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Responsiveness of Wii Fit Balance Board to the change after physical therapy and rehabilitation of lower limb lymphedema following thigh liposuction

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ABSTRACT

The aim of this study was to measure and calculate the responsiveness of the Wii Fit Balance Board after physical therapy and rehabilitation of patients with lower limb lymphedema following thigh liposuction. The design of the study was a non – experimental, observational study. Sixty-three female patients with lymphedema following thigh liposuction, with a mean age of 51.2 years and who were undergoing physical therapy and rehabilitation, participated in this study. The Wii Fit Balance Board was used as a study instrument. Participants were asked to stand on the Wii Fit Balance Board (feet without sleeves), using skiing games for 10 seconds and 2 weeks apart after physical therapy treatment; the sixty-three patients were asked to do the same task again. The first score and second score were recorded respectively. Responsiveness of the Wii Fit Balance Board was measured by utilizing the standardized response mean (SRM) and the effect size (ES). Our study results showed that the Wii Fit Balance Board has an excellent responsiveness after physical therapy and rehabilitation of patients with lower limb lymphedema following thigh liposuction, as observed by ES and SRM values of 1.3 and 1.4 respectively. In conclusion, the Wii Fit Balance Board has a large degree of responsiveness after the physical therapy and rehabilitation program for patients with lymphedema following thigh liposuction.

KEYWORDS

Responsiveness; Wii Fit Balance Board; Lymphedema; Thigh Liposuction

1. INTRODUCTION

A virtual setting made by a computer is characterized as a built functional region of multisensory interaction with an easily governed motivational aim (Adamovich et al., 2009). A

virtual reality interface gadget developed by moo financial fetched provides more prominent openness and transferability for individuals with CP (cerebral palsy) in neurological care settings. The Nintendo Wii architecture makes virtual reality treatment simple and affordable (Rojas & Rebolledo, 2014). The Nintendo Wii and its fringe adjust board has been promoted as training equipment to help the elderly, persons with add-on knee replacements, stroke patients, and Parkinson's disease sufferers to improve their standing abilities (Fung et al., 2012).

Other research has recently determined how well two Wii Fit body test parameters correlate with standardized adult health, balance, and portability assessments (Reed-Jones et al., 2012). The "Basic Adjust Test" and "Prediction Test" in the Wii Fit computer program were compared to a set of clinical assessments. Clinical testing and results from Wii Fit software-based balancing exams had a minimal connection in general (Gras et al., 2009). The majority of adjusting intercessions, including the Wii Fit system, have depended on the balance-specific training games included with the Wii Fit computer application. The purpose of the Wii Fit balance games is to move a virtual representation of the player (dubbed a "Mii") on a television screen by moving the player's center of pressure (COP) over the Wii Balance Board (WBB). COP control is required along a single axis (e.g., medial-lateral) in a few games, limiting the user's control of the character. Other diversions include more obvious COP control through synchronized relocation along both the medial-lateral and anterior-posterior tomahawks (Deutsch et al., 2011).

In addition to the standard Wii Fit diversions, a tiny group of researchers has attempted to make their own modified mediation diversions employing COP data from a customized WBB computer program application. This technology enables the design of recreations that are specifically adapted to the needs of a specific demographic, such as the elderly or individuals with cognitive impairment. These programs can also record in-game execution, which could be beneficial for developing unique execution metrics (Gil-Gomez et al., 2011).

When excess liquid fills the extracellular space after liposuction, it causes extracellular lymphedema. Extracellular edema is caused by obstructed lymphatic seepage and insufficient capillary filtration. Lymphedema can't be confused with venous capillary edema. In two ways, the surgical effect of liposuction on lymphatics is unique. First, the majority of lymphatic capillaries within the targeted adipose tissue are disrupted or destroyed during liposuction. Second, the damage caused by liposuction to lymphatic capillaries is not permanent; lymphatic capillaries recover within a few weeks of being ripped apart by a liposuction cannula. Lymphatic damage, on the other hand, is irreversible after surgical lymph node dissection (Majino & Joris, 1994).

Lymphedema, according to researchers, can be difficult to manage in terms of postural balance (Angin et al., 2014). Chang et al. (2013) assessed the validity and reliability of a questionnaire for senior individuals. The Wii Fit balance board is recommended as an alternative tool for measuring senior people's balance ability. Thus, the aim of this study is to measure and calculate the Wii Fit balancing board's response after physical therapy and rehabilitation of patients with lower limb lymphedema following thigh liposuction.

2. METHODS

2.1. Subjects and design

The design of the study was a non - experimental two - stage observational study. The Wii Fit Balance Board was adopted because it is legitimate, dependable, and easy to use. From January 1st to November 20th, 2021, 63 female patients with lymphedema after thigh liposuction were treated at the lymphedema unit of the MG Clinic. The study included 63 female patients who were undergoing physical therapy and rehabilitation. Inclusion criteria: (1) Age: + 35, (2) patients with lower limb lymphedema following thigh liposuction, (3) being aware of the Wii Fit Balance Borad' benefits, (4) patients with no other lower limb injuries. Exclusion criteria: (1) patients with cognitive impairment as it would be hard to understand the Wii Fit assessment tool, (2) patients with visual or auditory complications, (3) patients with psychological disorders that would prevent them from taking part in the study process. All participants' rights were preserved ethically, and their names and identifying information would not be included in the study's database.

2.2. Instrument

2.2.1. Wii Fit Balance Board

The Nintendo Wii Fit was released just over five years ago to advance essential wellness and overall well-being. The ubiquity of poor adapts and disastrous falls, which are typically witnessed in more seasoned adults and numerous incapacity problems, has piqued interest in Wii Fit innovation (Goble et al., 2014). The Wii Fit balance board could be a useful appraisal tool.

The WBB-based framework consisted of the WBB (Figure 1), a laptop with Bluetooth, and a computer program (Balancia v1.0, Minto frameworks, Seoul, Republic of Korea) for signal gathering and analysis. With four stack cells, the WBB was predicted to be 45 x 26.5 cm. Data was transferred between the WBB and the laptop using the built-in Bluetooth and the Balancia software. The Balance application was built with C++ and LabVIEW. To filter the data at 50 Hz, a 4th order Butterworth

moo pass channel with a cut-off frequency of 12 Hz was utilized. The review constrains platform (AMTI, Waterton, MA, USA) was 50 × 50 cm in size and contained four six-axis stack cells (Park & Lee, 2014).

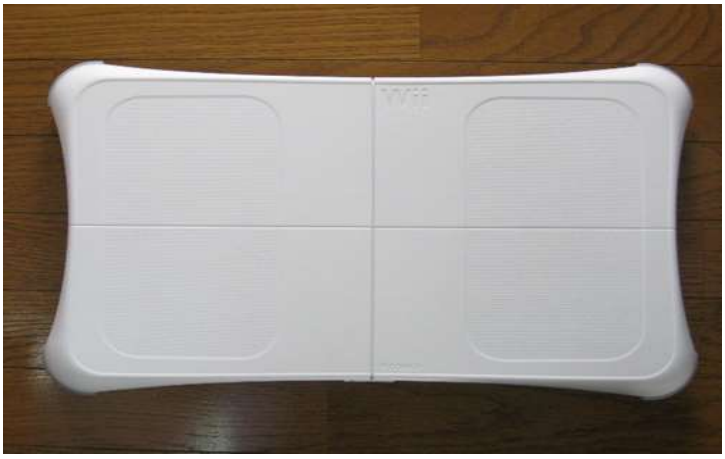

Figure 1. The Wii Fit Balance Board

2.3. Procedures

Responsiveness is a component of the validation process that refers to an instrument's ability to detect change over time (Keller et al., 2004). It is frequently measured using the effect size (ES) and the standardized response mean (SRM) (Jeon et al., 2011).

Sixty-three female patients with lower limb lymphedema following thigh liposuction were instructed to stand on the Wii Fit Balance Board (feet without sleeves), using skiing games for 10 seconds at the first session after initial evaluation. Weight distribution and the balance difference score between the right and left lower limb according to the center of balance (first score) were recorded. All patients have received the same rehabilitation program, which included: pneumatic compression pump, manual lymphatic drainage, kinesio-taping, bandaging, and balance training. Then, they were instructed to stand on the Wii Fit Balance Board (feet without sleeves) again, using skiing games for 10 seconds. After 6 sessions of the mentioned rehabilitation program, the balance board and the second scores were recorded. All data were recorded for weight distribution and balance difference score between the right and left lower limbs according to the center of balance (second score).

2.4. Statistical Analyses

The Statistical Package of the Social Sciences (version 24.0) was used for data analysis. Descriptive analysis was used to measure participant demographics (age and gender). The Wii Fit

Balance Board's responsiveness as an assessment tool was evaluated using the standardized response mean (SRM) and effect size (ES), and responsiveness to change for the Wii Fit Balance Board as an assessment tool was assessed using paired t-test.

3. RESULTS

3.1. Socio-demographic characteristics of the participants

Table 1 shows the socio-demographic characteristics of the sixty-three female patients who participated in this study and were treated at the MG Surgery Physical Therapy Clinic. The patients ranged in age from 37 to 59 years, with a mean±SD of 51.2±5.15.

Table 1. Socio-demographic characteristics of the participants

Variable	**N (%)**
Gender	
Females	63 (100)
Age (M±SD)	51.2±5.15

3.2. Responsiveness to the change

For both scores, the standardized response mean (SRM) and effect size were utilized to examine responsiveness statistics (ES). The SRM is calculated by multiplying the mean change in scores between baseline and follow-up by the standard deviation (SD) of the individual score changes. The ES is the mean change in the score between baseline and follow-up, and this mean change is divided by the SD of the baseline score. The higher the SRM or ES, the more responsive the system is (Jeon et al., 2011). The values of 0.5, between 0.5 and 0.8, as well as 0.8, were derived based on the degrees of the responsiveness numerator (Jeon et al., 2011).

The responsiveness of change was calculated through the following formula:

$$\textbf{SRM} = \frac{|\bar{x}\mathbf{3}-\bar{x}\mathbf{1}|}{\boldsymbol{SD3}}$$

$$\textbf{E. S}= \frac{|\bar{x}3-\bar{x}1|}{SD1}$$

According to the aforementioned formula, the responsiveness of the Wii Fit Balance Board was shown to be excellent, as observed by the ES and SRM values of 1.3 and 1.4 respectively (Table 2).

Table 2. Statistical results of the Wii Fit Balance Board responsiveness

Instrument	1st Score		2nd Score		Change	Responsiveness	
	$Mean_1$	SD_1	$Mean_2$	SD_2	Mean	SRM	ES
Wii Fit Balance Board	12.86	9.6	26.79	10.30	-13.9	1.4	1.3

As shown in Table 2**,** the Wii Fit Balance Board has excellent responsiveness after physical therapy and rehabilitation of patients with lower limb lymphedema following lhigh liposuction. As for results of the Wilcoxon signed-rank test (Table 3), we can see that we have clear variances in the mean of the first (M = 26.79, Ds = 10.30) and second scores (M = 12.86, Ds = 9.6) for the overall score (M = 13.9) of the Wii Fit Balance Board for 63 patients. Also, the Wilcoxon signed-rank test shows that in total we have 62 negative ranks, 1 positive rank and 0 ties. So the total of the ranks for the negative differences is 2013.50, resulting in a mean rank of 32.84 whilst the total of the ranks for the positive differences is 2.50, resulting in a mean rank of 2.50. The mean of the negative ranks is larger than that for positive ranks, so we have a significant difference between mean ranks as p-value shows (p = 0.001) (Table 3).

Table 3. The Wii Fit Balance improvement result

	First Score	Second Score	Total mean score difference
Mean±SD	26.79±10.30	12.86±9.6	13.9

	Rank				
	N	**Mean rank**	**Sum of rank**	**Z**	**p**
Negative ranks	62	32.84	2013.50	-6.884	0.001
Positive ranks	1	2.50	2.50		
Ties					
Total	63				

4. DISCUSSION

The aim of the current study was to measure and calculate the responsiveness of the Wii Fit Balance Board after physical therapy and rehabilitation of patients with lower limb lymphedema following thigh liposuction. This study was performed on 63 female patients with lower limb Lymphedema following thigh liposuction. Their ages ranged from 37 to 59 years with a mean age of M = 51.2, SD = 5.15. It was carried out in MG Physical Therapy Surgery Clinic. Our study results showed that the Wii Fit Balance Board has an excellent responsiveness after physical therapy and

rehabilitation of patients with lower limb lymphedema following lhigh liposuction, as shown by the ES and SRM values of 1.3 and 1.4 respectively (Table 2). So, the Wii Fit balance board was found to have good reactivity and the ability to detect change after physical therapy and rehabilitation for people who had lower limb lymphedema after thigh liposuction.

Erik et al. (2012) examined the intra- and inter-session dependability of Wii Fit balance scores, as well as the concurrent validity of the Nintendo Wii balance board with the Wii Fit game. They investigated the gadget with forty-five active people and discovered that it has poor concurrent validity and dependability. Also, Park & Lee (2014) assessed the stability and validity of balance testing software that included the Nintendo Wii balance board. They found it to be a reliable assessment device after testing inter-rater reliability, intra-rater reliability, and concurrent validity on twenty healthy participants. The device is surprisingly affordable, flexible, and effective for assessing balance in clinical situations. The researcher continues to evaluate the Nintendo Wii balance board's remaining psychometric qualities in this study by analyzing responsiveness to change after a physical therapy and rehabilitation program in sixty-three people who had lower limb lymphedema after thigh liposuction.

This study found that the Wii Fit Balance Board had a satisfactory level of response after a physical therapy and rehabilitation process for cases with lower limb lymphedema after thigh liposuction. Other psychometric features of the WBB, such as sensitivity and specificity, will be a useful topic for future research, according to the researcher.

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AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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