

# EFFECTIVITY OF NINTENDO WII AS REHABILITATION THERAPY IN POST STROKE PATIENTS: A SYSTEMATIC REVIEW

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## ABSTRACT

Post stroke patients need medical rehabilitation to live an independent life. Nintendo Wii technology presents an alternative choice that is quite safe, feasible, and has a high potential in rehabilitating & restoring motor function in post stroke patients. Although it has been widely used as adjunct therapy in stroke rehabilitation facilities throughout the world, only a few acknowledge its effectivity in post-stroke patients. This study aims to conduct a systematic review in order to identify and assess the results used in evaluating Nintendo Wii technology as rehabilitation therapy for stroke patients. Thus, the study used for this research is systematic review. Materials included in this study are research/studies found in NCBI, PubMed, Cochrane and other relevant online databases. From this research, it is found that Virtual Reality (VR) such as Nintendo Wii considered as an additional rehabilitation therapy that provides a significant improvement in various aspects of exercise therapy, such as; balance; walking ability; statistical and dynamic strengths; motivation as well as socialization; and recovery of physical function in stroke patients. Nintendo Wii can also be used safely in stroke patients and there have been no reports of side effects from this therapy.

**Keywords:** Stroke, nintendo wii, rehabilitation, therapy

## Introduction

Stroke is defined as a state of partial or total loss of neurological function (focal or global neurological deficits) that occurs suddenly, lasts more than 24 hours or causes death, which is solely caused by circulatory disorder of the brain due to reduced blood supply which is also called an ischemic stroke or spontaneous rupture of blood vessels known as hemorrhagic stroke.<sup>1</sup> In 2012, WHO data revealed that stroke is the leading cause of disability and the second cause of death worldwide. The total number of stroke patients based on healthcare workers' diagnosis in 2013 was 1,236,825 people (7.0%) and based on symptoms were 2,137,941 people (12.1%).<sup>2</sup>

Stroke management is generally divided into two stages. The first stage is the acute stage, where the goal of treatment is to save neurons and prevent other pathological processes that possibly threaten brain function. The second stage is the post acute stage or the recovery stage, where patients need more comprehensive treatment to minimize disability.<sup>3</sup> For post-stroke patients, medical rehabilitation interventions are needed so that they are able to independently take care of themselves and carry out daily life activities without being a burden to their families and surroundings.

Ischemic stroke will cause hypoxia and cause damage to brain neurons. However, brain neurons have plasticity, which has the potential to adapt to changes and compensate for the loss of function in other parts of the brain to restore normal brain function.<sup>4</sup>

Over the course of time, more effective stroke therapies have developed to prevent the severity of brain damage area. Nowadays, neuroscience research proves that there are neuroplasticity and neuro-regeneration activity in the central nervous system that runs in a human's body. The ability of the brain to learn new behaviors, form new memories, and change involved neural structures that are responsible for learning is called neuroplasticity.<sup>5</sup>

On the other hand, neuro-restoration is one of the active procedures involved in repairing damaged nervous systems functionally and pathologically. This neuro-restoration includes the process of forming new neurons (neurogenesis), new vascularization (angiogenesis), and the formation of synapses between neurons (synaptogenesis). It is hoped that the development of neuro-restoration therapy can reduce stroke morbidity in the future.<sup>6</sup>

Various factors regulate neurogenesis in the brain which also play a role in the neurogenic response to ischemic injury, one of which is rehabilitation/post-stroke training.

Table 1. Data Extraction

References	Objectives	Methodology	Result	Conclusion
Bang et al 2016 <sup>11</sup>	To investigate the effects of Nintendo Wii <sup>TM</sup> on balance and walking for stroke patients.	40 stroke patients divided into 2 groups: virtual reality training group and treadmill group. Both groups completed a 40-minute exercise 3x/week for 8 weeks. Their balance and ability to walk were measured before the program had started and after they fully completed the program.	Both groups revealed a notable difference in left/right and anterior/posterior weight-bearing. A significant difference in the stance phase, swing phase, and cadence also showed in the VR training group.	This study implies that virtual reality training which provides visual feedback allows stroke patients to correct their weight center and move visually. VR training most likely fit patients who want to regain their balance and walking ability by encouraging their interest to carry out programmed exercises regularly.
Tülay Tarsuslu & Şimşek & Kübra Çekok (2015) <sup>9</sup>	To analyze the outcomes of balance and upper extremity training program using Nintendo Wii on subacute stroke patients' daily living activities and quality of life.	The sample population was 42 stroke patients with a mean age of 58.04 and the average stroke recurrence time was 55.2 days ~ 8 weeks. Participants were randomly assigned to join the Nintendo Wii group (n = 20) and the Bobath Neuro Developmental Treatment (NDT) group. Visual Analog Scale (VAS) used as an assessment tool for satisfaction evaluation during the training. However, at the end of the training program (10 weeks), further evaluation was executed using the Functional Independence Measure (FIM) and the Nottingham Health Profile (NHP). FIM was the assessment tool used to evaluate the functional status of patients throughout the rehabilitation process, as well as their functional independence in carrying out daily life activities. On the other hand, NHP was the assessment tool used to evaluate patients' health-related quality of life.	There was a significant difference between FIM and NHP values in NDT and Nintendo Wii groups. There was a significant difference between FIM and NHP values in NDT and Nintendo Wii groups. However, there was no significant difference found between groups regarding FIM and NHP evaluation. It showed that the Nintendo Wii group has a higher satisfaction measure towards the therapy compared to the NDT group. In both groups, a notable difference were found between sub-parameters and total FIM score, all sub-parameters, and total NHP score.	This study proved that the Nintendo Wii training program was as effective as Bobath NDT in improving subacute stroke patients' functional independence in carrying out daily life activities and quality of life.
Ayca et al 2018 <sup>12</sup>	To analyze the effectiveness of balance rehabilitation program using the Nintendo Wii as an adjunct therapy to conventional method.	Evaluate 23 stroke patients using Berg Balance Scale, Functional Reach Test, Postural Assessment Scale. Further assessment was performed using postural sway and transfer and ambulation scores. Follow up procedure was done 4 weeks after the completion of the study.	There are significant differences using <i>Berg Balance Test</i> and <i>Functional Reach Test</i>	Post stroke rehabilitation therapy using Nintendo Wii increase static and dynamic balance on post stroke patients.
Hilland et al, 2018 <sup>13</sup>	To conduct an in-depth analysis of the benefits and challenges regarding the use of the Nintendo Wii as stroke rehabilitation training at home from the perspective of patients and practitioners.	15 physiotherapists and 19 stroke patients were interviewed after including Nintendo Wii as therapy at home for 6 weeks	From the interview results, it is found that there are 4 advantages of using Nintendo Wii during home-based stroke rehabilitation, which are physical, psychological, social and cognitive. In terms of physical health, it improved balance and strength. It is also physiologically motivating, fun, and help increase involvement with physiotherapists/others. Socially, it able to increase socialization with family and friends. In terms of cognitive improvement, it able to increase concentration/attention.	Nintendo Wii is a fun form of rehabilitation, promoting the involvement of physiotherapists / others, increasing motivation as well as social opportunities in home-based therapy. Nintendo Wii might be a promising strategy that can be used as an adjunct to stroke rehabilitation at home.
Markaida et al 2019 <sup>14</sup>	Evaluate effects on cognitive areas of attention, processing speed, and working memory in stroke patients after an intervention with the Nintendo Wii and compared to a control group that did not include Nintendo Wii.	A total of 30 stroke patients with a mean age of 65 years old were observed for 8 weeks. They were divided into 2 groups; the Nintendo Wii group (50%) and the control group (50%). The assessment of the intervention carried out by evaluating attention and processing speed (TMT-A dan B) and working memory (Digit Span of WAIS-III). The results of improvement on both groups were compared and analyzed using effect size tests and parametric tests.	The group that intervened with Nintendo Wii had better results in attention and speed compared to the control group. Working memory was measured using the WAIS-III Digit Span task. Based on the Digit Span Forward (DST Forward SS) task, the Nintendo Wii group had a better result than the accumulation of the control group regarding the effect size.	This study showed a positive result on the recovery of physical function in targeted stroke patients using Nintendo Wii. Although the evidence is not conclusive, results indicate beneficial outcomes in stroke patients who use Nintendo Wii, particularly in their area of attention and speed processing.

Post-ischemic stroke exercises are most effective if performed immediately after the acute phase. Daily rehabilitation which target fine motor and lower limb function can improve functional outcomes after ischemic stroke.<sup>7</sup>

Previous research has revealed that exercise or physical activity can provide neurological benefits and preservative effects on the brain, prevent cognitive decline, and improve cognitive performance. Research using animal models revealed that exercise potentially increases neurotrophic factors, glial cell activity, and cerebral blood flow. Thus, increasing the neurogenesis and neuron cell viability.<sup>8</sup>

Stroke rehabilitation is known as a learning method where motor learning mechanisms are operative and related to spontaneous recovery.<sup>9</sup>

Virtual Reality (VR) and interactive video games appeared as a new treatment strategy in a stroke rehabilitation center. Nintendo Wii is considered a simple and practical virtual therapy option that used in stroke rehabilitation units throughout the world.<sup>10</sup>

Through some research, it is found that the Nintendo Wii improves stroke patients' ability in carrying out daily life activities independently by increasing the upper limb function.

Nintendo Wii is confirmed to be safe and effective to recover upper limb function as balance training, which potentially becomes a great rehabilitation alternative for stroke patients.<sup>9</sup>

## Method

The Each author did a thorough survey during May-June 2019 through several online databases such as NCBI, PubMed, and Cochrane using PICO as a search strategy. Keywords used were: stroke, Nintendo Wii, and medical rehabilitation. The systematic review created by following PRISMA (Preferred Reporting Items for Systematic reviews and meta-analysis) guidelines.

### Inclusion Criteria

Journals related to the use of Nintendo Wii as rehabilitation therapy of post-stroke patients for the past five years.

### Exclusion Criteria

Editorial, articles, and meta-analysis were excluded due to the unavailability of desired data in order to create a systematic review.

## Data Extraction

Data extraction related to several journals/studies was carried out using standard tables developed by authors. The table consisted of; (1) Main author and year of publication; (2) Research objectives; (3) Methodology; (4) Research results; and (5) Conclusions.

P (Patient)	I (Intervention)	C (Comparison)	O (Outcome)
Male and female stroke patients aged 18-70 years old who still experience stroke sequel.	An intervention was carried out on the rehabilitation of stroke patients using the Nintendo Wii.	Compared to conventional training or other exercises.	Bring up new innovations in stroke patients' rehabilitation by using Nintendo Wii to improve rehabilitation results and patient compliance.

## Results

Data extraction was performed to selected studies put into tables that have been developed by the authors.

## Discussion

After reviewing five selected journals, it is found that there are evidences related to the effectivity of Nintendo Wii as rehabilitation therapy in stroke patients. Several studies have shown that Nintendo Wii provides a significant improvement in balance and walking ability in stroke patients who have intervened for 8 weeks. One of the reviewed-study also shows improvement in static and dynamic strength in stroke patients who undergone rehabilitation therapy with Nintendo Wii for 4 weeks. Nintendo Wii is highly recommended as additional therapy at home due to the fact that it can increase motivation as well as socialization of stroke patients. In addition, Nintendo Wii also showed positive results in physical function recovery of stroke patients after 8 weeks of exercise. However, another studies also show that Nintendo Wii has the same effectivity as Bobath NDT therapy in improving daily life activity functioning as well as quality of life in stroke patients. Due to limited available data related to this topic, further research focusing on Nintendo Wii as rehabilitation therapy for post stroke patients need to be done.

**Table 2.** Data Assessment

Author	Year	Sample Population	Exercise Duration	Result
Bang et al	2016	40	8 weeks (40 minutes/day, 3 days/week)	There is a significant improvement in balance and walking ability in patients who have intervened with Nintendo Wii.
Tülay Tarsuslu Şimşek & Kübra Çekok	2015	42	10 weeks (45-60 minutes/day, 3 days/ week)	Nintendo Wii has the same effectivity as Bobath NDT therapy in improving daily life activity functioning as well as quality of life of subacute stroke patients.
Ayca et al	2018	23	4 weeks (20 minutes/day, 5 days/week)	Stroke patients who undergone rehabilitation therapy with Nintendo Wii shows improvement in static and dynamic strength.
Hilland et al	2018	19	6 weeks (30 minutes/day)	Nintendo Wii improve motivation as well as socialization and considered as a promising strategy for adjunct therapy for stroke rehabilitation at home.
Markaida et al	2019	30	8 weeks (30 minutes/day, 3 days/week)	Nintendo Wii shows positive result in recovering physical function in stroke patients.

## Conclusion

From this study, it is found that rehabilitation in stroke patients using Virtual Reality such as the Nintendo Wii can be included as additional therapy that provides a significant improvement in various aspects of exercise therapy, such as; balance; walking ability; statistical and dynamic strengths; motivation as well as socialization; and recovery of physical function in stroke patients. Nintendo Wii can also be used safely in stroke patients and there have been no reports of side effects from this therapy. More research that includes Nintendo Wii as rehabilitation therapy for post stroke patients need to be done due to limited available data worldwide.

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