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## **MULTIPLE SCLEROSIS PATIENTS' EXPERIENCES IN RELATION TO THE IMPACT OF THE KINECT VIRTUAL HOME-EXERCISE PROGRAMME: A QUALITATIVE STUDY**

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Eur J Phys Rehabil Med 2016 Feb 17 [Epub ahead of print]

*EUROPEAN JOURNAL OF PHYSICAL AND REHABILITATION  
MEDICINE*

Rivista di Medicina Fisica e Riabilitativa dopo Eventi Patologici

pISSN 1973-9087 - eISSN 1973-9095

Article type: Original Article

The online version of this article is located at <http://www.minervamedica.it>

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## TITLE PAGE

### TITLE:

Multiple sclerosis patients' experiences in relation to the impact of the kinect virtual home-exercise programme: a qualitative study

Short title: Kinect Home Program and Multiple Sclerosis

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**Declaration of Interest:**

No conflicts of interest have been reported by the authors or by any individuals in control of the content of this article.

1) No funds were received for this study; 2) The authors have no financial disclosures to report; 3) Data from this study have not been presented in any other form.

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Multiple sclerosis patients' experiences in relation to the impact of the kinect virtual home-exercise programme: a qualitative study

**Abstract.**

**BACKGROUND:** Neurorehabilitation programs are among the most popular therapies aimed at reducing the disabilities that result from multiple sclerosis. Video games have recently gained importance in the rehabilitation of patients with motor neurological dysfunctions. Currently, the studies describing the perspective of patients with multiple sclerosis who have participated in rehabilitation programmes via home-based video games are almost inexistent.

**AIM:** To explore the experiences of multiple sclerosis patients who performed a virtual home-exercise programme using Kinect.

**DESIGN:** A qualitative research enquiry was conducted as part of a study that examined postural control and balance after a 10-week Kinect home-exercise programme in adults with multiple sclerosis.

**SETTING:** Patients were recruited from the Neurology Unit of San Carlos University Hospital.

**POPULATION:** The inclusion criteria were: subjects aged between 20 and 60 years, diagnosed with multiple sclerosis for over 2 years based on the McDonald Criteria; with an EDSS score ranging from 3 to 5.

**METHODS:** Purposeful sampling method was implemented. The data collection consisted of unstructured interviews, using open questions, and thematic analysis was conducted. Guidelines for conducting qualitative studies established by the Consolidated Criteria for Reporting Qualitative Research were followed.

**RESULTS:** Twenty-four patients with a mean age of 36.69 were included. Four main themes emerged from the data: a) Regaining previous capacity and abilities. The patients described

how, after the treatment with Kinect they felt more independent; b) sharing the disease. The patients sharing the experience of living with MS with their family, thanks to the use of Kinect; c) adapting to the new treatment. This refers to how the use of the videogame console incorporated novelties to their rehabilitation programme; and d) comparing oneself. This refers to the appearance of factors that motivate the patient during KVHEP.

**CONCLUSIONS:** The patients' experiences gathered in this study highlight perceptions of unexpected improvement, an eagerness to improve, and the positive opportunity of sharing treatment with their social entourage thanks to the games.

**CLINICAL REHABILITATION IMPACT:** These results can be applied to future research using video consoles, by individualizing and adapting the games to the patient's abilities, and by developing a new field in rehabilitation.

**KEY WORDS:** Multiple sclerosis- Postural balance- Video games- Qualitative research.

## **INTRODUCTION.**

Multiple sclerosis (MS) is a chronic inflammatory demyelinating disease of the central nervous system (CNS) of unknown aetiology and multifactorial origin (1). In MS, neuronal damage can occur anywhere in the CNS, resulting in a widely variable clinical presentation, which may include problems with fatigue, balance, postural control, mobility, and sensory difficulties. Multiple Sclerosis is also characterized by its unpredictable course, making prognosis difficult (2).

Multiple sclerosis is the most common chronic neurological disease in young adults in Europe and North America (1). Neurorehabilitation programs are among the most popular therapies aimed at reducing the disabilities and social disadvantages that result from MS. Many of the sequelae of neurological diseases are treated on an outpatient basis in hospitals and specialised centres. Importantly, these resources are limited and deficient in the clinical setting because of the time-constrained nature of rehabilitation (3).

In addition, most patients with MS have difficulties related to mobility, living in isolated locations, or both, which prevent them from receiving treatment at a rehabilitation centre (4). In response to this situation, interest has recently increased with regard to the development of eHealth projects. In the context of eHealth, telerehabilitation (TR) is the delivery of rehabilitation services via electronic systems using information and communication technologies (ICT) (3). Telerehabilitation extends rehabilitative care beyond the hospital setting in an eco-friendly environment, helping to detect new limitations and evaluate the effectiveness of the intervention at a sustainable cost (3). Among these technologies, virtual reality (VR) and video games have recently gained importance in the rehabilitation of patients with motor and cognitive neurological dysfunctions (5-6). The major features of these types of multimedia technology are that these enable interaction and sensory feedback in patients via a highly motivating multidimensional virtual environment in which

the patient performs virtual daily activities or tasks (4). Recently, studies related to the use of video game consoles have proliferated in the field of MS (7-13). This type of technology has showed favourable results in treating balance (7, 9-10) and postural control (PC) (11-12), as well as increasing activity levels (13), vitality and well-being in MS patients (14).

This paper presents the results of qualitative research (15) conducted as part of a longitudinal study that examined the potential benefits on postural control and balance of using the Xbox 360® with a Microsoft Kinect® console monitored via videoconference, the Kinect Virtual Home-Exercise Programme (KVHEP) (11-12).

Kinect uses a set of infrared sensors to recognize the physical position and estimate the size of the patient while a multi-array microphone detects voice and extracts ambient sound. The Kinect system enables users to create a digital skeleton. Participants use 3D motion-capture technology to control their avatar via hands-free bodily movement. The Xbox 360 and Kinect console were set up in the participants' homes by researchers (11-12).

MS patients were recruited from the Neurology Unit of San Carlos University Hospital (Spain). Fifty patients were recruited (11-12). The control group (n=25) received physiotherapy treatment twice a week (40 minutes per session). The experimental group (n=24) received treatment using the Kinect console. The experimental group attended 40 sessions, four sessions per week (20 minutes per session). The treatment schedule lasted 10 weeks for both groups. Protocol tasks: throwing and hitting objects with one's hands and feet, hitting and receiving balls with different body parts, dodging objects, overcoming obstacles, imitating postures (Games used: Kinect Joy Ride, Kinect Adventures and Kinect Sports I).

Table 1 Kinect Virtual Home-Exercise Programme description (16)

Currently, the studies describing the perspective of patients with MS who have participated in rehabilitation programmes via home-based video games are almost inexistent.

The aim of this study was to explore the experiences of MS patients in relation to the impact of the KVHEP.

## **MATERIAL AND METHODS.**

**Design.** A qualitative descriptive (15) study addressing the experiences of MS patients was conducted using thematic analysis (17). Qualitative studies are typically used to achieve a deeper understanding, and find explanations for people's behaviour under specific circumstances, such as disease or disability (15). The main characteristic of qualitative research is that the researcher is involved with the study participants and with their social context (18).

**Participants.** The qualitative study was performed parallel and independently to the KVHEP. All the participants were recruited from the experimental group. Twenty-four patients with a mean age of 36.69 were included in this study. There were no dropouts.

Table 2 Sociodemographic characteristics of the sample.

**Inclusion criteria** were: 20 to 60 years of age; confirmed diagnosis of MS for over 2 years based on the McDonald Criteria; medically stable during the 6 months prior to baseline; impaired balance associated with demyelinated lesions affecting the cerebellum and its connections; EDSS score ranging from 3 to 5; Hauser ambulatory index value higher than 4; absence of cognitive impairment according to the mini mental state examination test (MMSE >24); no visual deficits; internet connection at home. The level of experience with consoles and video games was not a criterion for the recruitment of patients. **Exclusion criteria** were: Medical diagnosis of another disease or pathological condition affecting balance; suffering an attack in the month prior to baseline or during the intervention process; having received an



intravenous or oral steroid cycle prior to beginning the evaluation protocol and within the 4-month duration of the project intervention.

Researchers made initial contact with the patients through the Principal Investigator of the KVHEP project. The purpose and design of the study was explained to the patients by the researchers in an initial face-to-face encounter.

**Sampling strategies:** Purposeful sampling was conducted to gather information from the MS patients themselves (17). This is defined as a gradual selection of units or cases based on their relevance to the research question, not their representativeness (19)

**Setting.** Patients were recruited from the Neurology Unit of the San Carlos University Hospital. Both the intervention (11-12) and the qualitative study (data collection) were performed within the participants' homes.

**Data collection.** Data collection consisted of unstructured interviews, using open questions (20): What has your experience been with the Kinect Home-Exercise Virtual Programme? Twenty-four unstructured interviews were collected from the participants, together with the 24 researcher field notes. Data collection was performed by three researchers expert in qualitative designs. Personal data collected from the participants are a rich source of information as they describe personal experiences from a first-person perspective. During the interviews, the researcher made notes including environment description, participant non-verbal responses, and the use of metaphors in their narratives. The interviews were limited to 45-90 minutes to avoid fatigue in MS patients (21). All subjects signed informed consent documents before participation, and prior to each interview, and written permission to record the interviews was obtained from all subjects.

**Analysis.** A full literal transcription of each of the interviews was drafted. The texts were collated to enable the performance of qualitative analysis (15). The researchers who performed the analysis was the same as the one who had been in contact with each patients.

Thematic analysis was performed (17). This process begins with the most descriptive content to obtain the meaningful units, and then goes into further depth and reduction to produce common meaningful groups; i.e., grouping of meaningful units referring to the same point or content until the topics that describe the patients' experience emerge. Following this, the results of the analysis were subsequently combined in joint sessions, where the data collection and analysis procedures were discussed (17). Checklist of Criteria for Thematic Analysis described by Braun & Clarke (17) were followed. No data analysis software was used.

**Quality Criteria:** Guidelines for conducting qualitative studies established by the Consolidated Criteria for Reporting Qualitative Research (COREQ) (22) were followed. The data verification method used consisted of: a) cross-triangulation of interviews by the researcher, which included planning sessions where the cases analysed by each team member were presented, with the aim of reaching a consensus, b) auditing of the materials obtained from 10 randomly selected cases by an external independent researcher, and c) post-interview and post-analysis MS patient verification (23).

### **Ethical Considerations**

This study was conducted according to the Declaration of Helsinki. Ethical approval for this study was granted by the Clinical Research Ethics Committee of Rey Juan Carlos University (Chair person: Dr. Jose Luis del Barrio Fernández; and the date of approval: April 23, 2012)

## **RESULTS.**

Four specific themes emerged from the analyzed material: a) Regaining previous capacity and abilities; b) sharing the disease; c) adapting the new treatment; and d) comparing oneself. What follows are quotations taken directly from the interviews, regarding the four emerging themes.

### **1. Regaining previous capacity and abilities.**

This refers to the effects that the patients perceived after the application of KVHEP. The patients described how, after the treatment with Kinect they felt more independent, and the feeling of “clumsiness” they once had, disappeared. They referred that they started to feel in control of their disease once again.

*“I could not move, and after several weeks of playing, I realized that I was not as tired, that I was moving again... it was like recovering the control over my body and over the disease.” (P3, female, 35 years old).*

On the other hand, they perceived how they developed the capacity to play in virtual environments, performing actions that they did not commonly perform (such as jumping and dodging). Half of the participants reported how surprised they were upon realizing that they were able to vertically jump again.

*“You play and train many skills and movements. In the hospital they don’t ask you to jump or dodge things. I didn’t think I would be able to jump again, I even forgot that I ever could.” (P15, male, 40 years old).*

All the participants referred that they gained awareness over their bodies, of the muscles that they use, identifying tense areas and that they were able to dose the effort needed for the games.

*“Maybe I cannot move my body, but I do learn to feel it. Now I know when to stop and what areas are tense and limit my movements.” (P20, female, 45 years old).*

Most of the patients referred experiencing a non-expected improvement, without perceiving having to make great efforts or sacrifices and without experimenting secondary effects from the therapy.

*“I was always waiting for some side-effect after the sharp pains from the drugs... With Kinect, time passed, I played... and one day, I realized that I was able to drink a cup of coffee standing up, without having to sit down.” (P12, female, 32 years old).*

Most patients explained how they applied everything they learnt and trained with the games to their every day life. There was applicability from the virtual world of the games to the real world.

*“You perform all types of movement in any context or situation within the game, and suddenly you are in the real world and everything you have played you can now apply, for instance to go to the market, walk your children to school and stroll with your wife holding hands, just like before...” (P22, male, 42 years old).*

## **2. Sharing the disease.**

This refers to the patients sharing the experience of living with MS with their family, thanks to the use of Kinect. The patients narrated how their body is a limitation for developing their lives. Kinect was perceived as a “window to the outside”, by allowing them to “connect” to reality once more, to communicate with other patients, and establish relations.

*“You cannot avoid feeling trapped, the disease limits you and you lose friends, relations... Playing, you are able to connect again to reality, share experiences one more, meet people and integrate again into the world.”(P18, female, 38 years old).*

On the other hand, the majority of the patients said that the treatment had allowed them to normalize and share the disease with the family. In some patients, an intergenerational reunion took place between parents and children, by sharing games.

*“It stops being a burden and instead you share it with those that love you. With the machine, the disease loses importance. You transform it into something normal, an everyday*

*thing. Playing is when we all get together, it's like watching a film with the family" (P13, male, 49 years old)*

*"... I had disagreements with my son, he spoke and I didn't understand him, it was like speaking in a different language... We grew apart, since he was 14 ... and three years later we are playing, shouting, competing, it's like having a dictionary that makes us understand one each other again" (P10, male, 52 years old).*

### **3. Adapting to the new treatment.**

This refers to how the use of the videogame console incorporated novelties to their rehabilitation programme. The patients narrated how, prior to KVHEP, they had to be very disciplined in their battle against the disease. With Kinect, the goal is to play, and test oneself, by winning games.

*"Before we had to suffer treatments and battle it out, be disciplined. Now all I have to do is to play and have fun with my friends and family..." (P23, male, 39 years old)*

Also, some patients felt that, prior to KVHEP, some kind of physical conditioning programme for the games ought to take place.

*"Before beginning the programme, for some patients that are more worn down, there should be some kind of physical preparation before Kinect. The first week, my entire body ached." (P8, female, 36 years old).*

The long-distance rehabilitation was perceived by many patients as something very positive. Especially in the case of patients that lived far from the hospital or in rural areas, due to the fact that treatment with KVHEP turned into the main (or only) means of rehabilitation.

*"It is difficult and expensive to go into town for rehabilitation. But if you don't do it, you worsen... Kinect gives you the possibility of doing rehabilitation without having to travel and suffer for hours in the hospital, for just 30 minutes of therapy." (P2, female, 44 years old).*

The patients described Kinect as a high-cost therapy, even though during the study they had free access to all the equipment. On the other hand, they felt it was an investment, as the greatest expense was made at the time of its purchase and afterwards it would be money saved on rehabilitation.

#### **4. Comparing oneself.**

This refers to the appearance of factors that motivate the patient during KVHEP. The patients described an eagerness to surpass themselves. They wanted to perform new exercises that they never before would have been able to do, or they wanted to improve their scores on games that they had already mastered.

*“Before, I was scared even of moving. Now, I can’t wait to pass another level in order to begin the next and see which new movements I must do.” (P9, female, 40 years old)*

Many patients described how they tended to compare their results with other patients, or with their family or friends, and the appearance of a “competitive effect”, with competitiveness emerging between them. They narrated how they wanted to be the ones achieving the best scores in the games. This made them continue to play once and again. Also, some patients referred a certain addiction or getting “hooked” on the games.

*“When I first saw M, who was in crutches, she had better scores than myself in the game where we had to dodge balls. I didn’t stop playing until I beat her.”(P5, male, 30 years old).*

*“The truth is that during the first few weeks I got really hooked on Kinect, even my children asked me what was going on. Hours went by really fast, it was like a drug.” (P15, male, 40 years old).*

#### **DISCUSSION.**

Prior studies (24-25) have shown that patients with MS describe how they progressively lose the control over their body (2), as well as their autonomy (2,24), reporting changes in their identity (25), and in their self image, in relation with changes in posture, mobility and falls (2). Indeed, the effects of chronic illnesses on identity have been well recognized (26-27). Loss of control has been identified as a contributing factor to identity issues in people with MS. Chronic conditions produce negative effects on the body, the identity, and the self (27). Our results show how patients with MS regain the feeling that they are in control over their bodies and their lives thanks to the performance of games using Kinect.

Our results are in line with previous studies (28-31) that have shown that social support, self-efficacy, outcome expectations, enjoyment, history of physical behaviour, and self-identity are positively associated with physical activity among MS patients. Also, Plow & Finlayson (13) described how patients with MS that played with the Wii Fit console increased their feeling of control, decreased the difficulty for walking and made them feel that they had recovered a part of their identity by becoming physically active once again. The physical activity performed via the video console helps patients with MS feel their bodies once more and improve their motor symptoms (31-32) producing a decrease in the sense of doubt and loss of control (2). Mozo-Dutton et al (25) have also described how the self-perception and identity of the patients with MS change with the physical changes that take place in the body. The disease forces patients to modify their own self-image. In this manner, by connecting again with their body, the patients rediscover a part of themselves. In fact, previous studies (24,33) reported that, in patients with MS, proprioception and/or functional activities are vital to enhancing their understanding of their individual movement disorders, and they may provide expanded insight involving everyday tasks (33). Contextualized perceptions of improvements in movement may even strengthen the person's sense of ownership and thus

promote autonomy and self-encouragement (24). In the adaptation to the disease, physical activity plays a fundamental role (25).

The unexpected improvements after the application of Kinect also appear with the use of Wii Fit (13). The patients perceive that they recover functionality, without a sense of effort (13). A possible explanation for our results is that some patients spend more time playing than what was predetermined in the KVHEP protocol because many patients get “hooked” on the game, and so “time flies” and they have no perception of actually performing rehabilitation.

According to our results, patients described how the skills applied in the Kinect game were applicable to every day life. Plow & Finlayson (13) described how practice with Wii Fit helped patients with MS to improve their physical activity, and develop social relations within the community. These results may be explained due to the fact that video games help patients train new skills, but they also reinforce those used on a daily basis, such as standing up, coordinating the body, lateral and frontal weight transfers, etc.

Furthermore, our patients used Kinect in order to ‘normalize’ the disease and share their experiences with their families. Disability is a visible marker of MS and the patients feel they are different (31). Along these lines, Dlugonski et al (31) described how the reason for performing multiple activities in patients with MS is for the purpose of “being normal”. With time, the relation with the body is rendered more normal, via factors such as a) recovering the social roles (2,34) and b) receiving support from the family, friends and colleagues (25). They also allowed participants to establish a sense of worth, purpose, and well-being. In this manner, the support from partners, family members and friends is key in determining how the patients socially interact (34).

Our results demonstrate how thanks to the video console some of the patients have been able to reunite with their children. Taylor et al (4) reported that the potential for social



interaction, as a motivating tool to facilitate rehabilitation, must not be overseen. Also, gaming systems can be part of an engaging and interactive multiplayer tool to help reconnect patients with their social environments, either with the rehabilitation itself or with partners and children and/or grandchildren (35). The use of cutting edge video consoles can be an incentive for sharing treatment with the younger family members.

The worth of treatment via games using video consoles has been proved previously in patients with MS (7-12,14). Our results coincide with the study by Plow & Finlayson (13) who demonstrated that patients with MS do not have the sensation of effort during treatment with video games, they just have fun. Previous studies (31-32) show how playing and having fun are fundamental elements for the performance of activities in patients with MS.

According to our results, patients who presented a greater deterioration (EDSS>4) needed more time to perform the games, but they did not experience excessive difficulties. Despite this, some patients felt the need for a physical conditioning programme prior to the use of Kinect. They gave their reasons, based on self reported beliefs and comments with other patients. Kayes et al (36) described the beliefs of patients with MS when performing physical activity: it can be both beneficial as well as harmful, and the greater the physical activity the greater amount of resistance and of energy. These beliefs can condition the participation in rehabilitation programmes via video consoles that use games and physical activity.

Within the aspects of Kinect described as relevant, the application of treatment “from a distance” was noteworthy. Cano-de-la-Cuerda et al (3) described how telerehabilitation presents opportunities for the diagnosis, treatment and follow up of neurological pathology. Furthermore, it provides advantages such as the cost-reduction, the application of rehabilitation in populations with difficulty accessing health centres, as well as the continuation of treatment after hospital leave (3).

The economic cost is a factor considered by our patients. During the study, when applying KVHEP, the patients received all the equipment free. When the experimental treatment was over and the console was taken back, many patients reflected on whether to buy the console themselves. Despite the high cost, the console was perceived as an investment.

Our patients presented an eagerness to improve their own scores and tended to compare their achievements with other players. This comparison has also been observed in patients with MS who used the Wii Fit (13). Harmful effects can occur when the patient does not like the result and feels inaccurate, or, on the contrary, beneficial effects occur when they observe an improvement in their progression and better scores (13). The eagerness to improve their own scores, and the competition that arises with other players, could have effects such as over-exposure to the Kinect rehabilitation treatment. On the other hand, a positive effect is the adherence to rehabilitation treatment with video consoles. This new possible factor of treatment adherence merits further study.

In relation with this last aspect, our patients described an “addiction” to playing. This addiction to games using consoles or virtual platforms may be harmful in certain ages, causing isolation, a decrease of social relations and distance from reality (37). However, it can be very motivating in patients in rehabilitation, increasing adherence to treatment and the effects of treatment (4).

Prior studies (13,38) describe other inconveniences related with the application of rehabilitation via video consoles. Patients with MS refer that the barriers they have always had towards performing physical activities are not removed (13), such as not having enough time for playing. Also, they describe that were worried about possible falls. Fear of falling did not appear in our study. Plow & Finlayson (13) warned of the excessive expectations that the patients who use videogames have for improving their physical capacity and autonomy. This is due to the fact that unrealistic expectations might lead to frustration when expectations are

not met or unexpected barriers are encountered. Plow et al (38) reported that that inactive MS patients may not be able to realistically evaluate the physical activity barriers they encounter and therefore inflate their confidence estimation for overcoming barriers.

The main strength of this study is that it is the first to describe the experiences of MS patients regarding the impact of a home-based video game within rehabilitation programs, using the Kinect Virtual Home-Exercise Programme. This study has several limitations. In the first place, some patients expressed reservations about sharing their opinions because they were afraid that their health care coverage or treatment might change as a consequence of revealing information. In order to mitigate this problem, participants were informed that all researchers were external and independent from the health care team that serviced them. Secondly, before beginning treatment, the younger patients were more predisposed to using KVHEP. However, once treatment began, all patients adapted with ease to the new therapy. Also, our results showed an over-exposure to the Kinect rehabilitation treatment. This resulted in the prolongation of the intervention (in time) regarding the daily programmed sessions, evident in the calculation of total hours per week for the experimental group. This is a relevant factor to take into consideration when developing new treatments and studies. Finally, since this is a qualitative research conducted in a specific context, it may be difficult to transfer the outcome to the general population (18-23).

## **CONCLUSIONS.**

This study describes the patients' perspective after the application of KVHEP. Their experience highlights the perception of an unexpected improvement, the comparison and eagerness to improve, and the opportunity to share the treatment with their social entourage thanks to the games.

These results can be applied to future research using video consoles, by individualizing and adapting the games to the patient's abilities, and by developing a new field of clinical intervention for professionals working in rehabilitation. The proposed approach could be efficiently combined to enhance other effective rehabilitative protocols.

**Conflicts of Interest:**

The authors report no declarations of interest.

1) No funds were received for this study; 2) No financial benefits are derived to the authors from this study; 3) Data from this study have not been presented in any other form.

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**TABLE****Table 1. Kinect Virtual Home-Exercise Programme description (16)**

<b>BRIEF NAME</b>	Kinect Virtual Home-Exercise Programme (KVHEP).
<b>WHY (rationale of treatment)</b>	To demonstrate the potential improvements in balance and postural control among patients with multiple sclerosis who completed a virtual reality telerehabilitation program as a feasible alternative to physical therapy for situations in which conventional treatment is not available.
<b>WHAT: materials</b>	Materials: an Xbox360® console with Microsoft® Kinect was used. The gaming protocol consisted of three games: Kinect Sports®, Joy Ride® and Adventures®. The home television sets of patients were used as the interface for the video games. A physiotherapist monitored and supervised all interventions using online meetings via videoconferencing (webcam) to avoid adverse events.
<b>WHAT: procedures</b>	The gaming protocol (Kinect Sports®, Joy Ride® and Adventures®) proposed tasks such as throwing and hitting objects with the hands and feet, hitting and receiving balls with different body parts, dodging objects, overcoming obstacles, imitating postures, or managing virtual elements to improve key aspects of postural control in different positions across a stepwise gradient of difficulty. The software raises

	<p>the gaming difficulty level depending on the patient's results and progress.</p> <p>Computerized dynamic posturography and clinical outcomes (Berg Balance and Tinetti scales) were used at baseline and at the end of the treatment.</p>
<p><b>WHO</b> (profession, expertise, background, specific training)</p>	<p>-Two physiatrists and three physiotherapists from the Rey Juan Carlos University (Spain) with more than 10 years of experience in rehabilitating patients with multiple sclerosis designed the gaming protocol.</p> <p>-A physiotherapist with more than 10 years of experience in rehabilitating patients with multiple sclerosis monitored and supervised all interventions using online meetings via videoconferencing to avoid adverse events.</p> <p>-A blinded physiotherapist to the intervention with more than 10 years of experience in rehabilitating neurological patients performed all the assessments.</p>
<p><b>HOW</b> (modes of delivery)</p>	<p>Participants received individual telerehabilitation treatment using the Xbox360® console with Microsoft® Kinect within their homes. All sessions were monitored and supervised using online meetings via videoconferencing (webcam).</p>
<p><b>WHERE</b></p>	<p>The telerehabilitation exercise programme was conducted at</p>

<b>(infrastructure and relevant features)</b>	<p>patient's homes. Besides the Xbox360® console with Microsoft® Kinect and a webcam, no other equipment was necessary.</p> <p>The computerized dynamic posturography and clinical outcomes were conducted at the Motion Analysis Laboratory at Rey Juan Carlos University (Madrid, Spain).</p>
<b>WHEN and HOW MUCH (number of sessions, duration, intensity or dose)</b>	<p>The gaming protocol comprised 40 sessions at intervals of four sessions per week. The treatment schedule lasted 10 weeks. Treatment time was progressively increased based on individual patients' fatigue level, up to 20 minutes per session. The gaming protocol started with seating positions to standing and dynamic movements of the limbs. The protocol was designed to go from less to more difficulty in terms of the tasks required.</p>
<b>TAILORING (personalization)</b>	<p>There was a progressive increase based on individual patients' fatigue level, up to 20 minutes per session.</p>
<b>MODIFICATIONS (from existing or initial protocol)</b>	<p>No modifications were made.</p>
<b>HOW WELL: planned (adherence and procedure to maintain</b>	<p>-Adherence was assessed by the % of completed sessions by the physiotherapist who monitored the telerehabilitation programme.</p>

it)	-Satisfaction was assessed by a questionnaire that was developed by a group of experts specializing in the care of multiple sclerosis, adapted from the “Home telehealth satisfaction item bank questionnaire” of the American Telemedicine Association (ATA) and the Client Satisfaction Questionnaire (CSQ-8).
<b>HOW WELL: actual</b>	The results of this study indicated a high degree of adherence (86,02% completed sessions) and satisfaction (87,4% of the sample was highly satisfied) with the experimental intervention.

**Table 2. Sociodemographic characteristics of the sample (n=24)**

Age (years). Mean and standard deviation	36.69 SD 8.13
Sex	Female 54.2% (n=13) Male 45.8% (n=11)
Years since diagnosis. Mean and standard deviation	9.68 SD 6.76
MS type	PP 20.0% (n=5) RR 71.9% (N=16) SP 8.1% (n=3)
EDSS	Score 3 EDSS 16.4% (n=4) Score 4 EDSS 75.5% (n=17) Score 5 EDSS 8.1% (n=3)

MS: Multiple Sclerosis; EDSS: Expanded Disability Status Scale; SD: Standard Deviation;  
PP: Primary Progressive; RR: Relapsing Remitting; SP: Secondary Progressive.