Interactive videogame versus core stability exercises on postural control in female patients with overweight

Shimaa G. El Sayed[1], Aya Fawzy Mohamed Ali[2], Haitham M. Elmasry[3], Zeezy S. Eraky[4], Sara S. El-Din[5], Amira Hassan Abdelaziz[6], Dalia Galal El Sayed[7]

Abstract

Background: Obesity is a chronic, neurobehavioral disease influenced by genes and environmental factors affecting brain development. Purpose: The purpose of this study is to compare the effects between videogame exercises and core stability exercises on postural control dysfunction in female patients with overweight. Methods: Forty patients (women) aged 40-60 years with body mass index over 25 were randomly assigned into the following two groups. Group (A) received the Wii fit balanced exercises for three times per week for four weeks as total treatment duration in form of (Ski Slalom, Advanced Skiing, Ski Jumping followed by Header and Jump Rope).; Group (B) received core stability exercises for 4 weeks (3times/week) in form of 1. Supine bridge (3 sets x 10 repetitions x 10 second holds), 2. Curl up (3 sets x 10 repetitions), 3. Supine unilateral bridge (3 sets x 10 repetitions for each leg x 10 second holds), 4. Abdominal crunching (10 repetitions x 10 second holds), 5. Plank (3 sets x 10 repetitions) and 6. Bird dog (3 sets x 10 repetitions for each limb). Results: The between-group analysis showed significant improvement in group A after treatment ($p<0.05$). Discussion: Videogame exercises are effective more than core stability exercises in the treatment of postural control dysfunction in female patients with overweight.

[1]Lecturer in Department of Physical Therapy for Internal Medicine and Surgery
E mail: Shima.Galal@acu.edu.eg
[2]Assistant Professor, Department of Physical Therapy, Faculty of Allied Medical Sciences Philadelphia University, Amman, Jordan E mail: ayafawzy865@gmail.com Orcid ID : 0009-0009-6403-8060
[3]Lecturer at the Department of Physical Therapy for Basic Science, Faculty of Physical Therapy, MTI University. E mail: haitham.momen@pt.mti.edu.eg
[4]Lecturer at the Department of Physical Therapy for Internal Medicine and Elderly, Faculty of Physical Therapy, MTI University. E mail: Zeezyeraky@gmail.com
[5]Department of Physical Therapy, College of Applied Medical Sciences, Najran University, Najran, Saudi Arabia E mail: sara.salah.ssed@gmail.com
[6]Department of Physical Therapy for Paediatrics and Women Health, Faculty of Physical Therapy, Ahram Canadian University (ACU), Giza, Egypt. E mail: Amira.hassan@acu.edu.eg Orcid ID: 0009-0008-9578-3517
[7]Assistant Professor at the Department of Physical Therapy for Dermatology and Surgery, Faculty of Physical Therapy, MTI University. E mail: Dalia.galal@pt.mti.edu.eg

Keywords: Core stability exercises; Overweight; Videogame**.**

Introduction

Obesity is a serious health problem that affects people in industrialized and developing countries of all ages. A body mass index (BMI) of more than 25 kg/m2 is considered overweight, but an index of more than 30 kg/m2 is considered obese. Overweight and obesity are caused by a variety of variables, including environment, genetics and nutrition.[2] In addition to a greater death rate, obesity is linked to an increased risk of atherosclerosis, vascular problems, coronary artery disease, colon cancer, hypercholesterolemia, high blood pressure, gallbladder disease and metabolic disorders. [17]Psychosocial factors, bad diet and sedentary lifestyles all contribute to weight growth.[2]

Overly high lordotic curvature, issues with shifting one's weight and poor biomechanics are all consequences of obesity. These altered biomechanics cause postural instability, which impairs one's ability to balance. Therefore, an increased risk of falling as well as injuries and disability brought on by falls have been associated with obesity. [16] We need postural equilibrium to go about our daily lives in a normal manner. Equilibrium is the state in which the body is able to control its center of mass within the base of support and remains in balance.[9]

According to recent research, core stability is essential for preserving balance, functional mobility, gait, fall phobia and better anticipatory postural adjustment.[15] Exercises for core stability are voluntary movements that are designed to improve the neuromuscular control, strength, endurance, and coordination of the muscles that are essential for preserving the trunk's and spine's dynamic stability. In integrated kinetic chain activities, the capacity to regulate the trunk's position and motion over the pelvis and leg enables the best possible force production, transfer and control to the terminal segment.[1] As it stabilizes the pelvis and spinal column for "proximal stability for distal mobility," it is crucial to provide a strong foundation of core strength to apply or resist force.[12] The ability of the core to position the skeleton to withstand a force that remains constant is known as static core functionality.[10]

Nintendo introduced the Wii Balance Board (WBB), a gaming gadget that demands users to engage in physical activity. The Wii Fit app, which enables users to track their level of physical activity while completing the game's recommended workouts, was linked to the WBB. Considering that weight and postural data, such as the centre of pressure (CoP) path, can be estimated. WBB offers a few benefits, including affordability, accessibility and portability.[26] More recently, a great deal of research has been done on the beneficial effects of Wii Fit games on the motor, psychological, and physiological aspects of clinical patients, including people with Down syndrome, multiple sclerosis and Parkinson's disease, particularly in older adults.[27]

There is, however, not enough of study on the various effects of Videogame exercises on overweight patients.[23] In addition, no studies have been found to compare the effect of Videogame exercises and core stability exercise on postural control in female patients with overweight. Therefore, this study seeked to compare the effect of 4-weeks Videogame exercises and core stability exercise on postural control in female patients with overweight.

Methods

Design

This research was a randomized controlled trial that was performed from October 2022 to April 2023 in the outpatient MG clinic's physical therapy department.

Ethical Approval

The protocol of this study was approved by the ethical committee of the Faculty of Physical Therapy, Cairo University, Egypt **(No: P.T.REC/012/005653).**

Subjects

Following their informed agreement, forty female patients with overweight who ranged in age from 40 to 60 years were randomly assigned to two equal groups. For carrying out the randomization, a sealed envelope was used. The 40 patients who satisfied the inclusion criteria were gathered by a therapist before to the study's beginning, and each patient was given the task of choosing one of the sealed envelopes. Forty envelopes were sealed; twenty belonged to the enveloped group (A) and twenty to the group (B).

The study's inclusion criteria were as follows: (1) age between 40 and 60 years old; (2) overweight, or BMI over 25; (3) lack of pharmaceutical treatment; (4) absence of hormonal, orthopaedic, metabolic or cardiovascular illness at the time the research began; (5) ability to follow instructions; (6) ability to perform sit-to-stand transfers without assistance; (7) ability to ambulate independently prior to admission and adequate vision. The following were the exclusion criteria: Individuals suffering from mental illnesses; (2) thrombosis; (3) vision or auditory impairment; and (4) BMI is less than 25.

Material

Evaluation

An alternate technology for evaluating person's postural control is the Wii Fit balance board. Before and after four weeks of treatment, postural control was assessed using the Wii Fit Balance Board (Mac OS X v10.4, Nintendo, Japan). The measurement took place for five minutes. Every patient in this study was told to stand on the Wii Fit Balance Board, which calculates the center of pressure values for every case both before and after four weeks of therapy. The software will be able to display the real-time sensor readings, and the data from the sensors will be communicated over Bluetooth. To assess the state of balance, the center of gravity's average displacement will be computed. The force plate, which will be attached to a computer screen, includes four strain gauges and can measure the pressure caused by posture variations. The center of gravity point can be shown on the screen to gauge the user's level of balance and to give them visual feedback.[6] The left and right halves of the body's respective pressure levels were estimated using the balancing board. The ideal COP percentage is 50/50, or 1.00, because in a perfect world, each side of the body would contribute half of the strain applied to the board.[8]

Interventions

Without shoes, measurements of height, weight, and body mass was taken. Exercises was done in 30-minute sessions, with a two-minute break in between. Every patient completed twelve sessions. Three sessions every week. Each program included the patients for ten minutes each.[3]

Balance board working with Wii made up of hardware that included a Wii Fit balance board, a standard PC. To measure force distribution, WBB has four uni-axial vertical force transducers at each corner of the board.[4] The board's sensors have a 40 Hz factory sampling frequency and can measure up to 150 kg (330 pounds) with accuracy. The WBB's usable surface is 45 by 26.5 cm in size. The board uses Bluetooth protocol to establish wireless communication with other devices. The study participants may be viewed as players in an application that was implemented like a game. Following every game (trial test), a tabbed file including the frame time and raw data obtained from each sensor, organized as a temporal structure, was recorded.[22] The exercise was performed in form of (Ski Slalom, Advanced Skiing, Ski Jumping followed by Header and Jump Rope).

The patient received aural feedback from the system during the session. When the patient achieved her aim, the system provided a positive reinforcement; when the patient made a mistake, the system provided a different reinforcement. The WBB's sensitivity would be automatically adjusted to each patient's restrictions following configuration. An avatar mirrors the patient's motions on the screen as they climbed the balancing board. The apparatus would offer haptic feedback by vibrating the Wii remote control in addition to visual and aural feedback.[6]

For group (B), individuals in the core stability group will engage in the following core exercises three times a week for 4 weeks: 1. Supine bridge (3 sets x 10 repetitions x 10 second holds), 2. Curl up (3 sets x 10 repetitions), 3. Supine unilateral bridge (3 sets x 10 repetitions for each leg x 10 second holds), 4. Abdominal crunching (10 repetitions x 10 second holds), 5. Plank (3 sets x 10 repetitions) and 6. Bird dog (3 sets x 10 repetitions for each limb). Progression: Proceed if participants can complete 30 repetitions while holding each one for eight seconds.

Sample Size

Data Sampling was calculating by Using G Power software program. The appropriate sample size was determined by using a pre-post comparison of the subjects' responses, at the effect size of 0.25, power of 80%, and significance level of 5%. The appropriate sample size was 40 subjects. The patients were allocated randomly into two groups equally, by a computer-based randomization program, by an independent researcher. No dropping out of patients from the study was reported after randomization.

Results

Demographics were reported as mean± SD and were analysed with independent t-test (corrected value was used when violating homogeneity assumption as in BMI). Chi-square test was used for degerming differences between groups in the studied outcome (proportion of patients who reached normal/near normal symmetry index [85-117%] in Wii balance). Statistical package for social sciences (SPSS) software program (IBM, version 27) was used for analysis. Alpha was set at $P \leq 0.05$.

Baseline characteristics:

Age and BMI of patients of both groups were presented in table (1). There were no significant differences between groups regarding baseline characteristics ($p>0.05$). (Figure 1).

Table 1 Baseline characteristics.

	Group A (Study) Mean ±SD	Group B (Control) Mean ±SD	P-value
Age (Years)	54.4±2.5	54.2±2.7	0.76
BMI (kg/m^2)	28.05±1.2	27.7±0.98	0.28

BMI: Body mass index, SD: Standard deviation

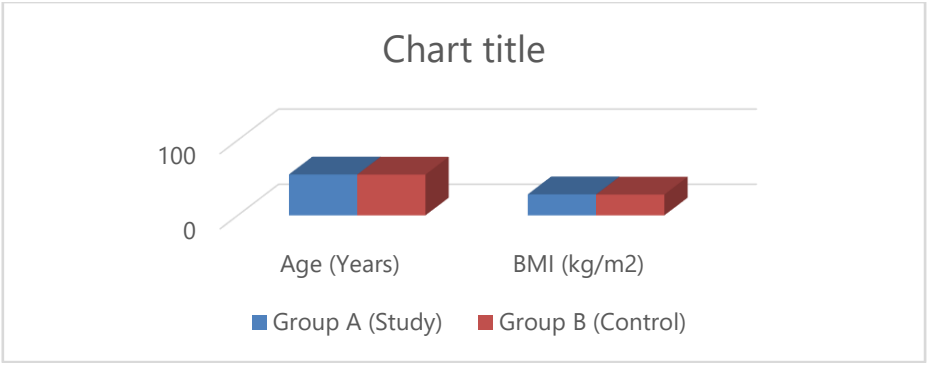

Fig. (1): Mean values of age and BMI in both groups.

Effect of intervention on WII balance (Symmetry index):

Symmetry index (SI) was calculated as ratio of balance scores on right side divided by balance scores of the left side; normal SI was defined here as range between 0.85 to 1.17. Balance scores of both sides and proportions of patients with normal SI within both groups at pre and post-treatment were shown in table (2). There was significant difference in proportion of patients with normal SI between groups, in favour of study group who had higher proportion of normal SI post-treatment (85% vs. 15%) (p>0.05). (Figure 2&3).

Table 2 Balance scores of both sides within both groups at pre and post-treatment.

Time	Side	Group A (Study) Median (IQR)	Group B (Control) Median (IQR)
Pre-treatment	Right limb	53.5 (30.8)	37.2 (32.7)
	Left limb	46.5 (30.8)	62.8 (32.8)
	SI (R/L)	1.21 (1.31)	0.59 (1.34)
	Proportion of patients with normal SI; normal/total (percentage)	1/20 (5%)	1/20 (5%)
Post-treatment	Right limb	49 (1)	43.3 (22.5)
	Left limb	51 (1)	56.7 (22.5)
	SI (R/L)	0.96 (0.04)	0.77 (0.88)
	Proportion of patients with normal SI; normal/total (percentage)	17/20 (85%)	4/20 (23.5%)
Chi-square test-value for proportions		16.94	
P-value		<0.001*	

BMI: Body mass index, IQR: Inter-quartile range, SI: symmetry index, P: probability, *: significant.

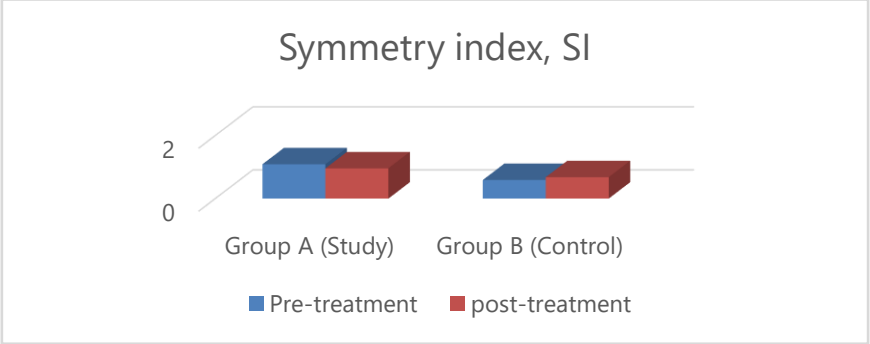

Fig. (2): Median symmetry index values for both groups pre and post-treatment

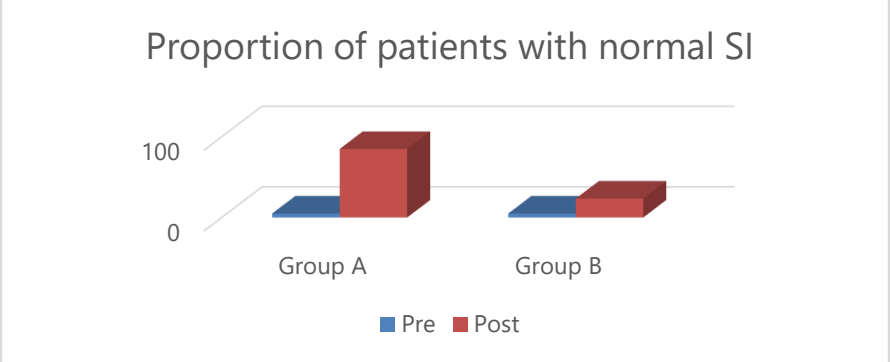

Fig. (3): Proportion of patients with normal SI (symmetry index, R/L) for both groups pre and post-treatment

Discussion

This study was conducted to compare and contrast the effects of Videogame exercises and core stability exercises on the postural control in female patients with overweight. According to our results, there was a statistically significant difference between group A and group B, Wii fit improve postural control more than core stability exercise and there is statistically significant difference between them. Our findings aligned with the findings of Rojas VG et al. who indicated that patients who receive Wii fit has a notable improvement in the static balance, with a notable decrease in the center of pressure (CoP) displacement area. These findings support the idea that Videogame exercises could be a beneficial health tactic for senior Individuals**.** [18]

As far as we are aware, this is the first study to evaluate how Videogame exercises affect the postural control of female patients with overweight. Additionally, the current study found that the Videogame exercises improve the postural control of female patients with overweight, which is in line with findings Toulotte C. et al. who indicated a substantial change in the center of mass position in the Wii training groups and the Wii-assisted adaptive physical activity group. [24] In order to test the static balance through the Wii platform, Young et al. built a interface that enabled feasible to calculate the center of pressure (CoP) incorporating it in virtual reality, recommending its usage as a low cost evaluation instrument. In a four-week period training with Wii, totaling 10 sessions of twenty minutes each, it was possible to acquire a considerable improvement in anteroposterior corporal balance in closed-eyes condition following training. [25]

According to Liu et al., Wii Fit exercise may be a helpful strategy for improving the functional, static, and dynamic balance of older adults as compared to those who did not participate in physical activity. [14] Sayed et al. Suggested that when it comes to treating balance issues in people with postmastectomy unilateral lymphedema, Wii Fit balance exercises are more beneficial than core stability exercises. [20]

Batista et al. stated that proprioceptive stimuli through plantar receptors, which are crucial for preserving balance during barefoot exercises, can be provided by Nintendo Wii Fit via the Nintendo Wii Balance Board. [5] According to a prior study, both immediately following training and at the 1-month follow-up, Wii Fit exercisers shown significant improvements in their vestibular integration and visual integration skills when compared to the control group. [13] The patient can see on the screen which lower limb moves more weight during the alternate hip movements, resulting in a displacement of the center of gravity, by using the Nintendo Wii Balance Board. [5] During the exercise session, the patient can receive visual feedback from the Nintendo Wii Balance Board. Games that provide visual feedback can be used in a healthcare context to improve functional condition and aid in short-term rehabilitation. Additionally, the exercises can boost patients' interest and treatment compliance when done in a group setting. [21]

In contrast to our findings, Cho et al. reported that virtual reality balance training (VRBT) did not significantly enhance patients' static balance. According to theses results, neither group's Time Up and Go much improved. Their increased training duration and sample size could be the cause of this discrepancy.[7]

Implications of Physiotherapy Practice

Videogame exercises are effective more than core stability exercises in the treatment of postural control dysfunction in female patients with overweight.

References

1. Akuthota V., Ferreiro A., Moore T. and Fredericson M.(2008): Core stability exercise principles. Current sports medicine reports ;7(1):39-44.
2. Alice A., Yadav M., Verma R., Kumari M. and Arora S. (2022): Effect of obesity on balance: A literature review. International Journal of Health Sciences;6(S4), 3261–3279.
3. Barcala L., André L. F., Roberto P., Grecco C. and Collela F. (2013): Visual biofeedback balance training using Wii Fitafter stroke: A randomized controlled trial. J. Phys. Ther. Sci.; 25: 1027–1032.
4. Bartlett H. L., Lena H.T., Jeffrey T.B. (2014):"Accuracy of force and center of pressure measures of the Wii Balance Board". Gait&Posture; 39.1:224-228.
5. Batista J.S., Wibelinger L.M., De Marchi A.B. and Pasqualotti A.(2014): Evaluation and physiotherapeutic intervention in older with deficit balance through the Scale of Berg and Wii Balance Board platform. ISSN 0103-5150 Fisioter. Mov., Curitiba, v. 27, n. 1, p. 21-28, jan./mar.
6. Chang W., Lee C. and Feng C. (2013): Validity and reliability of Wii Fit balance board for the assessment of balance of healthy young adults and the elderly. J Phys Ther Sci ; 10: 1251–1253.
7. Cho G., Hwangbo G. and Shin H. (2014): The effects of virtual reality-based balance training on balance of the elderly. J. Phys. Ther. Sci.; 26: 615–617.
8. Clark R., Bryant A., Pua Y., McCrory P., Bennell K. and Hunt M. (2010): Validity and reliability of the Nintendo Wii balance board for assessment of standing balance. Gait and Posture; 31(3): 307-310.
9. Emara A., Mahmoud S. and Emira M.(2020): Effect of body weight on static and dynamic posturography. Egypt J Otolaryngol; 36, 12.
10. Israely S., Leisman G. and Carmeli E.(2018): Neuromuscular synergies in motor control in normal and poststroke individuals. Rev Neurosci ;29(6):593-612.
11. Kanga K., Choib J. and Lee S. (2012): Effect of Core Strengthening Exercise Programs on Symmetric Double Limb Support and Balance Ability for the Elderly. J Int Acad Phys Ther Res.;3(1):345-411.
12. Kibler W.B., Press J. and Sciascia A.(2006): The role of core stability in athletic function. Sports Medicine;36(3):189-198.
13. Liao Y.Y., Yang Y.R., Wu Y.R. and Wang R.Y.(2015): Virtual reality-based Wii fit training in improving muscle strength, sensory integration ability, and walking abilities in patients with Parkinson's disease: a randomized control trial. Int J Gerontol. 1873-9598
14. Liu H., Xing Y. and Wu Y. (2022): Effect of Wii Fit Exercise With Balance and Lower Limb Muscle Strength in Older Adults: A Meta-Analysis. Front. Med.; 9:812570.
15. Marzolini S., Robertson A.D., Oh P., Goodman J.M., Corbett D. and Du X.(2019): Aerobic Training and Mobilization Early Post-stroke: Cautions and Considerations. Frontiers in neurology;10:1187.
16. Mondal R., Banik P., Ritu R., Mashreky S. and Zaman M. (2021): Associations of obesity with balance and gait among young adults in bangladesh. journal of xiangya medicine; 6. doi:10.21037/jxym-21-19.
17. Palwe J.S., Ghumatkar M. and Kumar A.(2020): Assessment of Balance in Obese Women with Respect to Grades of Obesity. International Journal of Current Advanced Research; 22360-22363.
18. Rojas V.G., Cancino E.E., Silva C.V., López M.C. and Arcos J.(2010): F. Impacto del entrenamiento del balance a través de realidad virtual en una población de adultos mayores. Int J Morfol.;28(1):303.
19. sagar J., Ghumatkar M. and kumar A. (2020): Assessment of balance in obese women with respect to grades of obesity. International Journal of Current Advanced Research; Vol. 9, Issue 05(E), pp.22360-22363.
20. Sayed S. G. E., Baky A. M. A. E., Waked I. S. A.- aziz and Mohamed A. E. (2022): Virtual reality balance training versus core stability exercises on balance in patients with unilateral lymphedema. International Journal of Health Sciences; 6(S2), 5151–5160.
21. Scheffer A.C., Schuurmans M.J., van Dijk N., van der Hooft T. and de Rooij S.E.(2008): Fear of falling: measurement strategy, prevalence, risk factors and consequences among older persons. Age Ageing; 37(1):19-24.
22. Sgrò F., Monteleone G., Pavone M. and Lipomaa M.(2014): Validity Analysis of Wii Balance Board Versus Baropodometer Platform Using an Open Custom Integrated Application. AASRI Procedia; 10.1016/j.aasri.08.005.
23. Staiano A. E., Beyl R. A., Guan W., Hendrick C. A., Hsia D. S. and Newton R. L. (2018): Home-based exergaming among children with overweight and obesity: A randomized clinical trial. Pediatric Obesity; 13, 724–733.
24. Toulotte C.,Toursel C. and Olivier N. (2012): Wii Fit training versus adapted physical activities: which one is the most appropriate to improve the balance of independent senior subjects? A randomized controlled study. Clin Rehabil.;26(9):827-35.
25. Young W., Ferguson S., Brault S. and Craig C. (2011): Assessing and training standing balance in older adults: a novel approach using the 'Nintendo Wii' Balance Board. Gait Posture.; 33(2):303-5.
26. Wikstrom E.A.(2012): "Validity and reliability of Nintendo Wii Fit balance scores". Journal of Athletic Training; 47.3:306-313.

27. Willaert J., De Vries A. W., Tavernier J., Van Dieen J. H., Jonkers I. and Verschueren S. (2020): Does a novel exergame challenge balance and activate muscles more than existing off-the-shelf exergames? Journal of NeuroEngineering and Rehabilitation; 17, 6.