

An Evaluation of the Nintendo Wii™ as a Home-Based Stroke Rehabilitation Intervention: A Qualitative Interview Study

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Abstract

Background: Traditional physical therapies in stroke rehabilitation are costly and time consuming, which has led to the growing use of virtual reality based rehabilitation.

Objective: The aims of the study were to explore stroke care practitioners' and patients' perspectives on utilizing the Nintendo Wii™ during home-based stroke rehabilitation.

Methods: Fifteen practitioners and 19 stroke patients from two stroke units were interviewed.

Results: Four higher order themes relating to the benefits and challenges of employing the Nintendo Wii™ during home-based stroke rehabilitation emerged; physical, psychological, cognitive and social.

Conclusions: The Nintendo Wii™ was an enjoyable form of rehabilitation, promoting engagement, motivation and social opportunities in home-based therapy. However, some adverse physical and psychological consequences were reported, and these need to be taken into consideration when using the Wii™ as a form of rehabilitation. The Nintendo Wii™ may be a promising strategy that can be used as an adjunct to home-based stroke rehabilitation. This study is novel in presenting qualitative data to the area from both practitioner and patient perspectives.

Introduction

It is estimated that, worldwide, 15 million people suffer a stroke each year. Stroke is one of the most common causes of death, exceeded only by ischaemic heart disease [1,2]. Approximately 100,000 strokes occur each year in the UK, and the National Health Service (NHS) and social care costs are estimated at £1.7 billion a year [3,4]. Stroke is also the largest cause of adult disability in the UK [5] and the reduced ability to perform activities of daily living negatively affects the quality of life of people who have suffered a stroke [6-8].

The primary means of promoting functional recovery and preventing secondary complications of a stroke is through task-specific, intensive and repetitive rehabilitation [9,10]. These traditional rehabilitation therapies are costly, resource intensive and time consuming [11,12]. Further, patient adherence to stroke rehabilitation is low [13,14], with only 50-55 % of patients adhering to treatment regimens [15,16]. An explanation of low adherence to stroke rehabilitation is that patients report that rehabilitative tasks are painful, monotonous and dull [17], as well as poor health and a lack of motivation [18,19]. Patient adherence to stroke rehabilitation might be improved through the use of virtual reality based rehabilitation, including interactive video games like the Nintendo Wii™ [20,21]. The Nintendo Wii™ offers an accessible, affordable and motivating mode of therapy that is increasingly used in stroke rehabilitation units worldwide [11,22-25]. Virtual reality games are designed to be enjoyable and interactive, with a range of motivational features, for example in-game medals, encouraging commentaries and video playbacks [13]. As a consequence, some evidence suggests that patients are more likely to adhere and comply with their virtual reality physical rehabilitation regimen [17,26,27].

Patient engagement with the Nintendo Wii™ as part of their rehabilitation program can facilitate a range of positive functional outcomes. Evidence suggests that the use of Nintendo Wii™ improves motor function [11,28,29], motor power [13], balance [30-33], and range and speed of motion [21,24]. Furthermore, therapists can incorporate the Nintendo Wii™ as part of their practice to capitalize on patients' functional abilities in a fun and novel manner [30,32].

Although the Nintendo Wii™ has shown beneficial outcomes in randomized controlled trials [11,34], there have been few studies that have assessed the benefits and challenges of employing the Nintendo Wii™ as a home-based rehabilitation modality from a practitioner and patient perspective. Randomized Controlled Trials (RCTs) are considered the most rigorous design for evaluating whether an intervention is effective under optimal conditions. However, RCTs generally yield limited insights into the benefits of an intervention from the perspective of patients or practitioners. To address this limitation, there is growing acknowledgement of the important contribution of qualitative research can make to the evaluation of interventions [35]. Qualitative research can assist in an understanding of why interventions are effective and triangulate findings from RCTs [36]. Furthermore, to determine the acceptability of incorporating Nintendo Wii™ into practice, assessment of the benefits and challenges from the perspective of health practitioners and patients are essential. Practitioner beliefs about the benefits and challenges of interventions are strongly associated with incorporating these interventions in to practice, and should thus be examined [37].

The aim of this study was to undertake an in-depth examination of the benefits and challenges, from patient and practitioner perspectives, of utilizing the Nintendo Wii™ in home-based stroke rehabilitation. This will provide evidence about the acceptability of incorporating the Nintendo Wii™ into routine stroke patient care.

Methods

Setting and Participants

Fifteen stroke care practitioners (Physiotherapists [PT] n=9; Occupational Therapists [OT] n=5, and a physical activity coordinator n=1), and 19 stroke patients (16 men, 3 women) from two hospitals in the North West of England volunteered to participate in the study. Stroke care practitioners selected patients if they felt that they would benefit from using the Nintendo Wii™ during supported discharge in the home setting. Patients were asked to participate if they were (1) Continuing occupational therapy following discharge from hospital, (2) Aged 18 or older, (3) Been diagnosed with a medically confirmed clinical stroke, (4) Considered suitable for participation by their healthcare team, and (5) Were able to independently manipulate the Nintendo Wii™ control. The project received ethical approval from National Research Ethics Committee (NREC) and Liverpool John Moores University Ethics Committee.

Procedure

The first author set up the Nintendo Wii™ in each of the patients' homes and provided 1 hour of training. Patients were provided with the following games; Wii Sports™, Wii Sports Resort™, Wii Fit™ and the Wii Big Brain Academy™. Participants were encouraged to engage with the Nintendo Wii™ for 30 minutes per day. Semi-structured interviews were conducted with stroke care practitioners' and stroke patients' to elicit their perspectives of using the Nintendo Wii™ during stroke rehabilitation. The interviews with the stroke care practitioners took place in a nominated non-clinical location within the stroke unit. The stroke patients were interviewed at home, up to three weeks after the completion of their 6-week home-based trial with the Nintendo Wii™. An interview schedule was adopted to ensure both standardization and an opportunity for stroke care

practitioners and patients to deviate/elaborate further from the prescribed questions. The schedules were developed by a team of experienced qualitative researchers based on current literature about stroke rehabilitation, basic rehabilitation principles, and following consultation with stroke care practitioners. Items were then piloted with five stroke care practitioners and four stroke patients, amendments were made accordingly based on their feedback (see Table 1 for example questions). Stroke care practitioner's interviews lasted between 21 and 46 (mean = 33) minutes, stroke patients interviews lasted between 15 and 28 (mean = 24) minutes. Opportunities were provided at the end of each session for participants to make further comments on anything they deemed appropriate but had not been covered. After three months of sampling, and 15 interviews with stroke care practitioners and 19 interviews with patients, categories emerging from the analysis of the interviews were repetitive, therefore it was agreed by the research team that saturation point had been reached. The first author conducted all of the interviews, which were recorded by Dictaphone and transcribed verbatim with any identifying characteristics to the participants or hospitals removed. Interviews transcriptions comprised 219 (139 practitioners and 80 patients) pages of typeset data Arial font, size 12, double spaced.

NVivo-software (version 11) was used to facilitate data analysis, management and retrieval. A thematic analysis of the data followed the phases of data immersion, coding, creating categories and identifying themes [38]. Each transcript was read several times by two members of the research team (TAH & RCM), who independently analyzed the data using a deductive and inductive approach. Data were then cross-examined by the research team until a consensus was reached, comparing and contrasting meaningful quotes, clustering quotes into categories and highlighting common themes between participants. The outcomes of this analysis process were then represented via pen profiles, which provide an appropriate and efficient method for representing analysis outcomes, using diagrams, verbatim quotes and frequency data of key themes [39-41]. Methodological rigor, credibility and transferability were achieved via verbatim transcription of the data, triangular consensus and reverse tracking procedures employed from pen profile to transcript. Results are presented below describing the two general dimensions of stroke care practitioner and patients' perceived benefits and challenges of employing the Nintendo Wii™ during home-based stroke rehabilitation (Figures 1 & 2), and the associated higher and lower order themes. Self-defining verbatim quotes are included for illustration and n refers to the number of participants who discussed the particular theme.

Results

Practitioners' and patients' perspectives of perceived benefits and challenges of employing the Nintendo Wii™ during home-based stroke rehabilitation were grouped in to four key themes: (1) Physical, (2) Psychological, (3) Social; and (4) Cognitive. Figure 1 displays the higher and lower (positive & negative) order themes relating to the general dimension of stroke care practitioners' perspectives. Figure 2 displays the higher and lower (positive & negative) order themes relating to the general dimension of stroke care patients' perspectives.

Physical

Stroke care practitioners cited several physical benefits for the stroke patients, including improvements in balance/stability (n=11),

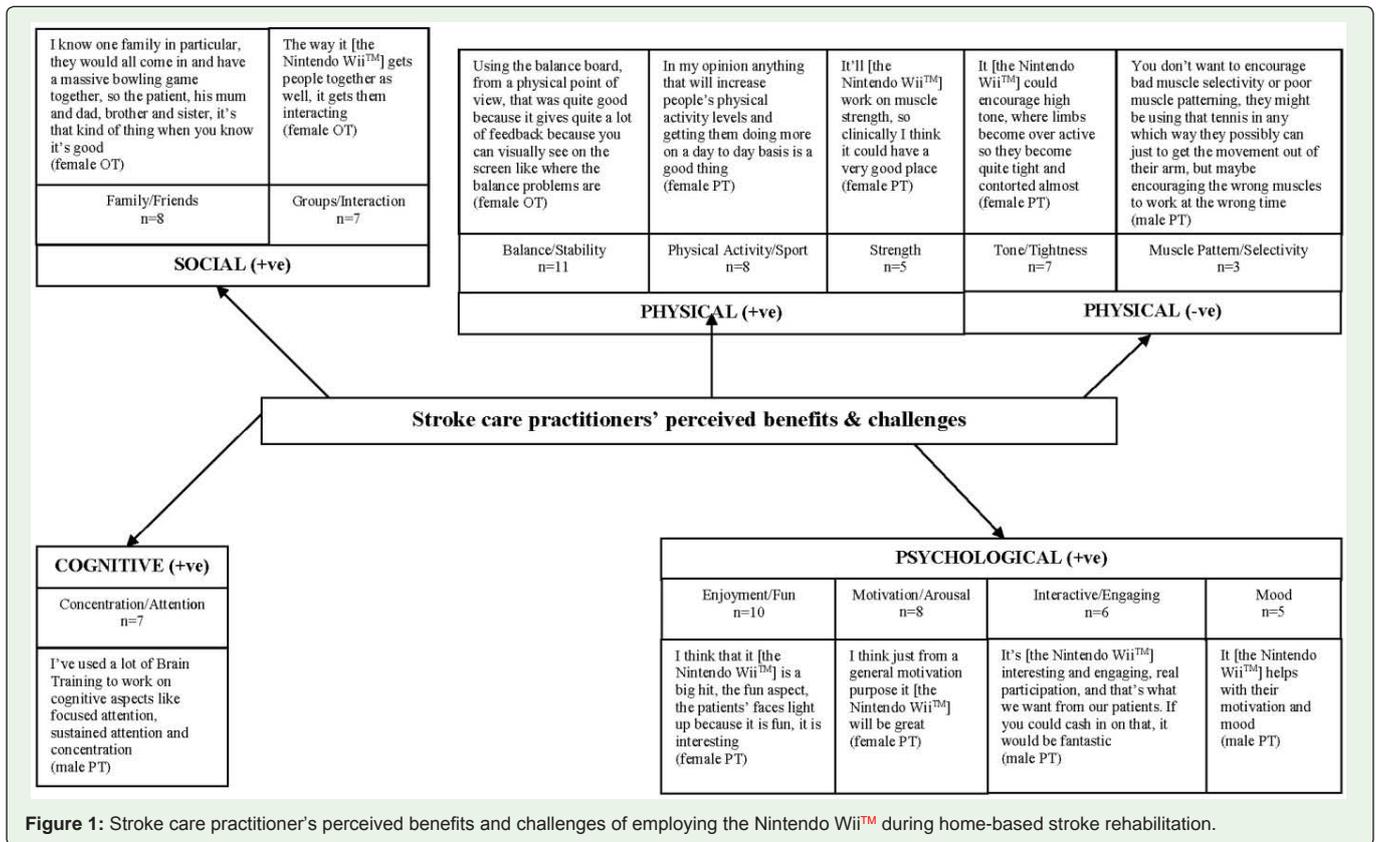


Figure 1: Stroke care practitioner's perceived benefits and challenges of employing the Nintendo Wii™ during home-based stroke rehabilitation.

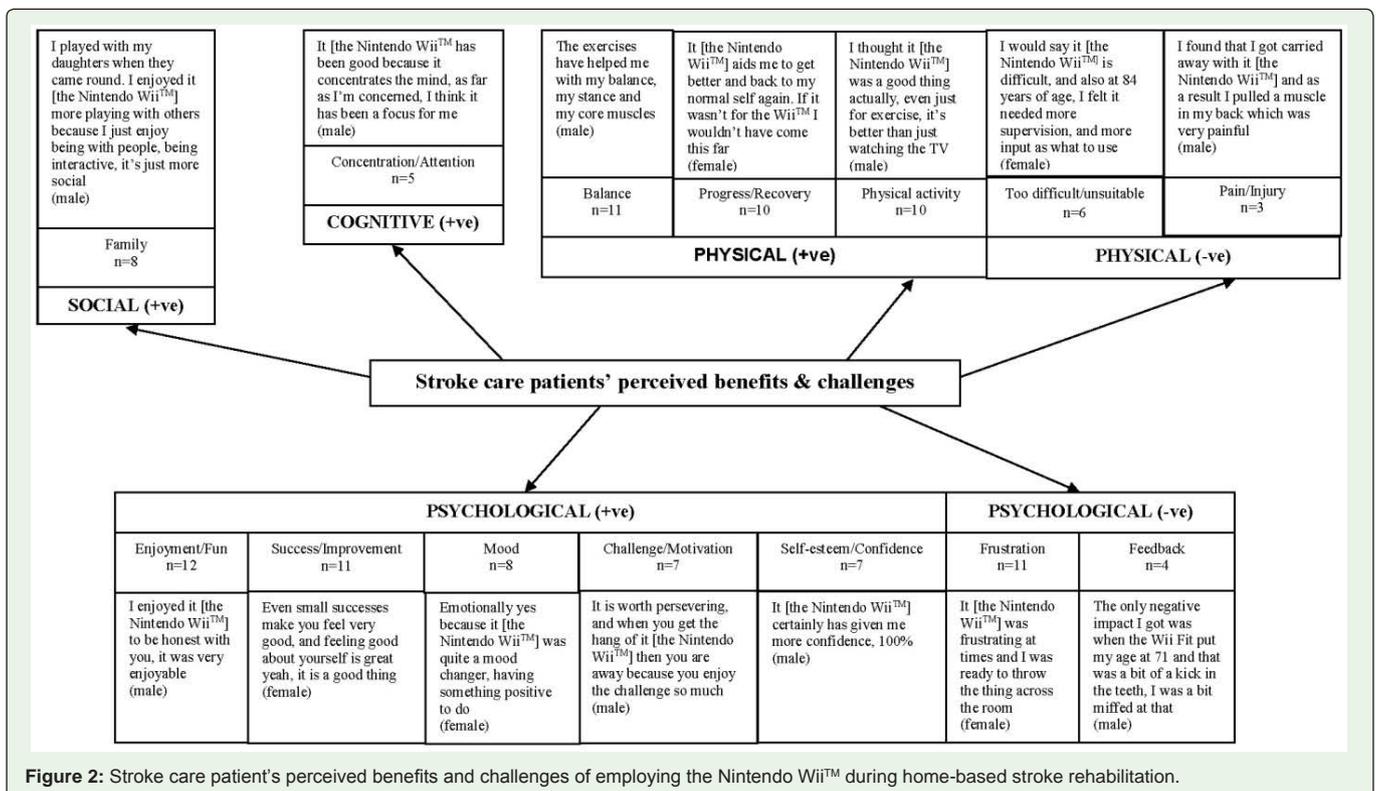


Figure 2: Stroke care patient's perceived benefits and challenges of employing the Nintendo Wii™ during home-based stroke rehabilitation.

being engaged in physical activity/sport (n=8), and an increase in strength (n=5). Comments included that “the Nintendo Wii™ is great for patients who have balance problems, using the balance board and all the different games for that, working on people’s balance and core stabilities which are obviously inherent things that we work towards as Physio’s” (male physiotherapist), and, “it just keeps them active and it provides them with a good level of exercise intensity which is really important, and I think it’s a nice education tool to get them back into something they may have previously enjoyed as a hobby or as a pastime” (female physiotherapist) (Table 1).

Patients also believed that using the Nintendo Wii™ assisted them physically, including improving their balance (n=11), physical recovery/progress (n=10), and engagement in physical activity (n=10). Comments included that, “it’s been brilliant for my balance, since I’ve been using the Wii™, I’m now able to walk around without my walking cane and without the assistance of my wife” (male), and, “I think the Wii™ has influenced my physical progress, like maybe just getting up the stairs even, because I don’t use the hand rail as much as I used to now” (male).

Stroke care practitioners also stated two adverse physical effects, including muscle tone and tightness (n=7), and poor muscle patterning and selectivity (n=3). Comments included, “in terms of their negative behaviors, so encouraging poor patterning, bad selectivity of muscles, it encourages what we call high tone and high tone is basically where limbs become over active so they become quite tight and contorted almost” (female physiotherapist). Stroke patients discussed the Wii™ as being too difficult and therefore unsuitable for them (n=6), “it was difficult playing games that were probably not suitable for me, and this is really my complaint I would register about this scheme” (male). Another theme included injury (n=3), as one stated, “I pushed myself too far, and I was really aching from head to foot the next day” (female).

Psychological

Stroke care practitioners discussed several psychological benefits for patients, including enjoyment/fun (n=10), motivation/arousal (n=8), interaction/engagement (n=6), and mood (n=5). Comments included, “they loved it, they absolutely loved it, and they found it a much more fun way of doing therapy” (male physiotherapist), “I think from a patient point of view it boosted mood and motivation, I think it gave them a sense that they are doing something worthwhile and that they are achieving something in their day, it gave them something to look forward to (female physiotherapist), and, “she was sat there engrossed in it” (female occupational therapist).

Stroke patients also mentioned psychological benefits of enjoyment/fun (n=12), success/improvement (n=11), mood (n=8), challenge/motivation (n=7) and self-esteem/confidence (n=7). Comments included, “the main thing was that I wanted to play on it, I

thoroughly enjoyed it” (female), “with the Wii™ I enjoy the activities, so that cheers me up, it gets rid of low feelings” (male), and, “it has been the challenge that I have wanted, sometimes if I don’t do too good I have another go to see if I can get it a little better you know and improve” (male). Patients indicated that winning, progressing and improving enhanced their self-esteem and confidence. A patient stated that “the greatest stimulant is when you are successful, even the smallest things, it makes you want to get on a chair and cheer and tell the whole world and you want to wear a badge, I felt just as I did when I was young and a teacher would say something wonderful if you did the slightest thing, it suddenly meant an awful lot to me, and I couldn’t let it pass without telling my husband or any member of the family you know, and hoping they would appreciate it too” (female). However, 11 patients also suggested that it caused them frustration when they were unsuccessful or did not progress. A patient stated that “some of the games were frustrating when I couldn’t do it or I couldn’t get the right answer, that’s when it gets frustrating” (male). In line with this, four patients also discussed the feedback that the Wii™ provides, which had a negative impact upon mood and motivation, as one patient stated, “it was insulting sometimes like with your weight and all of that, the games tended to demoralize you” (female).

Social

Stroke care practitioners (n=8) and patients (n=8) revealed a major social benefit of utilizing the Nintendo Wii™ involved socializing with family and friends. Comments included, “families feel they’re doing something as well then. I think the thought of doing physio or something would scare them because they’d think they weren’t qualified. But supervising someone on the Wii™ or playing against them, they feel like they’ve got a role then (female occupational therapist), and, “when the kids are there they would encourage me, so I’d enjoy the social element of it with the family” (male). Stroke care practitioners (n=7) suggested there were further benefits with regards to group sessions and interaction. An occupational therapist stated that, “it’s like social engagement as well, like quite often what we would have is to have a couple of patients together, I mean you often do get on the ward like a group of patients or a couple of patients that do make a bit of a friendship and in that sense it’s quite good to bring them through together from a social interaction point of view, because it can be quite isolating just sitting next to a bed” (female).

Cognitive

Stroke care practitioners (n=7) and stroke patients (n=5) reported cognitive benefits of improved concentration/attention. Comments included, “I liked the Big Brain Academy, the fact that they have got to sit and concentrate on something for a period of time that was good” (female occupational therapist), and, “yeah we’ve played the frisbee, the archery with the kids and that was good, I think it helped my concentration” (male).

Table 1: Example interview questions.

Stroke care practitioners	Do you envisage any benefits or problems/barriers to both practitioners and patients using the Nintendo Wii™ as part of the rehabilitation process?
	What type of patients do you expect the Nintendo Wii™ would be appropriate / inappropriate for?
Stroke patients	What was your experience of using the Nintendo Wii™ during your rehabilitation at home like?
	Can you describe if/how the Nintendo Wii™ influenced your physical, social, emotional and mental well-being?

Discussion

In this study, stroke care practitioners' and their stroke patients' perspectives of utilizing the Nintendo Wii™ in home-based stroke rehabilitation were explored, including an examination of the benefits and challenges of using Nintendo Wii™. This study is novel because it provides evidence about the acceptability of incorporating the Nintendo Wii™ into routine stroke patient care and the outcomes of the use of the Nintendo Wii™ that are important to patients and practitioners. Stroke care practitioners and stroke patients reported a range of physical, psychological, social and cognitive benefits and challenges of employing the Nintendo Wii™. Our results indicate that, as well as benefits, there are also challenges that need to be considered when including such devices in to patient care. To overcome frustration and prevent injury, the choice of game for individual patients is vital and practitioner support also needs to be carefully considered.

Our findings showed that both patient and practitioners perceived a range of physical benefits from use of the Wii™, including balance/stability, physical activity/sport, strength and progress/recovery. These findings concur with previous research, suggesting that the Nintendo Wii™ can provide physical benefits including improvements in balance [28,31,33,42,43]. In the largest randomized clinical trial to date investigating the Nintendo Wii™ for balance retraining after stroke, participants were allocated to either the balance group (Wii Fit Plus™), or upper limb group (Wii Sports/Sports Resort™) [32]. There were significantly greater balance outcomes for the group utilizing the Wii Fit Plus™, on the Step test and the Wii Balance Board™ derived centre of pressure test. It has been suggested that such physical improvements may result from the use of the Nintendo Wii's™ due to facilitation of neuroplastic mechanisms that engage the mirror neuron system through repetitive, intense, task-oriented training [11,44,45]. In addition, a Wii-based balance and mobility program has been compared to a standard of care program, it was concluded that the participants' balance improvement in the Wii-based program was of greater magnitude at post-test than the individual in standard care [33]. However, the individual in the standard of care program retained the gains and made additional improvements at follow-up while the Wii-based participant did not. A number systematic reviews and meta-analyses have also been conducted in this area which has concluded that the data is still unclear to assure the Nintendo Wii's™ efficiency in balance [9,22]. The current study extends these quantitative studies by gaining an in-depth qualitative exploration of stroke care practitioners' and patients' perspectives.

Stroke care practitioners also commented on gains in patients' strength due to the Nintendo Wii™. This concurs with findings from the first reported randomized control study (EVREST) to test the Nintendo Wii™ during stroke rehabilitation [11]. Patients in the Nintendo Wii™ group had an improvement in grip strength, compared to those in the recreational therapy group. In a qualitative exploration of stroke care patients and care givers' experiences, in the trial of Wii™ in stroke (TWIST) study, it was found that by the end of the intervention, the patients' physical condition, including strength, had improved [46]. Furthermore, a meta-analysis concluded that there was a 4.9% higher chance of improvement in motor strength for those stroke patients using virtual reality technology, compared to conventional rehabilitation [47].

Both practitioners and patients in the current study commented on the positive engagement and participation in physical activity and sport that the Nintendo Wii™ provides. This is consistent with findings that the Nintendo Wii™ can improve physical activity levels for chronic stroke patients, it has been reported that energy expenditure during Wii™ Sports boxing and tennis was sufficient to improve and maintain health [48]. The Nintendo Wii™ is being increasingly used by the NHS, in clinical and care settings, as a form of rehabilitation therapy and to promote engagement in physical activity [17]. Furthermore, therapists also suggest that through the Nintendo Wii™ patients can play sports without over-exerting themselves or using a day's worth of energy that they need to save for basic living activities [49].

As well as physical benefits, both patients and practitioners also reported several negative physical effects of using the Wii™. Patients reported that the games were too difficult / unsuitable and that they caused injury / pain and practitioners cited overwork of certain muscles and poor muscle patterning. These findings are consistent with previous research which found that when using the Nintendo Wii™ to improve reaching in stroke patients, they adopted a variety of movement strategies to successfully play the game, some of these strategies were deemed to be not necessarily ideal adaptive strategies [50]. Furthermore, previous studies have concluded that participants complained of increased spasticity [29], and that avoiding compensatory movement patterns is even more challenging when individuals practice without the presence of a therapist (e.g., home-based Nintendo Wii™ therapy) [23]. Previous studies have also found that stroke patients describe pain, soreness and feelings of exhaustion and fatigue following Nintendo Wii™ therapy sessions [11,13,17,48,51]. In two qualitative studies, a small number of patients reported pain in their arm and/or shoulder (Celinder & Peoples, 2012; Wingham et al., 2015) [46,52]. Furthermore, in a RCT, participants in the balance group (Wii Fit Plus™) described lower back and leg pain, whereas the upper limb group (Wii Sports/Sport Resort™) reported shoulder and neck pain, however no pain increase lasted more than 24 hours [32]. The current findings suggest that information on adverse events, such as injuries, should be routinely collected to ascertain if benefits of using devices such as the Wii™ outweigh the costs. In addition, our findings indicate that some supervision of patients using the Wii™ may be required to ensure that the correct muscles are being used, and that games be carefully selected so that they match the patient's physical and psychological capacity.

Patients and practitioners perceived a range of psychological benefits of using the Wii™, including enjoyment, motivation and engagement, which are also in agreement with previous research in this area [24,32,46,53]. For example, it has been concluded that the Nintendo Wii™ allows occupational therapists and physiotherapists to engage with their patients in a fun and novel manner [49], which has been suggested increases motivation during stroke rehabilitation [54]. Review studies have also reported that the majority of participants in these studies expressed increased motivation, which resulted in sustained rehabilitation and a decreased risk of dropout [22,43]. Therefore, as the Nintendo Wii™ games are designed to be enjoyable and interactive, patients are more likely to adhere and comply with their physical rehabilitation at home. In addition, it has been previously reported that feedback from stroke patients' experiences of using the Nintendo Wii™ is overwhelmingly positive,

with 81.3% finding it fairly to highly enjoyable, and 87.5% wanting to continue using it as part of their rehabilitation programme [13]. Despite these results being based upon a questionnaire, they are in line with qualitative data, which found that the Nintendo Wii™ sessions broke up the boredom of rehabilitation, provided motivation and feelings of engagement during stroke rehabilitation [52]. In the current study it was also found that the Nintendo Wii™ increased patients' self-esteem and confidence. Improvements in self-esteem and confidence are likely to lead to improved psychological health and quality of life of patients, as well as being central to adherence to rehabilitation [55,56]. Despite their importance, the effect of the Wii™ on self-esteem and confidence has rarely been examined and our results indicate that they should be included as outcome measures in future studies that assess effects of the Nintendo Wii™.

Negative psychological outcomes reported by patients included frustration and negative feedback. Frustration has been previously reported in other studies with stroke patients, due to some of the games requiring precise hand-to-eye co-ordination and quick reactions, these challenges caused disappointment and frustration [21,46,52]. Negative feedback has not been examined in other studies and interestingly, practitioners did not perceive any negative psychological outcomes of use of the Wii™. This might be because patients did not report such feelings to practitioners. It is important that the Wii™ games match the skill level of participants, or this could lead to frustration and patients 'giving up'. Furthermore, the matching of patient skills with the challenge of the games are essential to the development of positive self-esteem and confidence.

One of the key benefits of the Wii™, from the perspectives of both patients and practitioners were the social benefits, including family, friends and group interaction. Social support has been identified as important in post-stroke recovery and community-based exercise programs [57,58]. Therefore, the use of the Nintendo Wii™ may help to overcome the social isolation and loneliness that has been previously reported by stroke patients [59]. Furthermore, the theme of family and friends has been reported elsewhere, where for some patients it was important to share their experiences of the Nintendo Wii™ with peers and family [52]. It has also been found that social factors influence the use of the Nintendo Wii™, such as friends visiting or staying over [46], and that the Nintendo Wii™ may offer an opportunity to address patients' social and leisure needs, if they use it in pairs or in groups [13]. Therefore, a key benefit of the Nintendo Wii™, from both the patient and practitioner perspective, is that it can enhance social connectedness, social participation and involvement of friends and family in patients' rehabilitation. This social connection is likely to explain positive outcomes from the use of the Wii™ and also positive patient adherence to the use of the Wii™.

Both patient and practitioners perceived a range of cognitive benefits, including a positive effect on concentration and attention from utilizing the Nintendo Wii™ which has previously been reported [17,24,60]. It has been suggested that these improvements are because the player is required to attend, comprehend, recall, plan and execute appropriate responses to the visual cues provided on the screen [13]. In addition, it has been concluded that stroke patients were "very concentrated and engaged" throughout the Nintendo Wii™ sessions, which resulted in improved

cognitive skills [52]. Patients become engrossed in playing on the Nintendo Wii™, so much that they forget that they are exercising and are 'almost oblivious to the rigour' [60,61].

Practical implications and future research

Strengths of this study include an in-depth examination of both the challenges and benefits of the use of the Wii™ from patients and practitioner perspectives in a 'real world' rehabilitation setting. In addition, triangulation of data, which limited interviewer bias, and the completion of all interviews by the same investigator. This study adds further evidence for the potential of utilising the Nintendo Wii™ as part of home-based rehabilitation for stroke patients. The Nintendo Wii™ is acceptable to both patients and practitioners and may be a promising strategy that can be used as an adjunct to stroke rehabilitation. It was found that the Nintendo Wii™ was an enjoyable form of rehabilitation, promoting engagement, motivation and social opportunities in home-based therapy. Our findings suggest that improvements in self-esteem and confidence are important outcomes of using the Wii™, but these have been rarely examined in previous studies. Therefore, it is recommended that these are included as potential outcomes in future research. Some patients experience adverse physical and psychological consequences from using the Wii™ and that need to be taken in to consideration when using the Wii™ as a form of rehabilitation. Our findings suggest that to overcome frustration and prevent injury, practitioners should be proactive in seeking feedback from patients about their ability to use the games and could assist patients in game selection to ensure that games suitable to the patient skill level and ability. Furthermore, it is important the adverse events are reported both in research trials and in practice when using Wii™ devices.

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