postural control (Physiopedia, 2021).

Even though there is no direct correlation between motion sickness and balance mentioned in the literature above, it is somehow shown in one study. In the study by Joshi (2020), he assessed the balance of individuals with MS and without MS. He hypothesized that there is a difference between the balance of individuals with and without MS. The result of the study showed that there is an increase in sway velocity in individuals with MS. This result concluded that individuals with MS have impaired balance compared to those without MS.

Another study by Albalwi et al. (2020) focused on three conditions: static (no head movement), horizontal head motion, and vertical head motion. The authors hypothesized that individuals with chronic motion sickness (CMS) would experience a greater decline in postural stability during head movement, particularly in horizontal and vertical conditions, compared to non-CMS individuals. This expectation is rooted in the assumption that CMS is often associated with heightened sensitivity to motion stimuli, potentially disrupting the vestibular and proprioceptive systems that contribute to postural control. However, the findings revealed that both CMS and non-CMS groups exhibited similarly reduced postural stability during horizontal and vertical head motion, relative to the static condition. Importantly, no significant differences were found between the CMS and non-CMS groups in terms of how these head movements affected postural stability, contrary to the researchers' initial predictions. This suggests that, at least in healthy young adults, chronic motion sensitivity may not have as distinct an impact on postural control during head motion as previously thought.

Motion Sickness Goggles

The design and how motion sickness goggles work will be discussed in this section of the paper. There is no published study or evidence that these glasses work in alleviating motion sickness. The article on Healthline about motion sickness goggles explained how the glasses work. According to Joy (2020), the glasses are framed with 4 tubular rims with liquid in them, two in front and one on each side. The liquid moves along with the user's movement or when the vehicle moves creating an artificial horizon. The instructions indicate that users should put them on at the first sign of motion sickness and wear them for 10 minutes, until the symptoms are relieved. This artificial horizon was claimed by the creator as the one who balances the information that our brain integrates. This highlights that the artificial horizon created by the liquid in the goggles helps to balance the sensory mismatch resulting in the termination of motion sickness symptoms. In another article on EYESEEMag (2022), they mentioned the same motion sickness glasses developed by Boarder Ring. It was a clinically tested, trademarked medical concept, and the company claimed to have a 94% effectiveness rate. Both of the articles instructed to wear it for 10 minutes, until the symptoms of motion sickness are relieved.

Role of Visual and Vestibular Inputs in Balance Rehabilitation

This section talks about the role of visual and vestibular stimulation in balance rehabilitation through sensory integration. This article, the integration of visual and vestibular inputs by the brain to perceive motion and preserve spatial orientation (Shaikh et al., 2020). Each sensory system alone is frequently unreliable or ambiguous, and motion perception depends on information from the visual, vestibular, and proprioceptive systems. Additionally, abnormalities in the parieto-temporal cortex of the brain that integrate visual and vestibular signals may be a contributing factor to navigation issues, such as freezing of gait and veering, that are observed in neurological conditions like Parkinson's disease.

The study by Thompson et al. (2020), tests to determine if sensory integration training may help elderly individuals with chronic stroke and healthy adults (ages 50–80) with their balance. Through targeted sensory inputs—visual (eyes open vs. closed) and somatosensory (light touch, different foam surfaces beneath the feet) during standing and dynamic balance exercises—the training aimed to improve balance. The Balance Error Scoring System (BESS) was used to measure the participants' balance before and after six weeks of sensory training. The findings demonstrated that the training significantly enhanced balance, particularly under trying circumstances. Stroke individuals showed improvements in all contexts, but healthy people performed better in scenarios with a limited base of support (such as tandem and single-leg standing on foam). Sensory integration training appears to be an effective method for improving balance in older adults, including those with chronic stroke.

In conclusion, sensory integration is necessary for balance and spatial orientation. Combining visual, vestibular, and proprioceptive inputs has a more significant effect. According to Thompson et al. (2020), integrating visual and somatosensory stimuli shows a considerable improvement in balance in older adults and chronic stroke patients. This highlights the inclusion of sensory integration training makes an effective intervention for balance rehabilitation and fall prevention.

Innovative Tools in Balance Rehabilitation and Challenges

Wearable devices equipped with sensors are increasingly being explored as tools for biofeedback rehabilitation in individuals with neurological diseases (PwND). A recent systematic review and meta-analysis by Bowman et al. (2021) aimed to provide an overview of their application in clinical practice, focusing on their effectiveness in improving balance and gait outcomes. This study evaluated the use of wearable sensors for delivering real-time biofeedback during movement execution and examined the associated outcomes. The review highlighted that biofeedback is primarily provided in real-time, utilizing biomechanical sensors to offer positive reinforcement through auditory or visual cues. For stroke patients, pressure sensors and electromyography (EMG) were predominantly employed to enhance weight-bearing and muscle recruitment in the paretic leg. In contrast, inertial sensors were commonly used in individuals with Parkinson’s disease to regulate movements of axial segments and limbs. Despite these advancements, the study emphasized that the optimal configuration of sensors—such as their number and positioning—remains unclear and requires further investigation. While the findings suggested potential benefits of wearable device biofeedback rehabilitation (WDBR) in enhancing dynamic balance for PwND, the current quality of available research limited the ability to draw definitive conclusions about its effectiveness. The study pointed out the necessity of integrating specific design principles into WDBR systems. These principles include adhering to motor-learning theories, optimizing feedback mechanisms, improving sensor configurations, and ensuring clinical practicality to maximize the therapeutic impact. Ultimately, the review called for higher-quality randomized controlled trials (RCTs) with larger sample sizes to establish reliable evidence on the effectiveness of WDBR. Until then, the promising but inconclusive findings serve as a foundation for refining wearable sensor technology and its application in neurological rehabilitation.

Innovative tools have become widely popular in recent times to improve patient intervention outcomes. Many studies have already proven the effectiveness of innovative tools and devices in balance rehabilitation, but do not compare them directly to conventional rehabilitation. The systematic review and meta-analysis by Bersotti et al. (2024) investigated the effectiveness of virtual reality (VR) therapy compared to conventional physical therapy (PT) in enhancing gait functionality among elderly individuals. The study focused on key outcomes such as gait speed and performance on the Timed Up and Go (TUG) test, providing insights into the potential of VR as a rehabilitation tool for this population. The analysis revealed that conventional PT is more effective at increasing gait speed, an essential component of mobility and fall prevention in elderly individuals. On the other hand, VR therapy showed superior results in improving TUG test performance, which evaluates functional mobility and balance. However, when either therapy was compared to a control group receiving no intervention, the results were inconclusive, highlighting the need for further investigation. The authors emphasized the importance of conducting additional studies with robust methodological designs to strengthen the evidence base. Despite the mixed findings, the study noted the promising potential of VR therapy as an innovative approach to enhancing mobility and functional independence in healthy elderly individuals.

In conclusion, while conventional PT remains more effective for certain aspects of gait rehabilitation, VR therapy demonstrates unique strengths, particularly in improving functional mobility. This emerging technology holds promise as a complementary or alternative rehabilitation method, warranting further exploration to fully realize its benefits in geriatric care. In another study by Tuba Kanyılmaz et al. (2021) randomized controlled study evaluated the effectiveness of conventional vestibular rehabilitation (VR) exercises compared to virtual reality-based vestibular rehabilitation in elderly patients experiencing chronic dizziness. The study aimed to determine whether incorporating virtual reality (VR) into rehabilitation programs could provide additional benefits in managing dizziness-related symptoms and improving functional outcomes. The findings revealed that vestibular rehabilitation exercises delivered in a virtual reality environment offered significant advantages over conventional methods. Patients who engaged in VR-based rehabilitation demonstrated greater improvements in dizziness symptoms, disability levels, balance, and mobility. These enhancements are particularly valuable for elderly individuals, for whom dizziness and impaired balance can significantly affect quality of life and increase the risk of falls.

The meta-analysis on robot-assisted gait training (RAGT) in post-stroke patients by Loro et al. (2023) evaluates the impact of this innovative rehabilitation technique on balance recovery. RAGT, which focuses on improving gait, has been considered a promising tool for enhancing the rehabilitation of stroke survivors. However, the findings of this systematic review and meta-analysis suggest that while some trials have reported significant improvements in balance, the overall statistical evaluation does not show that RAGT provides superior outcomes compared to traditional therapy. One important observation is that there was considerable heterogeneity between the studies included in the analysis, making it difficult to draw clear, definitive conclusions. Despite this, the results indicate that combining RAGT with conventional therapy could yield better outcomes than using either method alone. Thus, when both treatments are available, it may be beneficial to combine them to address balance impairments in stroke patients. It is worth noting that RAGT is primarily focused on improving gait, with balance typically being a secondary consideration. Recent research suggests that robot-assisted balance training, a different focus from gait training, warrants further investigation to determine its potential in clinical settings. To advance this area of rehabilitation, future trials should aim for more structured inclusion criteria, ensuring that participant characteristics are better aligned with the specific goals of the study. Furthermore, performing subgroup analyses based on factors such as age and the time elapsed since the stroke could help create more personalized rehabilitation protocols. This would allow for a clearer understanding of which patients might benefit most from robotic rehabilitation and whether it truly offers better outcomes compared to conventional treatment methods. Ultimately, continued research into robot-assisted therapies has the potential to refine rehabilitation practices and improve the clinical outcomes for post-stroke patients.

Although these innovative approaches are proven effective even compared to conventional training, it is still not significant enough to replace them. Challenges are still present and are a factor in balance rehabilitation. Loro et al. (2023) suggest the reduction of robotic costs should be made along with the development of the said technology. In addition, Bowman et al. (2021) in their systematic review of wearable devices, physiotherapists showed appreciation for wearable technology, however, they suggested simplifying the calibration process. The study (Honaker & Kretschmer, 2014; Steckhan et. al., 2024) suggests that fear of falling is a significant barrier to engaging in daily activities, which in turn can limit the rehabilitation process and reduce overall outcomes. Both patients and caregivers report heightened anxiety and reduced activity levels due to the fear of falls. Additionally, the study emphasizes the importance of addressing the fear of falling during rehabilitation to ensure a comprehensive treatment approach. A thorough evaluation of FoF before and after therapy is essential to improving patient outcomes and supporting caregivers. The study advocates for a holistic approach to rehabilitation, highlighting that treating the fear of falling alongside physical balance and vestibular issues is crucial for enhancing both patients' and caregivers' well-being.

In addition, Kerem Ersin et al. (2023), state that stress level induced by VR images plays a significant role in the rehabilitation process. For patients with vestibular system disorders (balance issues caused by inner ear or vestibular dysfunction), stress-free videos are more beneficial, as they promote better integration of visual and vestibular signals without overwhelming the system. However, for patients whose balance problems stem from somatosensory system disorders (issues related to sensory input from muscles and joints), using more stressful or dynamic VR images might be helpful. These stressful images create a challenge that can enhance rehabilitation by engaging the somatosensory system more effectively. In summary, the study suggests that when using VR for vestibular rehabilitation, the choice of images should be tailored to the type of balance disorder. Stress-free images are ideal for vestibular dysfunctions, while more challenging, stress-inducing images may benefit patients with somatosensory-related balance issues. This research highlights the importance of considering the visual content in VR therapy to optimize outcomes for different patients.

The Effect of Visual Distraction and Environment Setting

The human mind enables us to learn and remember motor skills, which can be performed with accuracy and consistency as long as the person focuses completely on the task. However, cognitive distraction arises in daily life and requires a divided focus. This results in demand on the brain's information processing capacity, which might impair its ability to control motor action. According to Wilke et al. (2020) in the study on how visual distractions affect landing biomechanics indicates that having distractions can have an effect on the way athletes and people land after jumping and may increase the risk of injuries—happening as a result of this impact negatively affecting joint angles and stability during landing and altering how forces are distributed upon landing when attention is not fully focused on the task at hand.

Different visual settings affect individuals with visual-vestibular mismatch (VVM), a condition often causing dizziness and disorientation due to conflicting visual and vestibular (inner ear balance) cues. Al-Sharif et al. (2022) investigate the impact of surroundings, on how people react to discrepancies between what they see and what they feel in terms of balance and sensory responses through analyzing activity. The results show that when there are differences between vestibular signals it causes an increase in EDA (indicating stress) as well as changes in posture stability – all influenced by the environment around them visually. Another study by Lubetzky (2021), gives a review of how different visual settings affect body sway and head stability, particularly in those who have balance issues. Researchers designed a few environments and made a note of participants' bodily responses. When they tested head balance while viewing complex real-world stimuli, they discovered that, in comparison to visually less complex scenes, environments with high visual complexity—such as crowded or dynamic scenes—had a significant impact on balance and head stabilization.

In conclusion, environmental factors and visual distractions have a big impact on how someone reacts in terms of activity and balance. Minimizing distractions will uphold fewer balance issues and conflicts in visual stimuli. As Lubetzky (2021), implies that the visual environment plays a role in how our bodies interpret and adapt to inconsistencies; which suggests practical implications for fields such, as virtual reality and rehabilitation. Visual environment plays a role in how our bodies interpret and adapt to inconsistencies.

Concept of Artificial Horizon

The growing context of motion sickness leaves anecdotal evidence that suggests different factors in reducing feelings of motion sickness. The horizon when on the ship's deck becomes visible reduces the intersensory conflict between the visual and vestibular senses. The study of Hemmerich et al. (2020) that adds in suggesting a beneficial effect of a visible horizon in the reduction of MS. They observed that the presence of a stationary earth-fixed horizon while performing a time-to-contact task in VR, significantly lowers VIMS, as measured by FMS-ratings. While the absolute difference in VIMS ratings between experimental groups was small, this effect could not be found for an earth-stationary fixation point, nor a head-fixed horizontal line. Only the artificial horizontal line sufficed to provide sufficient rest-frame information. According to Shahnewaz et al. (2021), additional visual cues may improve the user's postural stability. They incorporate static rest frame (SRF) in VR, and the result suggests a positive effect in helping users maintain better postural stability for better balance. The same subject goes with the artificial horizon discussed in the study of de Thierry de Faletans et al. (2024), evaluated the effect of a dynamic visual feedback system by creating an artificial horizon that was referenced to Earth to adapt the movement of the boat and the perceived movement due to motion sickness. The result shows a beneficial effect, delaying the onset symptoms of MS rather than eliminating them. In the same study, the result provides positive feedback regarding the sensory conflict theory, where providing visual information about movements will appear to reduce the conflict between visual and vestibular systems. In another study by Camille et al. (2024), they aimed to test the effectiveness of obstructing peripheral vision on MS and the possible effect of combining the peripheral vision obstruction with the artificial horizon. The artificial horizon was created with the use of boarding glasses, which are liquid-filled lenses that provide a visual field recreating the artificial horizon. The result showed a delayed onset of MS symptoms, both peripheral visual obstruction and the combination of peripheral visual obstruction with an artificial horizon.

In addition, the idea of a peripheral field of vision is also stated in the different studies mentioned above. According to the study of de Thierry de Faletans et al. (2024), obstruction of peripheral vision delayed the onset of symptoms of MS, which shows a positive effect in managing MS. However, the study by Hemmerich et al. (2020) suggested that orientation cues in the peripheral vision created by the artificial horizontal line give off a continuous spatial orientation even when their gaze is diverted to perform another task. Even the study by Emond et al. (2023) showed that visual cues are more effective when presented in the peripheral field of vision.

In conclusion, the artificial horizon created through different ways produces a beneficial effect in reducing the symptoms of MS. The artificial horizon acts as a visual cue to adapt the movement of the subject to the perceived movement of the external stimuli, resulting in decreased conflict between the visual and vestibular systems. In addition, the studies about the role of peripheral vision suggest and align with the design of motion sickness goggles which also have fluid-filled lenses on the peripheral side that help as a constant source of spatial orientation.

Synthesis of Reviewed Literature

The following section provides a synthesis of the review of the literature covering the themes of motion sickness and balance, motion sickness goggles, the role of visual and vestibular inputs in balance rehabilitation, innovative tools in balance rehabilitation and challenges, the effect of visual distraction and environment setting, and the concept of artificial horizon. Even though there is no direct correlation between motion sickness and balance, the components of each term match. However, the effect of motion sickness on balance was discussed by Joshi (2020), showing there is an increase in sway velocity. On the contrary, Albawi et al. (2020) suggest that in healthy young adults, chronic motion sickness may not have a distinct impact on postural control during head motion. The main tool of the current study is the motion sickness goggles which were discussed in the articles of Joy (2020) by Healthline, and EYESEEMag (2022). The articles explain how the glasses work and their mechanism in creating an artificial horizon to alleviate the symptoms of MS. Sensory integration was explained by Shaikh et al.(2020) that motion perception relies on the information of the different sensory systems. The inclusion of sensory integration training to improve balance was discussed and proven effective by Thomas et al. (2020), and Gazzola et al. (2020). Combining visual, vestibular, and proprioceptive inputs has more significant effects. The innovative tools and their comparison with conventional training in balance rehabilitation were discussed by Bowman et al. (2021), Marrese Bersotti et al. (2024), Tuba

Kanyılmaz et al. (2021), and Loro et al. (2023). Reduction of cost and simplifying the process of the devices were suggested by Loro et al. (2023), and Bowman et al. (2021). In addition, factors affecting patient outcomes in balance rehabilitation were discussed by Steckhan et. al. (2024), and Kerem Ersin et al. (2023).

The effects of visual distraction and environmental settings have a big impact on how someone reacts in terms of activity and balance. This was proven by Wilke et al. (2020), Al-Sharif et al. (2022), and Lubetzky (2021 minimizing distraction will have fewer balance issues and conflicts in visual stimuli.

The role of artificial horizon in decreasing the conflict between visual and vestibular systems to reduce the symptoms of MS and the idea of peripheral vision was discussed and proven in the studies by Hemmerich et al. (2020), and de Thierry de Faletans et al. (2024).

Gaps Bridged by the Present Study

After a comprehensive review of the literature, the researchers found gaps that need to be addressed by the present study.

1. Literature found that there is a need for studies that consider the ease of use and practicality of tools and wearable devices. The current study will address these gaps by determining the level of acceptability of motion sickness goggles.
2. Studies found that there is a need to adjust the overstimulating and immersive effect of VR since it leads to the adverse effects of provocative stimuli. The current study will address this gap by integrating motion sickness goggles as a less invasive tool and adjusting the environment setting by decreasing visual distraction
3. Literature suggests reducing the cost and simplifying the process of devices. The current study will address this gap since the motion sickness goggles are affordable and easy to navigate and use.
4. A gap was also found, there is lacking published literature about motion sickness goggles in any area. The current study will address this gap as motion sickness will be used in the study..

METHODOLOGY

Research Design

The study will use a quantitative research design, specifically a descriptive research. When the goal of the study is to identify traits, frequencies, trends, and categories, descriptive research is a suitable option. When little is known about the subject or issue, it is helpful. Understanding how, when, and where something occurs is necessary before you can investigate why it occurs according to McCombes (2019).

This research method will help the researchers understand what the respondents think about the motion sickness goggles. The researchers will develop a structured survey questionnaire that will help to get a complete picture of the insights of physical therapists about the tool. The data that will be collected from the survey will draw conclusions and suggestions that will determine the acceptability of motion sickness goggles in balance rehabilitation. In addition, the findings of the study will act as a recommendation and suggestion for further development of the tool to test its effectiveness.

Sources of Data

The study has two sources of data, namely, primary and secondary sources. The primary source of data is survey questionnaires that will be given to Licensed Physical Therapists with a minimum of two (2) years of experience in balance rehabilitation that helps the researcher to achieve the acceptability of the motion sickness goggles.

The secondary sources of data include the use of various journals, studies, and literature cited from Google Scholar, NCBI, PubMed, and ResearchGate that can be related to motion sickness and balance, motion sickness goggles, the role of visual and vestibular inputs in balance rehabilitation, innovative tools in balance rehabilitation and challenges, the effect of visual distraction and environment setting, and the concept of artificial horizon.

Population of the Study

The population of the study will be composed of at least 30 licensed Physical therapists with a minimum of two (2) years of experience in balance rehabilitation in hospitals, rehabilitation centers, and home care located within the National Capital Region (NCR) or in the province of Laguna. The number of participants follows Roscoe's (1975) guidelines for determining sample size and has been a common choice in the last several decades. Roscoe's rule of thumb for determining sample size, that "sample size larger than 30 and less than 500 are appropriate for most research" (Roscoe, 1975; Irinco, 2023).

The researcher will utilize purposive sampling, according to Nikolopoulou (2022), purposive sampling is a collection of non-probability sampling methods where units are deliberately chosen based on specific characteristics required for the sample.

The researcher established specific criteria that participants must meet. Individuals possessing the relevant characteristics, qualifications, and credibility essential to the study will enable the researcher to gather pertinent information.

Instrumentation and Validation

The researchers will develop a researcher-made survey questionnaire to collect the primary data. The researchers will develop a survey questionnaire to collect the primary data. The questionnaire will first be validated by experts, to ensure the accuracy of statements, and construction of words, and to ensure a clear definition of the objectives of the questionnaire. The validation will bring the researcher to a more accurate extraction of data that will lead to more reliable data to be interpreted.

The first part of the questionnaire will consist of two (2) main questions namely, challenges and limitations in the current practice of balance rehabilitation, and common tools used in balance rehabilitation. These questions will be answered by the respondents through words and should be specific.

In addition, for the second part of the questionnaire, five (5) point Likert scale will be used to measure satisfaction on each section of the questionnaire. There will be four (4) main sections namely, ease of use, durability, appearance, and usability, with three (3) sub-questions on each of the four (4) main questions.

Lastly, the third part of the questionnaire will consist of the overall acceptability of the motion sickness goggles and will be measured using five (5) point Likert scale.

The questionnaire will aim to answer the problems that are determined in the statement of the problem of the study.

Evaluation and Scoring

The researchers will measure the acceptability of motion sickness goggles by answering the prepared questionnaire using a Likert scale, where 5 is the highest and 1 is the lowest in terms of satisfaction. The figure below shows the assigned points, verbal interpretation, and ranges by the study of Salac (2020).

Average Weighted Mean Range	**Descriptive Equivalent (Level of Acceptability)**
4.21 - 5.00	Highly Acceptable
3.41 - 4.20	Moderately Acceptable
2.61 - 3.40	Acceptable
1.80 - 2.60	Fairly Acceptable
1.00 - 1.79	Poorly Acceptable

Figure 2

Figure 3

Data Gathering Procedure
Pre-Implementation Phase

After the researchers successfully defended chapters 1 to 3 and their title was approved, the panel suggested minor revisions, and the researchers immediately revised the paper. After finalizing the paper, the researchers bought three (3) motion sickness goggles through an online shop. When the goggles arrived, the researchers carefully inspected them to ensure that there was no damage. The researchers wore the goggles and found out that it was slipping on the head. As a reaction to this, the researchers bought three (3) adjustable straps and included them in the goggles as a support and keep the goggles to stay in place.

Implementation Phase
The researchers went to different rehabilitation departments of hospitals and clinics and gave the letters of consent and talked with the chief PTs to agree upon a set time when most of their physical therapist staff are available. Thankfully, four (4) clinics and three (3) hospitals said that they would be able to allot their time in the next two (2) weeks. The researchers went to a total of seven (7) hospitals and clinics and tallied a total of thirty (30) respondents. The questionnaire was distributed along with the motion sickness goggles among the participants, who were accepted according to the criteria prepared by the researchers. The researchers did not have a hard time implementing as there were no conflicts with the schedules of all four (4) clinics and three (3) hospitals, as they allotted an hour of the day agreed upon for the implementation of the research. The implementation was a success since it garnered the target population and the targeted number of respondents as well.

Post-Implementation Phase

The researchers collected all the questionnaires after each assessment and began tallying the results acquired from the actual implementation after gathering all the questionnaire responses. After doing so, the researchers proceeded to the research institute of the medical university to contact the statistician assigned to the researchers. Upon establishing contact, the researchers submitted the tally and waited a few days for the statistician to complete their analysis. Once the analysis was finished, the researchers interpreted the data with the assistance of research sources found online. Finally, the researchers commenced drafting chapters 4 and 5 of their study. Following the initial draft, the researchers consulted their research adviser, received revisions to incorporate, and proceeded with the revisions. Additionally, the researchers inspected the device for any damage or problems, ensuring everything was secured.

Ethical Consideration

The study emphasizes the importance of upholding ethical standards through the preservation of moral, social, and human values, as well as ensuring the safety of both researchers and participants.

Before the structured questionnaire checklist, there will be a cover letter included that highlights the study's purpose, stresses the significance of the respondent's participation, ensures confidentiality of responses, and provides the deadline for responses. Before participating in the study, the respondents will be provided with informed consent, confirming their willingness to take part and their full understanding of the accompanying explanation letter.

The anonymity and confidentiality of the respondents' identities will be rigorously maintained. The researchers will also assure the participants that their responses will be treated confidentially, and stored securely and that the findings will solely be utilized for academic reasons. Participants will be promptly advised that they could withdraw at any point if they feel uncomfortable with the process.

There is a minimal risk associated with participating in this study, to mitigate these risks, the researchers will moderate any distractions and all recorded questionnaire data will be treated confidentially. There will be a direct benefit for the participants, insights and perspectives of the participants will contribute to a better understanding of the motion sickness goggles that the researchers provide, which will be an acceptable tool within the field of physical therapy. If any unforeseen incidents occur, the researchers will be responsible for covering the medical costs associated with treating any resulting accidents.

The participation of respondents in the study will be voluntary and will not receive any compensation from the researchers. Once concluded, the study's results will be accessible at the University of Perpetual Help - Dr. Jose G. Tamayo Medical University Library can be expressed in a more refined manner.

Statistical Treatment of Data

This study applied statistical treatment that employed frequency, percentage, and general weighted mean. After the respondents complete the survey questionnaire, the gathered data will be computed using the mentioned statistical treatment and will be organized using tables. Frequency and percentage will be utilized to determine the common challenges, limitations, and tools used in balance rehabilitation.

Weighted mean will be utilized to determine the level of acceptability of the motion sickness goggles in terms of ease of use, durability, appearance, usability, and overall acceptability.
It will find out the average score of each question in the survey that respondents answered to determine the acceptability of motion sickness goggles in balanced rehabilitation in the field of physical therapy.

RESULTS

Table 1
Most Common Tools Used in Balance Rehabilitation

EQUIPMENT	FREQUENCY	PERCENTAGE
Bosu ball	14	13.59
Cones	5	4.85
Walker	I	0.97
Parallel bars	6	5.83
Vestib ball	22	21.36
Wobble board	24	23.3
Mirror	1	0.97
Visual aids	1	0.97
Yoga mat	3	2.91
Towel	5	4.85
Step stool	6	5.83
Balance beam	2	1.94
Foam pads	6	5.83
Resistance band	3	2.91
VR	1	0.97
Weights	1	0.97
Postural mirror	2	1.94

Based on the results, the most commonly used tools in balance rehabilitation are the wobble board (23.3%), vestibular ball (21.36%), and bosu ball (13.59%). These tools are known for improving balance, posture, and coordination, and they are often used in clinics and rehabilitation centers. Other tools that were mentioned include cones, foam pads, parallel bars, step stools, and towels, each with smaller percentages. Less frequently used items include visual aids, mirrors, yoga mats, and virtual reality (VR), which had usage rates of less than 3%.

In relation to the literature, traditional tools such as these continue to be preferred because they are accessible, familiar, and effective. According to Thompson et al. (2020), sensory integration training which includes stimulating the visual, vestibular, and proprioceptive systems is important in improving balance. Tools like wobble boards and balance balls activate these systems in a controlled and functional manner, making them valuable in rehabilitation programs.

However, advanced tools like virtual reality (VR) are not commonly used, likely due to issues of cost, unfamiliarity, and lack of training. As highlighted in the literature, VR and wearable devices can enhance motivation and training intensity (Hilfiker et al., 2022; Bowman et al., 2021), but their complex setup and overstimulating effects limit their use in standard practice.

Table 2
Challenges and Limitations Experienced in the Current Practice of Balance Rehabilitation

CHALLENGES AND LIMITATIONS	FREQUENCY	PERCENTAGE
Lack of equipment	19	39.58
Limited knowledge	5	10.42
Patient concerns	13	27.08
Lack of space	6	12.5
Affordability of equipment	3	6.25
Availability of tools in homecare/carry-over equipment	2	4.17

When it comes to the difficulties encountered in balance rehabilitation, the most common issue is lack of equipment (39.58%), followed by patient concerns (27.08%), such as fear of falling or poor participation. Lack of space (12.5%) was also a major concern, especially in smaller clinics or home settings. Other challenges mentioned include limited knowledge of proper techniques (10.42%), high cost of equipment (6.25%), and lack of tools for home use (4.17%).

Literature supports these findings. For example, Loro et al. (2023) emphasized the need for cost reduction and easier setup in robotic and sensor-based technologies. Similarly, the study by Bautista et al. (2022) identified affordability, usability, and privacy concerns as key barriers to adopting AR/VR tools in the Philippines. These limitations also explain why more innovative tools like motion sickness goggles despite their potential have not been fully explored or integrated into clinical practice. Additionally, patient concerns such as fear of falling impact rehabilitation. According to Honaker & Kretschmer (2014), fear of falling can hinder participation and progress in therapy. This reinforces the need for user-friendly, non-threatening tools that patients feel comfortable using.

Table 3
Respondent's Level of Acceptability in terms of Ease of Use

	Weighted Mean	Standard Deviation	Verbal Interpretation	Rank
1. The tool is easy to use	4.13	1.14	Moderately Acceptable	1

2. The tool is convenient to use during balance rehabilitation	3.63	1.13	Moderately Acceptable	3
3. Maintenance of the device is easy	4.10	1.06	Moderately Acceptable	2
Mean	3.96		**Moderately Acceptable**	

The questions are ordered in descending order according to the acceptability level based on Ease of Use. Respondents rated the tool's ease of use as moderately acceptable, question number one score of 4.13. Question number three was also highly rated 4.1, suggesting simple upkeep. However, question number two received a slightly lower score 3.63, hinting at potential limitations in clinical practice resulting in a total mean score of 3.96.

The literature study emphasizes how crucial it is to reduce cognitive stress while undergoing rehabilitation. Motion sickness goggles assist cognitive load theory by simplifying visual vestibular integration through their artificial horizon function. Joy's (2020) analysis describes how these goggles help reduce visual conflicts, which supports the high ease of use rating (Mean = 4.13) found in the survey This is in line with Bowman et al. (2021), who highlighted the necessity of useful and easy-to-use tools for balance rehabilitation.

Table 4
Respondent's Level of Acceptability in terms of Durability

	Weighted Mean	**Standard Deviation**	**Verbal Interpretation**	**Rank**
1. The tool maintained its function after term of use	3.80	1.00	Moderately Acceptable	2
2. The tool resisted damage from common environmental factors	3.83	0.95	Moderately Acceptable	1
3. The durability of the tool makes a good value in balance rehabilitation	3.73	1.01	Moderately Acceptable	3
Mean	3.79		**Moderately Acceptable**	

The questions are ordered in descending order according to the acceptability level based on Durability. The tool's durability scored highly (3.73–3.83), indicating reliable function and resilience to environmental stressors. Question number two has the highest weighted mean of 3.83 followed by question number one got a 3.80, lastly the question number three got 3.73, resulting in a total mean score of 3.79.

In clinical settings, where regular usage and exposure to a variety of conditions are expected, durability is essential. The goggles' mean durability score (3.79) suggests that they can endure normal use conditions, This suggests suitability for long-term use in clinical and home rehabilitation settings. Which is consistent with research by Loro et al. (2023) that highlighted the significance of device robustness, particularly in robotic and wearable technology used in rehabilitation.

Table 5
Respondent's Level of Acceptability in terms of Appearance

	Weighted Mean	Standard Deviation	Verbal Interpretation	Rank
1. The tool has good materials	3.83	0.83	Moderately Acceptable	1
2. The tool is comfortable to wear	3.50	0.94	Moderately Acceptable	2
3. The tool is applicable in balance rehabilitation	3.47	1.17	Moderately Acceptable	3
Mean	3.60		**Moderately Acceptable**	

The questions are ordered in descending order according to the acceptability level based on Appearance. Based on the first question, materials were rated as good with a weighted mean of 3.83, while question number two had a lower rating of comfort during usage 3.50, but on question number three, it was regarded as applicable in balance rehab 3.47. Resulting in a total mean score of 3.60.

Given a moderate mean score of 3.6, appearance demonstrated respectable comfort and aesthetics. Lubetzky (2021), who highlighted the importance of visual and environmental comfort in rehabilitation settings, is in agreement with this. Visual attractiveness may affect a patient's willingness to participate in therapy, even though it is not a major determinant of efficacy.

Table 6
Respondent's Level of Acceptability in terms of Usability

	Weighted Mean	Standard Deviation	Verbal Interpretation	Rank
1. The tool is helpful in executing treatment	3.40	1.13	Acceptable	1
2. The tool is helpful to improve my performance	3.07	1.01	Acceptable	3
3. The tool is useful in my line of work	3.27	1.08	Acceptable	2
Mean	3.24		**Acceptable**	

The questions are ordered in descending order according to the acceptability level based on Usability. Received the study's lowest scores, which ranged from 3.07 to 3.4 and were all classified as acceptable, instead of "Moderately Acceptable." Question number one is ranked first with a mean of 3.40, followed by question number three with a mean of 3.27, question number two with a mean of 3.07, resulting in a total mean score of 3.24. This implies that although the instrument has a role in physical therapy practice, its efficacy, or how well it fits into everyday life may need more improvement or modification by the therapist.

The goggles were deemed to be reasonably useful for carrying out therapeutic activities, receiving a usability of total mean score 3.23. This supports worries expressed in the literature regarding the difficulties associated with complicated or overstimulating devices (e.g., Bowman et al., 2021; Bersotti et al., 2024). Motion sickness goggles offer a simpler,

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less intrusive option to more expensive or immersive technologies like virtual reality. They are particularly helpful in settings where cutting-edge technology might not be available.

Table 7
Respondent's Level of Overall Acceptability (questionnaire)

	Weighted Mean	Standard Deviation	Verbal Interpretation	Rank
Ease of Use	4.00	0.97	Moderately Acceptable	1
Durability	3.97	0.89	Moderately Acceptable	2
Appearance	3.70	0.92	Moderately Acceptable	3
Usability	3.60	1.04	Moderately Acceptable	4
Total Mean	3.82		**Moderately Acceptable**	

The findings indicate that the tool's acceptability for use is generally moderate. Ease of use, durability, appearance, and usability with all sub-problems being factored in which tells that it can be considered for an effectiveness study in the future.

DISCUSSION

Findings

The findings of the Study are presented as follows:
1. Wobble board had the most percentage with 23.3% for the most common tool used in balance rehabilitation followed by Vestib ball (21.36%) and Bosu Ball (13.59%) based on the given answers by the respondents.
2. In terms of challenges and limitations, lack of equipment garnered the highest percentage by 39.58%.
3.1. Moderately acceptable was the result of the acceptability in terms of the ease of use with the weighted mean of 3.96. The sub-question "The tool is easy to use" attained the highest mean rating of 4.13.
3.2. The durability of the motion sickness goggles had 3.79 based on the weighted mean resulting in moderate acceptability. The sub-question "The tool resisted damage from common environmental factors" attained the highest mean rating of 3.83.
3.3. The level of acceptability in terms of appearance was 3.60 which means that the tool is moderately acceptable, has good materials, comfortable to wear and is applicable in balance rehabilitation. The sub-question "The tool has good materials" attained the highest mean rating of 3.83.
3.4. Based on the answers given by the respondents. The usability of the tool was classified as acceptable with a weighted mean of 3.24. The sub-question "The tool is helpful in executing treatment" attained the highest mean rating of 3.40.
4. As for the overall acceptability, the level of acceptability is moderately acceptable with a weighted mean of 3.82. The sub-problem "ease of use" attained the highest mean of 4.00.

CONCLUSIONS

1. Traditional and low-cost tools remain dominant in clinical settings due to their effectiveness, accessibility, and familiarity. High-tech tools such as VR were rarely used, suggesting barriers related to cost, training, or complexity.
2. Clinical barriers in balance rehabilitation include limited resources, patient-related factors, and environmental constraints. These challenges support the need for affordable, space-efficient, and patient-friendly innovations.

3. Respondents found the goggles less strong in terms of usability and appearance, suggesting the need for design improvement and clinical adaptation.
3.1 Therapists found the goggles generally easy to use and maintain. This supports their potential for quick adoption in clinical settings with minimal training needed.
3.2 Therapists perceived the device as reasonably durable, indicating its potential for consistent use in varying rehabilitation environments.
3.3 The aesthetics and comfort of the device are moderately acceptable but may benefit from improvements in style, fit, and appeal to enhance user compliance.
3.4 While the tool is seen as useful, it scored lowest in this category. This suggests the need to improve clinical integration and practical application during therapy sessions..
4. Motion sickness goggles were generally accepted by physical therapists as a potential tool in balance rehabilitation. Their ease of use and durability were strengths, while usability and aesthetic aspects warrant further development. The results support conducting future studies focused on efficacy and patient-centered outcomes.

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