Potential Benefits of Nintendo Wii Fit Among People with Multiple Sclerosis

A Longitudinal Pilot Study

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We examined the potential of Nintendo Wii Fit (Nintendo Co, Ltd, Kyoto, Japan) to increase physical activity (PA) behavior and health among people with multiple sclerosis (MS). The study consisted of a repeated-measures design with a baseline control period and involved 30 people with MS who had the ability to walk 25 feet with or without a cane (26 individuals were included in the analyses). Nintendo Wii was set up in the homes of participants, who were prescribed a Wii Fit exercise program lasting 14 weeks, 3 days a week. The Physical Activity and Disability Survey, Modified Fatigue Impact Scale, and 36-item Short Form Health Status Survey were administered three times before participants gained access to Wii Fit (control period, at 2-week intervals), and three times after they received Wii Fit (posttest 1: immediately after; posttest 2: 7 weeks after; posttest 3: 14 weeks after). Mobility, balance, strength, and weight were assessed at the first pretest, immediately prior to obtaining access to Wii Fit, and 7 weeks after obtaining access to Wii Fit. Results from the questionnaires indicated that PA significantly improved at week 7, but at week 14, PA levels declined relative to week 7 and the difference was no longer significant compared with the control period. Physical assessments indicated that balance and strength significantly improved at week 7. One adverse event was reported (repetitive knee injury). Physical assessments indicated that people with MS may be able to improve their fitness levels by using Wii Fit. Future studies should incorporate behavior change strategies to promote long-term use of Wii Fit, and explore whether individuals with more severe symptoms of MS can safely use Wii Fit. ***Int J MS Care.*** **2011;13:21–30.**

Regular physical activity (PA) has established benefits among people with mild-to-moderate multiple sclerosis (MS).[1] It has been shown that regular PA over a 5-year period has a positive effect on quality of life and physical function in people with MS.[2] A 15-week aerobic training program was found to reduce fatigue and body fat percentage as well as improve strength in individuals with MS.[3] Romberg et al.[4] found that a home-based resistance strength training program resulted in improved walking speed in people with MS. Even regular participation in a 4-week exercise program resulted in improved health perception and reduced fatigue among MS patients.[5] Nevertheless, a meta-analysis found that, in general, people with MS are inactive.[6] Furthermore, few clinical trials have identified intervention strategies to promote routine participation in PA and/or exercise programs.

The low rates of PA among people with MS may be due to the personal and environmental barriers to routine PA faced by this population. Symptoms related to MS, such as fatigue, pain, and depression, as well as mobility impairments, can reduce motivation and capacity to engage in PA.[7-10] Furthermore, social obligations (eg, domestic roles), reactions to the social environment (eg, stress), and accessibility of health clubs can all interfere with PA.[11,12] Given these numerous barriers, innovative intervention strategies are needed to promote PA in people with MS. One such innovative strategy may be the use of interactive video game technology. Advances in gaming technology now allow individuals to exert

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physical effort while playing video games (eg, Dance Dance Revolution [Konami Digital Entertainment, Inc, Los Angeles, CA] and Nintendo Wii [Nintendo Co, Ltd, Kyoto, Japan]).[13-15] Evidence indicates that interactive video games can improve cardiovascular fitness and exercise adherence among healthy adults.[15] Furthermore, preliminary research suggests that interactive video games may be beneficial among individuals with disabilities.[16-19] However, no published studies to date have explored the potential benefits of interactive video games among people with MS.

One of the top-selling home video game consoles is Nintendo Wii, which is marketed as an easy-to-use gaming console for a broad demographic audience. The game Wii Fit is designed to promote PA through interactive exercise games. Wii Fit has over 40 exercise games that incorporate strength training (eg, leg extensions, lunges, push-ups, and sit-ups), balance training (eg, soccer heading, skiing, and table tilt), aerobics (eg, marching, boxing, and hula hooping), and yoga (eg, deep breathing, warrior pose, and tree pose). Players are instructed through demonstration on how to perform the exercises correctly. In contrast to Wii Sports, which includes such games as tennis and boxing, in Wii Fit on-screen action is controlled mainly with a platform (Wii balance board) that is placed on the floor. The platform can provide personalized feedback about accuracy of movement patterns using pressure sensors and Bluetooth technology. The body-testing program can evaluate players' weight and balance and enable them to set weight-loss goals. Playing Wii Fit generates rewards in the form of Wii Points, which can be used to unlock new exercise games. These interactive features (modeling proper exercise biomechanics, encouraging participants to set health-related goals, increasing self-monitoring of behavior, and rewarding regular use) may help increase self-efficacy, which in turn could promote PA.[20,21]

Wii Fit could be very beneficial for people with MS. Yoga, strength, balance, and aerobic training, which are all included in Wii Fit, have been found to reduce fatigue, increase fitness levels, and improve quality of life in people with MS.[1,22] Furthermore, Wii Fit may minimize MS-related barriers to engaging in PA. For example, Wii Fit may enable people with MS to engage in exercise in their homes without expending unnecessary energy that is associated with exercising at a health club. Wii Fit may also address a potential drawback of typical home exercise programs: loss of opportunities for socialization. Wii Fit may foster socialization by allowing participants to play and compete with friends and family members. Last, but perhaps most important, Wii Fit games may be fun to play, which may provide distraction or relief from the daily problems and stress that people with MS can experience and help foster intrinsic motivation to promote routine PA.[23]

Given these potential benefits, a growing number of rehabilitation professionals are using Nintendo Wii in their clinical practices.[24] However, no published studies to date have documented the benefits of playing Wii Fit and whether it is safe for people with MS to use Wii Fit in their homes. Therefore, the purpose of this longitudinal pilot study was to evaluate the potential of Wii Fit to positively influence PA behavior and health among people with MS. Specifically, data from people with MS were collected to preliminarily test the following hypotheses: 1) Access to Wii Fit will significantly increase PA behavior, health-related quality of life (HRQOL), and self-efficacy, as well as decrease the impact of fatigue as compared with a baseline control period. 2) Increases in PA behavior will result in improved fitness levels (ie, mobility, balance, strength, and weight).

Methods

Overview

A repeated-measures time-series design with a baseline control period was used to gather preliminary data to test the hypotheses of the study. Advertising was used to recruit a convenience sample of 30 people with MS. Questionnaires were administered by telephone a total of six times. Physical assessments were conducted during three home visits. The University of Illinois at Chicago Institutional Review Board approved the study.

Participants

Participants were recruited through e-mails sent out by the National Multiple Sclerosis Society (NMSS), postings in neurologists' offices, and visiting MS support groups. Inclusion criteria were a physician-confirmed diagnosis of relapsing-remitting MS (RRMS) and approval to participate, location within 40 miles of the university, age of 18 to 60 years, and ability to ambulate 25 feet with or without a cane. Exclusion criteria were 150 minutes or more of PA per week, pregnancy, metabolic or cardiopulmonary disease, lower-extremity amputation, low vision (unable to see a television), severe fatigue (score of $\geq$6.5 on the Fatigue Severity Scale),[25] major depression (two screening questions),[26] epilepsy, two or more falls in the past 6 months, neuropsychological deficits (score of ≥27 on the MS Neuropsychological Screening),[27] or any other condition or problem that compromised safety or ability to engage in the Wii Fit exercise program (Figure 1). Participants were also required to own a color television set, have enough space in their home to use Wii Fit, and not already have a Nintendo Wii in their home.

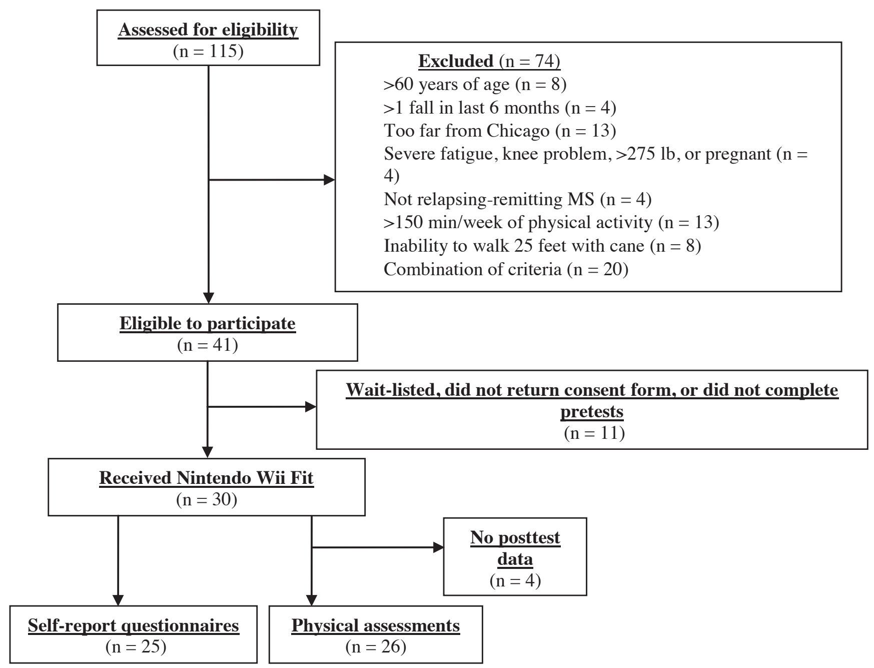

Figure 1. **Flow of participants through the study**

Intervention

After the control period, Nintendo Wii was set up in participants' homes, and they were prescribed a Wii Fit exercise program. All participants were initially prescribed a 3-times-a-week exercise program that consisted of yoga, balance, strength, and aerobic training in each session. To accommodate differences in fitness level, exercise duration (ie, number of Wii playing minutes) was based on participants' rate of perceived exertion (RPE, 1–10) when playing the "Basic Run" game. Participants who reported an RPE of greater than 6 were initially prescribed Wii playing sessions lasting 10 minutes each; an RPE of greater than 4 to 6, 15 minutes each; and an RPE of 1 to 4, 30 minutes each. Participants were telephoned every other week (a total of four times) for the first 7 weeks after receiving Wii Fit to monitor adverse events and to encourage increases in the duration or frequency of using Wii Fit. During these phone calls, participants were asked to set goals to increase the duration or frequency every other week, as well as discuss solutions for overcoming barriers to use. By the end of the 7 weeks, all participants were encouraged to play Wii Fit 3 to 5 times a week for 20 to 30 minutes per session.

Outcomes

All questionnaires were administered by phone three times before participants gained access to Wii Fit (control period, at 2-week intervals), and three times after they received Wii Fit (posttest 1: immediately after; posttest 2: 7 weeks after; posttest 3: 14 weeks after). Physical assessments were conducted in participants' homes at the first pretest, immediately prior to obtaining access to Wii Fit, and 7 weeks after receiving Wii Fit. The timeline of the study is shown in Figure 2.

Physical Activity Behavior

The Physical Activity and Disability Survey[28] was administered to comprehensively account for PA behav-

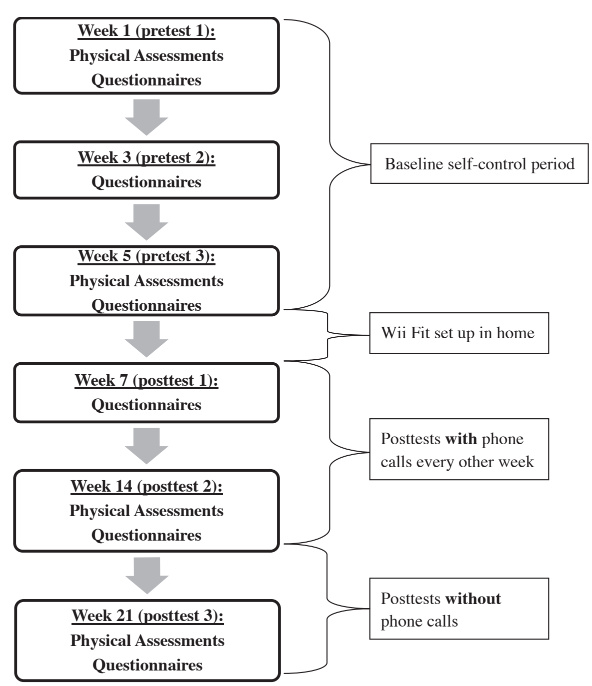

Figure 2. **Timeline of the study**

ior. This measure comprises five subscales: planned exercise/leisure-time PA, general PA, therapy, employment, and wheelchair use. The scale has been shown to be reliable and valid in a variety of populations with chronic diseases, including MS.[28,29] We used the revised measure and scoring technique of Kayes et al.[30] to calculate a total composite score for the analyses. A higher score indicated a greater amount of PA. Wii logs were also recorded during the last home visit, which provided information on frequency and duration of playing Wii Fit.

Quality of Life

The 36-item Short Form Health Status Survey (SF-36) is one of the most widely used scales to measure HRQOL and is considered valid and reliable in people with MS.[31] The SF-36 has eight subscales: physical functioning, role-limitations due to physical problems, bodily pain, general health perceptions, vitality, social functioning, role-limitations due to emotional problems, and mental health. Two composite scores, for physical and mental health, can also be calculated. We used only the composite scores for the analyses. A higher score indicated better HRQOL.

Fatigue

The Modified Fatigue Impact Scale is commonly used to measure impact of fatigue in people with MS.[31] The original measure, the Fatigue Impact Scale,[32,33] was developed from interviews among people with MS and has been shown to have discriminant validity between people with MS and individuals with general fatigue and essential hypertension. Ritvo et al.[31] modified the scale by eliminating redundant items that had a high inter-item correlation. This modified scale is considered valid and reliable in people with MS.[34,35] The scale consists of 21 items. The subscales are physical, cognitive, and psychosocial functioning; only the total composite score was used in the analyses. A higher score indicated worse fatigue.

Self-efficacy

The barrier self-efficacy scale, developed by Marcus et al.,[36] was administered to help explain why Wii Fit did or did not promote PA. The five-item scale measures confidence to overcome barriers related to weather, boredom, vacation, mood, and tiredness. During the baseline control period, the scale demonstrated adequate internal (α = 0.62, averaged across three pretests) and test-retest reliability.

Physical Assessment

Fitness tests were administered to assess mobility, balance, strength, and weight. These tests were selected because they correspond with Wii Fit exercises. During the first home visit, we administered the Timed Up and Go (TUG) test,[37] the Equiscale Balance test,[38] and the 3-minute stepping test.[39] However, because of concerns about ceiling effects, the second and third assessments were modified to incorporate more physically demanding tasks. Additional standardized assessments were selected from the Balance Evaluation Systems Test (BESTest)[40] and YMCA Fitness Testing.[41] The BESTest assessments were modified to incorporate additional and more challenging balance tests as well as using only time to balance or time to walk 3 m (up to 1 min) in the analyses. We decided not to incorporate subjective clinical judgments (eg, stable or unstable in a balance task) into the scoring to help minimize bias. Given the encouragement that Wii Fit provides in losing weight, we also recorded body weight from the Wii Fit log. A summary of the physical assessments that we administered is provided in Table 1.

Table 1. Summary of physical assessments administered immediately before and 7 weeks after access to Wii Fit

1) Mobility
Time (up to 60 s) to stand up from chair, walk 3 m, and return to sitting in chair:
- a) TUG
- b) TUG with head turns (verbal instructions to turn head left or right every 6 steps)
- c) TUG with stepping over boxes (stepping over 22.9-cm-high boxes every 1.5 m)
- d) TUG with dual tasks (counting backward from 100 in multiples of 3)

2) Endurance, strength, and weight
- a) Body weight (measured with Wii Fit)
- b) Maximum number of push-ups
- c) Timed number of sit-ups in 60 s
- d) Maximum number of steps in 3 min onto a 6-inch platform

3) Balance: number of seconds (up to 60 s)
- a) Eyes closed, feet together, firm surface
- b) Eyes closed, feet together, foam surface (Foam: Symphony Pillow by Tempur-Pedic)
- c) Eyes open, one foot, firm surface (added left and right foot time)
- d) Eyes closed, one foot, firm surface
- e) Eyes closed, one foot, foam surface

Abbreviation: TUG, Timed Up and Go test.

Statistical Analysis

The stability of the questionnaires between the first and second pretests, the second and third pretests, and the first and third pretests was evaluated using paired *t* tests and Pearson *r* correlations. Stable scores were averaged together and used as a baseline reference.

Four repeated-measures multivariate analyses of variance (MANOVAs) were conducted to test the hypotheses: 1) self-report questionnaires, 2) mobility, 3) weight and strength, and 4) balance. Post hoc contrasts determined which questionnaires or assessments changed significantly and when these changes occurred. A Bonferroni adjustment was made. Thus, the *P* value for post hoc contrasts was adjusted to .01 (.05/5) on self-report questionnaires, to .0125 (.05/4) on mobility, to .0125 (.05/4) on weight and strength, and to .01 (.05/5) on balance. Effect size (ES) or mean change (MC) was reported for significant and near-significant findings. All analyses were conducted using SPSS, version 17.0 (SPSS, Chicago, IL).

Results

The demographic characteristics of the 30 participants are shown in Table 2. However, five participants did not complete all of the postintervention data-collection measures. The total Wii Fit playing time at posttest 2 was 254.5 hours (range, 0.27–28.93, recorded from Wii; n = 26), and the total time at posttest 3 was 401.8 hours (range, 2.38–46.07, self-report; n = 20). The most frequently played exercises were the balance games, followed by yoga, aerobics, and strength exercises. One adverse event was reported, a repetitive knee injury from aerobic stepping. Nine participants reported having at least 1 week in which they were unable to use Wii Fit because of an increase in symptoms or illness after receiving access to Wii Fit. Five participants reported initiating a rehabilitation program (n = 1), a wellness program (n = 1), or an exercise class (n = 1) or going to a health club (n = 2) to exercise after receiving access to Wii Fit.

***Table 2.* Demographic characteristics (N = 30)**

Variable	Value
Age, mean (SD), y	43.2 (9.3)
Years since diagnosis, mean (SD)	9.0 (6.8)
Years since symptoms first started, mean (SD)	12.2 (7.9)
Gender	
Female	23
Minority	9
Employed (full- or part-time)	18
Education (>15 y)	19
Patient Determined Disease Steps	
Normal	8
Mild disability	7
Moderate disability	5
Gait disability	4
Early cane	5
Missing	1

Note: Unless otherwise indicated, values are number of participants.

Findings of the stability analyses conducted between pretests for the questionnaires are listed in Table 3. None of the questionnaires changed significantly between pretests. Furthermore, scores demonstrated moderate-to-high correlations (0.48–0.90) between pretests. Thus, the three pretests were averaged together and used as a baseline reference to assess the effects of Wii Fit. The MANOVA for questionnaires (testing hypothesis 1) indicated significance across time (Wilks Λ = 0.693, F = 1.785, *P* = .039). Post hoc contrasts indicated that only PA (*P* = .001, ES = 0.65) significantly improved at posttest 2 (Table 4). At posttest 3, PA levels

***Table 3.* Test-retest reliability of self-report questionnaires**

Instrument	Pretest 1 Mean (SD)	Pretest 2 Mean (SD)	Pretest 3 Mean (SD)	*P* value[a]/*r* 1 vs. 2	*P* value[a]/*r* 2 vs. 3	*P* value[a]/*r* 1 vs. 3
PADS	0.78 (1.08)	0.73 (1.07)	0.70 (1.14)	.75/0.76	.87/0.64	.6/0.77
SF-36: Mental Composite	54.01 (9.07)	53.20 (10.68)	52.27 (9.25)	.54/0.75	.54/0.67	.23/0.64
SF-36: Physical Composite	40.50 (8.16)	41.41 (9.45)	41.91 (8.63)	.48/0.70	.66/0.77	.20/0.75
MFIS	31.73 (17.97)	29.53 (17.56)	31.03 (17.44)	.18/0.88	.41/0.84	.63/0.90
Self-efficacy	3.15 (0.51)	3.25 (0.55)	3.17 (0.77)	.32/0.48	.39/0.76	.87/0.55

Abbreviations: MFIS, Modified Fatigue Impact Scale; PADS, Physical Activity and Disability Survey; SF-36, 36-item Short Form Health Status Survey.
[a]*P* value is for comparison between pretests, *not* Pearson *r* value.

Table 4. Post hoc analyses for self-report questionnaires: comparison of average pretest to posttest scores

Instrument	Pretest[a] Mean (SD)	Posttest 1 Mean (SD)	P value	Posttest 2 Mean (SD)	P value	Posttest 3 Mean (SD)	P value
PADS	0.72 (1.05)	0.91 (1.03)	.057	1.14 (1.01)	.001[b]	0.76 (1.20)	.800
SF-36: Mental Composite	54.68 (7.64)	53.93 (8.14)	.515	55.46 (6.28)	.462	52.75 (11.60)	.265
SF-36: Physical Composite	42.24 (7.69)	43.83 (9.10)	.067	43.44 (8.90)	.298	43.11 (10.77)	.565
MFIS	28.27 (16.77)	26.32 (17.94)	.151	24.84 (15.45)	.198	29.16 (20.01)	.797
Self-efficacy	3.29 (0.51)	3.38 (0.71)	.284	3.42 (0.70)	.156	3.07 (0.58)	.025

Abbreviations: MFIS, Modified Fatigue Impact Scale; PADS, Physical Activity and Disability Scale; SF-36, 36-item Short Form Health Status Survey.
[a]Average of three time points.
[b]Significant at an adjusted *P* value of .01.

declined relative to posttest 2 levels and the differences were no longer significant compared with the baseline control period. Self-efficacy approached a near-significant decline at posttest 3 compared with the baseline control period ($P = .025$, ES = −0.47).

In terms of the physical assessments (testing hypothesis 2), MANOVA for mobility indicated significance across time (Wilks Λ = 0.643, F = 3.057, $P = .038$). Post hoc contrasts indicated that TUG with head turns ($P = .036$, MC = 1.3 seconds) and TUG with dual tasks ($P = .014$, MC = 2.1 seconds) reached a near-significant improvement at posttest 2 (Table 5). The MANOVA for strength and weight demonstrated significance across time (Wilks Λ = 0.574, F = 4.076, $P = .013$). Post hoc contrasts revealed that the number of steps onto a 6-inch platform ($P = .005$, MC = 5.6), maximum number of push-ups ($P = .012$, MC = 4.5), and number of sit-ups in 60 seconds ($P = .013$, MC = 5.6) significantly increased at posttest 2 (Table 5). Weight loss approached significance ($P = .032$, MC = −1.3 lb). The MANOVA for balance indicated significance across time (Wilks Λ = 0.395, F = 6.421, $P = .001$). Post hoc contrasts showed that duration for which balance was maintained with eyes open ($P = .009$, MC = 4.7 seconds) and with eyes closed ($P = .01$, MC = 6.6 seconds) while standing on one foot on a firm surface significantly improved at posttest 2 (Table 5). Furthermore, duration for which balance was maintained with eyes closed while standing with feet together on a foam surface approached significant improvement ($P = .017$, MC = 7.9 seconds).

Table 5. Post hoc analyses for mobility, balance, weight, and strength

Outcome	Assessment	Pretest Mean (SD)	Posttest 2 Mean (SD)	P value
Mobility[a]	TUG, s	9.43 (4.22)	8.93 (3.91)	.054
	TUG with head turns, s	11.43 (6.01)	10.15 (4.52)	.036
	TUG with stepping over boxes, s	17.65 (14.49)	15.71 (12.33)	.119
	TUG with dual tasks, s	14.05 (10.51)	11.92 (8.26)	.014
Weight and strength[a]	Weight, lb	161.29 (32.42)	159.98 (31.70)	.032
	Maximum number of push-ups	15.15 (8.43)	19.62 (9.56)	.012[a]
	Timed number of sit-ups	31.19 (12.34)	36.77 (13.42)	.013
	Timed number of steps	65.73 (24.47)	71.35 (22.32)	.005[a]
Balance[b]	Eyes closed, feet together, firm surface, s	54.07 (16.75)	54.81 (14.87)	.244
	Eyes closed, feet together, foam surface, s	40.55 (24.78)	48.49 (21.07)	.017
	Eyes open, one foot, firm surface, s	49.40 (52.79)	54.05 (50.64)	.009[b]
	Eyes closed, one foot, firm surface, s	10.33 (17.80)	16.94 (24.40)	.010[b]
	Eyes closed, one foot, foam surface, s	5.34 (6.93)	6.76 (9.77)	.404

Abbreviation: TUG, Timed Up and Go test.
[a]Significant at an adjusted *P* value of .0125.
[b]Significant at an adjusted *P* value of .01.

Discussion

To date, no published studies have explored the potential of Nintendo Wii Fit to promote PA in people with MS. Physical assessments indicated that individuals with MS may be able to improve their fitness levels by using Wii Fit. Furthermore, only one adverse event was reported, which may suggest that people with MS who have minimal balance and mobility problems can safely use Wii Fit in their homes. However, self-report questionnaires indicated that HRQOL and fatigue impact were not affected by the use of Wii Fit. Moreover, Wii Fit does not appear to be the "magic pill" to promote long-term participation in PA. The fact that PA returned to baseline levels after the cessation of phone contacts and that self-efficacy approached a near-significant decline at posttest 3 indicates that future studies will need to incorporate behavioral change strategies to promote long-term use of Wii Fit.

There are many possible explanations for the nonsignificant findings of the Modified Fatigue Impact Scale and the SF-36. Self-report questionnaires may have reached a ceiling effect, as most study participants experienced only mild symptoms of MS and we excluded patients with severe fatigue. Exercise studies among people with MS that have found changes in quality of life and fatigue typically have a more diverse research sample in terms of functional level and type of MS.[22] It is also possible that the Wii Fit aerobic exercises were not performed at a sufficient intensity or frequency or the total duration of the study was too short to positively influence HRQOL and fatigue. Romberg et al.[4] found that quality of life was not influenced by a 6-month home-based strength training program. They concluded that aerobic training may be needed to increase HRQOL. Future research should compare different types of exercise programs to determine which programs improve HRQOL.

Because of safety concerns about the unsupervised Wii Fit exercise program, many individuals were excluded for severe mobility impairments and balance problems. We were concerned about the small size of the Wii balance board, which prevents individuals from using a wide base of support. However, participants who had minimal or moderate mobility impairments or balance problems were able to find ways to safely play Wii Fit. Some of these strategies included placing a chair in front of the board while playing challenging games or finding ways to modify the exercises. For example, one participant modified the yoga poses that required standing on one leg by placing the other leg on the floor next to the Wii board. Another participant who had weakness in her hip flexors decided to play the "Basic Run" game by doing repetitive squats instead of marching in place. Indeed, the ability to accommodate different functional levels increases the usability of Wii Fit for people with MS, as well as providing opportunities for therapists to tailor Wii Fit exercise programs to meet individual needs.

All physical assessment scores moved in a positive direction at 7 weeks, providing some indication that overall fitness levels improved. The improvement on the TUG with dual tasks is an interesting finding, but whether this improvement is clinically significant is unknown. Wii Fit requires individuals to integrate sensory stimuli and react accurately in a timely manner. It may be that this type of activity helps improve the ability to accomplish dual tasks. Given that many of the exercises in Wii Fit require stepping on and off the board, it was not surprising to see improvements in the 3-minute stepping test. Furthermore, improvements in strength and balance are also not surprising, given that many of the exercises emphasize core stability and there are exercises that directly correspond to the assessments (eg, push-ups and sit-ups). Although not clinically meaningful, the fact that weight loss approached a significant decline is an encouraging finding. Wii Fit helps individuals self-monitor their weight, which is an effective strategy for promoting weight loss.[42] Future studies should explore whether combining access to Wii Fit with nutritional education can help promote clinically meaningful weight loss among people with MS.

Future studies will also need to explore which behavioral change strategies are most effective in promoting the long-term use of Wii Fit. Indeed, promoting habitual engagement in any type of behavior is still a perplexing problem within the health behavior literature.[43] There are many possible explanations for the decline of PA behavior at posttest 3. Various factors, such as failure to foster intrinsic motivation,[44] dissatisfaction with outcomes,[45] and boredom[46] with the Wii Fit exercises, may have contributed to the decline of PA behavior. Potential strategies that could be used in a clinical setting to help promote long-term use of Wii Fit include teaching patients how to set and self-monitor reasonable and achievable goals for increasing the use of Wii Fit, encouraging self-rewards when they do achieve their goals, fostering realistic expectations about potential benefits of increasing PA, emphasizing the importance of incorporating a variety of Wii Fit exercises into their routine, and supporting the self-management of symptoms to help minimize barriers to PA.

Although Wii Fit allows users to set goals related to losing weight, it does not provide opportunities to set goals related to increasing frequency, duration, or intensity of exercise. Thus, we provided opportunities for participants to set these types of goals during the first 7 weeks of the program over the phone with the research assistant. This strategy seems to be a reasonable approach to promote the initial use of Wii Fit, and is consistent with other studies that have found goal setting to be a strong predictor of PA behavior in people with MS.[47] However, it does appear from this study that participants did not internalize the Wii Fit goals; that is, most participants were motivated to achieve their goals only when they were held accountable by the research staff. It may be that a more patient-centered approach will help foster the internalization of goals related to playing Wii Fit. Strategies such as motivational interviewing and building skills related to problem-solving and decision making should be explored in future studies.[48]

The decline or worsening of self-efficacy may suggest that efficacy-enhancement strategies are needed to promote long-term use, or may simply reflect a realistic assessment of confidence (ie, reflection on actual past behavior). Plow et al.[49] also found significant declines in self-efficacy after a 16-week home exercise program in people with MS. It was concluded that participants were able to assess their self-efficacy better in the posttest period because they had more experience with exercising. The same argument may apply to the findings of this study. Participants who experienced barriers to playing Wii Fit were less confident that they could overcome such barriers. It is also possible that participants were simply dissatisfied with the outcomes they were experiencing, which translated into low motivation and self-efficacy for overcoming PA barriers. The attitudes of people with MS toward the benefits of PA can be influenced by patterns of disease progression.[11,50] Thus, participants may have experienced an increase in symptoms or a disease exacerbation, and then concluded that Wii Fit was not effective and stopped playing it.

In spite of the findings that PA returned to baseline levels, we believe that Nintendo Wii Fit has the potential to be of benefit for people with MS and clinicians who treat them. As with any treatment, research will need to identify who is most likely to benefit from having access to Wii Fit so that clinicians can make evidence-based recommendations to their patients. There was a subgroup of participants (n = 6) who were extremely motivated to play Wii Fit throughout the study. Although this subgroup was too small to identify statistically meaningful patterns, these participants tended to be extremely inactive or were fairly active and found particular exercises that they liked to do with Wii Fit. Thus, future research should explore whether Wii Fit is beneficial in initially motivating people to engage in some type of PA and whether introducing variety into an existing exercise program helps promote PA. Many participants noted that they liked playing the balance games, which were the most frequently performed exercises. This fact, along with the findings that mobility and standing balance improved, provides some support for the clinical utility of Wii Fit. Future research will need to explore whether Wii Fit exercises translate into better overall mobility during daily tasks. For example, can Wii Fit exercises reduce fall risk, increase mindfulness of movement, prevent inactivity complications that contribute to mobility impairments (eg, deconditioning), or improve confidence in physical function? Such questions will have to be answered to help demonstrate the clinical utility of Wii Fit.

Limitations of this pilot study include the small sample size and failure to control for the maturation of participants over time and "extra motivation" during posttest assessments. Although care was taken to reduce the confounding effects of extra motivation during posttest assessments (eg, using the same number of verbal cues for pretest and posttest assessments, and emphasizing that participants should try their best for both types), social desirability bias is hard to overcome. These limitations, along with the fact that the research sample

PracticePoints

- Physical assessments indicated that people with MS may be able to improve their fitness levels by using Nintendo Wii Fit.
- People with MS who have minimal balance and mobility problems can safely use Wii Fit in their homes.
- Encouraging habitual use of Wii Fit may require the implementation of behavior change strategies.

included only people with RRMS who could walk with or without the use of a cane, reduce the generalizability of this study. Furthermore, because we conducted in-home assessments, it was not feasible to include a comprehensive measure of aerobic fitness (eg, testing of oxygen consumption per unit time), which may provide additional evidence for the clinical utility of Wii Fit. Nonetheless, this pilot study can inform the design of larger clinical trials in terms of sample size, inclusion and exclusion criteria, type of questionnaires, type of intervention, and so on.

Conclusion

As clinicians incorporate the use of Nintendo Wii into their practices, the need arises to evaluate the effectiveness of using Wii Fit. This study provides preliminary evidence that people with MS who have mild symptoms can safely use Wii Fit in their homes and can thereby improve their fitness levels. However, as with other types of exercise programs, long-term use of Wii Fit may require the implementation of behavior change strategies. The fact that balance games were most frequently played and that standing balance improved during the study provides a rationale to explore whether Wii Fit can be effective in reducing falls among people with MS. Future studies should also explore who will benefit the most from having access to Wii Fit and whether people with more severe balance and mobility problems can safely use Wii Fit without supervision. ☐

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