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Acceptability of Motion Sickness Goggles for Balance Rehabilitation

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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; Cognitive Load Theory; Sensory Integration

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.,* [1] 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

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goggles are primarily used to alleviate the symptoms of motion sickness. According to Joy [2], 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 [3]. This suggests that the horizon can help prevent motion sickness, as [3] 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 GP, *et al.,* [4], 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 [4], 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.,* [5] 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.

Methods

A quantitative descriptive research design was employed. This method systematically describes the characteristics and perceptions of respondents without manipulating variables, making it suitable for assessing acceptability. The study is anchored on the Cognitive Load Theory, which explains how sensory information is processed. By providing a stable visual reference (artificial horizon), the goggles reduce conflicting sensory input, lower cognitive load, and allow patients to focus on balance control. The sample consisted of 30 licensed physical therapists with at least two years of experience in balance rehabilitation, practicing in hospitals, rehabilitation centers, or home care settings in Metro Manila and Laguna.

Results

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 (Table 1).

According to Thompson *et al.,* [6], 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 [7], but their complex setup and overstimulating effects limit their use in standard practice (Table 2).

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

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.,* [8] emphasized the need for cost reduction and easier setup in robotic and sensor-based technologies. Similarly, the study by Bautista *et al.,* [1] 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

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

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**	-

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**	-

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**	

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**	-

into clinical practice. Additionally, patient concerns such as fear of falling impact rehabilitation. According to Honaker & Kretschmer [9], 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).

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 [2] 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.,* [7], who highlighted the necessity of useful and easy-to-use tools for balance rehabilitation (Table 4).

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.,* [8] that highlighted the significance of device robustness, particularly in robotic and wearable technology used in rehabilitation (Table 5).

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 [10], 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).

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

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**	-

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 support worries expressed in the literature regarding the difficulties associated with complicated or overstimulating devices (e.g., [7, 11]). Motion sickness goggles offer a simpler, 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).

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.

Conclusions and Recommendations

Based on the findings of the study, it is concluded that wobble boards, vestibular balls, and BOSU balls are the most commonly used tools in balance rehabilitation, while the lack of equipment remains the primary challenge encountered in clinical practice. Motion Sickness Goggles obtained an overall mean of 3.82, which classifies them as Moderately Acceptable; specifically, the device received the highest ratings in terms of ease of use and durability, but lower scores in appearance and usability. Despite these limitations, physical therapists recognize the potential of Motion Sickness Goggles as an adjunctive tool rather than a direct replacement for existing rehabilitation equipment. Accordingly, it is recommended that manufacturers improve the ergonomic design, comfort, and fit of the device to enhance patient compliance; that clinicians utilize the goggles as a complementary intervention alongside conventional exercises while developing clear application guidelines for safe and effective use; that future researchers conduct experimental studies to measure the actual effects of the device on balance outcomes, compare its performance with other established tools, and evaluate its long-term clinical application; and that healthcare institutions consider including Motion Sickness Goggles in their equipment inventories as a low-cost, practical addition to vestibular rehabilitation programs.

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