Published in final edited form as:
Lupus. 2011 October ; 20(12): 1293–1299. doi:10.1177/0961203311412098.

Using Wii Fit to reduce fatigue among African American women with systemic lupus erythematosus: A pilot study

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Abstract

Fatigue and physical deconditioning are common, difficult to treat conditions among patients with systemic lupus erythematosus (SLE). The aim of this pilot study is to evaluate the effectiveness of a home-based exercise program using the Wii Fit system in patients with SLE. Fifteen sedentary African American women with SLE experiencing moderate to severe fatigue participated in a home exercise program using the Wii Fit 3 days a week for 30 minutes each for 10 weeks. A one-group pretest-posttest design was used to evaluate the effectiveness of this program. Primary outcome measure was severity of fatigue. Secondary outcome measures were body weight, waist circumference, fatigue-related symptoms of distress, activity level and physical fitness. At the completion of the 10-week Wii Fit exercise program, participants perceived fatigue severity as measured by the Fatigue Severity Scale to be significantly decreased (P=0.002), body weight and waist circumference were significantly reduced (Ps=0.01). In addition, anxiety level as measured by Hospital Anxiety and Depression Scale, and overall intensity of total pain experience as measured by Short-form of the McGill Pain Questionnaire were also significantly reduced (Ps<0.05). Findings provide preliminary support that the Wii Fit motivates this population to exercise which leads to alleviation of fatigue and reduced body weight, waist circumference, anxiety level, and overall intensity of total pain experience.

Keywords

systemic lupus; games activities; exercise; fatigue

Introduction

Systemic lupus erythematosus (SLE) is a chronic inflammatory connective tissue disease that may result from an immuneregulatory disturbance brought about by the interaction of genetic, hormonal, and environmental factors.[1] The prevalence of SLE in women is approximately 10 times higher than in men, with a disproportionally higher prevalence of SLE reported in African Americans.[2] More than 80% of people with SLE experience clinically significant levels of fatigue .[3] Fatigue disrupts normal daily activities, which often leads to disability.[4, 5] The etiological mechanism of fatigue is not fully understood; however, the fatigue patients experience is not explained by their medications for SLE, inflammation, biochemical, immunological or other disease markers.[6]

Based on several critical reviews of literature regarding fatigue management in people with SLE, researchers concluded that one of the most effective behavioral intervention strategies for reducing fatigue is exercise.[7, 8] People with SLE who participated in supervised exercise programs reported multiple benefits, including significant reduction in fatigue levels, and improvement in sleep quality and physical fitness.[9] However, for center-based exercise programs which require participants go to a particular center to complete an exercise protocol, recruitment and retention are major limitations.[10] Furthermore, findings from such studies may not generalize to people who have limited access to exercise facilities because of transportation or scheduling difficulties.[11] Most importantly, because the loss of infrastructure, and support, motivation and reinforcement from research staff, participants' adherence to exercise typically drops significantly once the program ends.[12]

Home-based exercise training, on the contrary, has been shown to result in greater long-term adherence to exercise.[13] Home-based programs mitigate transportation and scheduling difficulties. Participants are not required to attend classes in a center.[11] However, adherence to home-based exercise program relies on self-report from participants, and the training effect is inferior when compared to center-based programs due to lack of supervision and feedback on performance.[13]

The incorporation of game activities as an incentive may help improve motivation and adherence to home-based exercise. Several studies have compared the effect of playing computer games versus rote exercise on duration of engagement in movement activity, or number of repetitions.[14, 15] In these studies, both game activities and rote exercise groups required participants to perform the same pattern of physical body movement. Results of these studies consistently indicated that participants assigned to the games-embedded exercise group had a higher number of repetitions within the given movement time, or engaged in longer duration of movement than those assigned to the rote exercise group.[14, 15] Furthermore, participants reported an overall higher level of enjoyment when engaging in games-embedded exercise than those engaged in rote exercise.[14, 15]

In physical rehabilitation, the use of game activities to motivate patient participation in exercise is not new. Traditional game activities require participants to actively choose the exercise program and duration, without individual feedback or memory of past performance. However, game activities that go beyond requesting participants to continue an exercise through activating a system with a switch are limited. The new generation of interactive health video game systems such as Wii Fit provide individualized, ongoing exercise-related feedback on the correctness of performance, frequency of participation, and goal attainment, which can be valuable to serve as a motivator for continued adherence to home-based exercise programs.[16]

The Wii Fit is an interactive video system that connects to an individual's television set and allows the user to participate in a variety of guided fitness activities. Fitness options include

programs for aerobic conditioning, muscle strengthening, balance enhancement, and yoga. Using feedback provided by a specialized balance board that the user stands on, and/or information communicated through handheld controls, the Wii Fit system analyzes movement and guides the user through the selected fitness program. The system also keeps a record of the number of workouts performed and tracks the user's progress over time. Information recorded in the Wii Fit that can be evaluated objectively included weight or body mass index, on what date the user play the Wii Fit, the duration of playing the Wii Fit, and scores on a particular game.

It has been demonstrated that playing Wii Fit is an effective way to improve fitness in middle-aged and older adults.[17] However, to date, no study has been conducted to investigate the effect of home-based interactive video game-embedded exercise on health measures among patients experiencing chronic fatigue such as SLE.

The purpose of this pilot study is to evaluate the effectiveness of a 10-week home-based exercise program using the Wii Fit interactive video game system to reduce severity of fatigue, fatigue-related symptoms of distress, body weight and waist circumference, and to increase activity level and physical fitness of sedentary African American women with SLE. Successful fatigue reduction will have a significant impact on these patients' daily functioning including self-care, work, social and leisure activities, as well as their quality of life.

Methods

Participants

Study participants were recruited through the Medical University of South Carolina Lupus Clinic facilitated by the longitudinal observational SLE Clinic Database and SLE in Gullah Health (SLEIGH) Database.[18] The two combined databases contain medical information on the majority of patients with SLE receiving treatment at the MUSC Lupus Clinic and patients have provided consent to be contacted for future studies. To be eligible for participation in the study, the following inclusion criteria had to be met: 1) female ≥ 18 years of age, 2) self-identification as African American, 3) diagnosed with SLE and fulfilled at least 4 of the revised American College of Rheumatology classification criteria for SLE,[19] 4) ambulatory; 5) experience fatigue for the last 3 months or longer as indicated by at least a rating of 4 (moderate fatigue) on a Fatigue Visual Analogue Scale of 0 to 10, with 10 being the most fatigue ;[20] (6) sedentary (exercise < 3 times per week for 30 min in the past 6 months); 7) functionally literate (i.e. able to read and follow exercise directions in English); and 8) had permission from their physician to participate in the study.

The exclusion criteria were: (a) cognitive dysfunction as indicated by a score < 24 in the Mini-Mental State Exam (MMSE);[21] (b) anemia (with a hemoglobin < 8 g/dL); (c) poor control of metabolic diseases; or other concurrent systemic health problems (e.g., infections, malnutrition), which are known to contribute to increased fatigue levels; (d) known electrolyte abnormalities; (e) documented psychiatric diagnosis of any major Axis I psychiatric disorder, such as melancholia; (f) severe visual and/or hearing impairment that cannot be corrected using assistive devices; (g) significant functional impairments due to heart disease, arrhythmias, chronic pulmonary disease, or conditions such as avascular necrosis of the hip or knee, or severe arthritis of 3 or more weight-bearing joints that prevent exercising; and (h) systolic blood pressure > 200 mm Hg or diastolic blood pressure > 115 mm Hg.

Procedures

During the initial telephone contact, the research coordinator explained the study to potential participants, including their involvement, availability during twelve consecutive weeks to allow for in-home evaluations (baseline, midway, and post 10-week exercise program), training, and regular monitoring visits, as well as commitment to perform the Wii Fit exercise 3 times a week for 10 weeks. For patients who agreed to participate and met initial inclusion and exclusion criteria, the research coordinator scheduled an initial home visit to confirm inclusion and exclusion criteria and obtain baseline information. At the participants' home, the research coordinator obtained signed informed consent, and administered the screening assessments including the MMSE and blood pressure measurement. The study protocol was reviewed and approved by the Institutional Review Board of the Medical University of South Carolina.

Baseline evaluation

Baseline evaluation included collecting the participants' socio-demographic information, exercise history, and recreational or leisure (physical) activities, as well as standardized psychosocial measures--Fatigue Severity Scale (FSS) to measure fatigue perception,[22] Hospital Anxiety and Depression Scale (HADS) to measure emotional state,[23] Pittsburgh Sleep Quality Index (PSQI) to measure sleep quality,[24] and Short-form of the McGill Pain Questionnaire (SFMPQ) to measure pain experience.[25] Rating of perceived exertion to a standardized submaximal workload was determined immediately after the participant completed the 3-minute Siconolfi Step Test.[26] Body weight and waist circumference were also recorded.

The research coordinator issued an activity monitor (GT3X ActiGraph accelerometer, Manufacturing Technology Inc., Fort Walton Beach, FL) to each participant, trained the participants on how to use it, and requested them to wear it at the waist during waking hours throughout the study period. The coordinator reminded participants to perform their daily activities as usual during the first week. The activity level data collected from the accelerometer during the first week was compared to that collected at the last week of the 10-week Wii Fit exercise program.

Wii Fit exercise intervention

At week 2, the research coordinator conducted an in-home session to train the participant on how to set up the Wii Fit system, and review the various Wii Fit exercise options. Participants also received a self-study user's guide at this time that addressed how to set up the Wii Fit system along with a list of recommended exercises. Further, during the in-home training session, participants were required to demonstrate competency in the use of the Wii Fit system for the study purposes.

The protocol for each exercise session began with a 5-min warm up (e.g., one of the games in Yoga involves stretching and/or deep breathing), after which the participant engaged in the aerobic exercise. This was followed by strength training. Each session ended with a 5-min cool-down involving deep breathing and/or slow stepping and walking. Initially, the Wii Fit exercise (aerobic and strengthening) may last for 10–20 min depending on the participant's ability, but the goal was to gradually increase to 30 min per session on 3 days per week over the 10 week period. Participants were allowed to increase their frequency and/or duration of the Wii Fit exercise if they wished to do so, and were encouraged to choose the exercise games that they enjoyed.

Participants were instructed to maintain their exercise intensity at a perceived exertion level of 11–13 ("fairly light – somewhat hard") on the 15 point Borg "Rating of Perceived

Exertion" Scale (ranging from 6 to 20) so as to avoid exacerbating fatigue or provoking pain, dizziness, or nausea while still providing a stimulus for improved fitness.[27] All exercise procedures followed the guidelines of the American College of Sports Medicine for a conditioning program, and were similar to those described in the literature for exercise programs for patients with SLE.[9, 28, 29] Participants were encouraged to invite their spouse, significant other, or other family members to engage in the Wii Fit exercises together for increased adherence. However, they were reminded that no one besides them should play as their Wii character.

Monitoring

After two weeks (weeks 2 and 3) of weekly supervised home exercise, the research coordinator conducted weekly telephone monitoring sessions alternated with a short in-home visit every 3 weeks for the next 9 weeks to download the data from the ActiGraph and to complete the midway and post 10-week Wii Fit exercise program evaluations. The purposes of the monitoring sessions were to check on the participant's progress, encourage adherence, answer questions related to the Wii Fit exercise, and help resolve any barriers to exercise. Data on medication changes during the study period were collected and analyzed.

Formal evaluation to collect outcome measures was conducted at baseline, midway, and post 10-week Wii Fit exercise program (i.e., at week 12). The purpose of midway evaluation was to serve as a safeguard (i.e., data were available for imputation) in case participants dropped out before the completion of the post 10-week exercise evaluation.

Adherence to Wii Fit exercise program

To analyze exercise adherence rates, we averaged the weekly adherence rates across the 10-week exercise as the ratio of the number of exercise sessions each week (regardless of the duration) registered in the Wii Fit to the minimum number of sessions prescribed (which was 3) per week. Exercising more than 3 days in a given week was treated as 3 sessions in a given week.

Outcome measures

The primary outcome measure was the FSS score; the secondary outcome measures were scores from the HADS, PSQI, and SF-MPQ, steps counts from Actigraph, perceived exertion response on the Borg Scale to the Siconolfi Step Test, body weight and waist circumference. Outcome measures at baseline were compared with those collected at post 10-week Wii Fit exercise evaluation. The recorded step counts of the first 5 days at week 1 were compared to that of the last 5 days at the 10-week Wii Fit exercise program.

Cumulative clinical damage was measured using the Systemic Lupus International Collaborating Clinics/ACR Damage Index (SDI) at baseline prior to the initiation of exercise and again at the conclusion of the exercise program.[30] No lab work was required to participate in the exercise program and therefore disease activity scores were not calculated.

Data Analysis

Since all participants completed the post 10-week exercise evaluation, midway evaluation data were not used for final data analyses. One participant was placed on prednisone after the midway evaluation; as a result, we used her midway fatigue evaluation score instead of the one at post 10-week. A one-sided, paired *t*-test was performed to test the hypotheses that scores of fatigue and other outcome measures at post 10-week Wii Fit exercise were significantly lower than those before the program. Because of the exploratory nature of the study, no adjustment of *P* values was conducted for multiple statistical comparisons of the outcome measures.[31] Statistical significance was set at $P<0.05$.

Results

Characteristics of the participants

Fifteen African American women with SLE met all inclusion and exclusion criteria and were enrolled in the study. The mean ± SD age of the 15 participants was 46.7±14.4 years old, ranging from 25 to 67 years, and 9 of the participants were post-menopausal. The mean ± SD duration of participants' diagnosis with SLE was 16.2±12.2 years, ranging from 3.4 to 39.8 years. The baseline mean SDI was 1.53 with a range of 0 to 11, with 8 of the 15 having no damage by SDI. Five participants were taking prednisone at baseline and one additional participant had prednisone added at week 6 for lupus-related rash. Five participants were either married or living with a partner; four lived in rural or country areas; and seven had at least some college education. In terms of employment, six participants were employed (four were full-time, and two were part-time), and five claimed disability. Seven participants reported that their annual household income was below $15,000. Two participants were current smokers. The mean (SD) score of the MMSE among the participants was 29.5(±8.3), and the mean (SD) fatigue level on the Fatigue Visual Analogue Scale was 7.2(±2.0), which is in the severe range.

At baseline assessment, 13 participants reported that they did not exercise on a regular basis. Two reported that they did exercise (i.e., walking) on a regular basis but the frequency was 1–2 days per week or less, and the duration of walking was about 10–20 minutes. Four participants also reported they engaged in some type of recreational or leisure (physical) activities (such as gardening, working on the yard, dancing) on a regular basis, but their frequency of participation was 1–2 days per week or less.

One participant was unable to do the step test at baseline, and another participant was not able to do the step test at the post exercise program assessment; both were due to severe leg pain. Of the 13 participants who completed the step test, three participants did not complete the whole 3-minute Siconolfi Step Test (due to excessive heart rate response, cardiopulmonary difficulty, and back pain) at baseline, and only one did not complete the whole 3-minute Siconolfi Step Test (due to leg pain) at post 10-week exercise program assessment. More participants were able to complete the 3-minute Siconolfi Step Test at the post 10-week exercise program assessment and their perceived exertion responses were lower, though this did not reach a significant level. The lower perceived exertion ratings suggest an improvement in cardiopulmonary fitness and/or improvement in exercise tolerance.

The mean (SD) adherence rate to the Wii Fit exercise program across the 10 weeks was 63.9% (±29.3%), with 60% of the participants achieving more than 73% adherence to the exercise program. Based on the record from the Wii Fit, two participants did not play any game at all after the midway home visit because they both had unexpected severe medical problems. Another participant who was not able to play Wii in her last week because she was scheduled to have a knee surgery after the 10-week exercise program, and all pain medications were discontinued. A fourth participant was sick periodically during the study period with a viral infection, and other complications from SLE.

Main findings

There was a significant reduction in fatigue at the post 10-week Wii Fit exercise assessment (P=0.002). The mean percent of decrease in the score of the FSS at the 10-week Wii Fit exercise assessment was 9.9, which is 18.4% reduction from baseline. There was no significant change in step counts from the activity monitor (Actigraph) between the first 5 days at week 1 (i.e., before exercising with the Wii Fit) and the last 5 days at the 10-week exercise program (P=0.40).

The anxiety level reduced significantly at post 10-week exercise (P=0.03). The number of participants who were classified as borderline abnormal in anxiety decreased from six to four, and the number of participants who were classified as abnormal in anxiety decreased from four to two. The depression level was also reduced at post 10-week exercise though not statistically significant (P=0.08). The number of participants classified as abnormal in depression score decreased from two to zero, and the number of participants classified as normal increased from 10 to 12.

Based on the scores of the PSQI, the sleep quality of the participants improved at post 10-week exercise, though not statistically significant (P=0.07). Using the cut-off score of five (≤5 is associated with good sleep quality), the number of participants with good sleep quality increased from two to five.

The overall intensity of total pain experience was significantly reduced at post 10-week exercise (P=0.04); and the total (sensory and affective) pain rating index was reduced at post 10-week exercise, though this did not reach to a statistically significant level (P=0.06).

The perceived exertion also decreased though not statistically significant (P=0.07). Finally, the weight and waist circumference were reduced significantly at post 10-week exercise (Ps=0.01). On average, there was a 1.9 kg reduction in weight, and 2.9 cm reduction in waist circumference.

Table 1 shows an overview of the outcome measures and the improvement in fatigue, symptoms of distress, physical fitness (body weight and waist circumference) of the participants at post10-week Wii Fit exercise. No new damage accrued by SDI in any of the participants following the exercise program. Only one participant required an increase in immunosuppression during the program (week 6) related to a flare of lupus-related rash, which resolved after initiation of prednisone and was deemed not related to the exercise. There were no reported adverse events related to the 10-week Wii Fit exercise program.

Discussion

Based on the results from this pilot study, a Wii Fit home-based exercise program is safe and feasible for this population of patients with SLE. The 10-week Wii Fit exercise program was effective in reducing the severity of fatigue (primary outcome measure), body weight and waist circumference at the end of the exercise program. The reduction was both statistically and clinically significant as a decrease in 15% of the FSS score is considered to be a clinical improvement.[32] Several domains of the symptoms of distress such as anxiety and overall intensity of total pain experience were also significantly reduced. One of the possible reasons for the minimal change in the step count as recorded by the activity monitor (Actigraph) between baseline (i.e., before using the Wii Fit) and at week 10 was that some of the participants forgot to wear it during their waking hours after the initial few weeks. This is confirmed by the prolonged periods of zero counts.

We cannot be 100% sure that other family members did not use the machine. However, we emphasized to the participants that “no one besides them should play as their Wii character. “Participants’ performance on the Wii Fit depends on the information (weight, height, and age) of a person enters, and each participant has her own password to login (if she prefers) and play the character she chooses. If another family member wants to play, they can easily create their own character and enter their personal information.

Given the unpredictable nature of SLE, characterized by frequent disease flares, it is encouraging that the adherence rate of our participants was 64%, which is similar to the average adherence rates (63%) among adults participating in clinical trials with exercise as

the intervention,[33] and fell within the range of values reported in home-based exercise studies aiming to reduce fatigue, which ranged from 60 to 85%.[34] The built-in recording system in Wii Fit to track participants' frequency of playing the games should be more accurate than an exercise log, which is based solely on participants' self-report. Often times, participants may forget to record or rely on their recall to complete the exercise log which can introduce bias.

Conclusion

This pilot study demonstrated the feasibility of using the Wii Fit for exercise among patients with SLE and adherence to the exercise program is comparable to patients with other chronic disease conditions. Findings provide preliminary support that the Wii Fit health video game system motivates this population to exercise which leads to alleviation of fatigue, and reduction in body weight, waist circumference, anxiety level, and overall intensity of total pain experience. However, it is important to emphasize that this pilot study did not include a control group, and the interpretation of the results was guarded by the pre- and post-test one group design. Future study should evaluate the efficacy of using Wii Fit exercise on alleviating fatigue and weight loss through a randomized controlled trial with a non-computer based home exercise program as the comparison group, and the sustainability of the Wii Fit exercise program over a long-term basis.

Acknowledgments

This project was supported by the South Carolina Clinical & Translational Research Institute, Medical University of South Carolina's CTSA, NIH/NCRR Grant Number UL1RR029882. The contents are solely the responsibility of the authors and do not necessarily represent the official views of the NIH or NCRR.

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Table 1

Changes in Primary and Secondary Outcomes

Measure	Baseline	Post Wii Fit	P-value (one-tailed)
Fatiguhe Severity Scale (FSS)	53.9±7.2	44.0±11.2	0.002
Steps counts from Actigraph (5 days)	20359.2±4783.2	19962.5±7685.9	0.40
Hospital Anxiety & Depression Scale (HADS)			
Anxiety	8.5±3.4	7.0±3.0	0.03
Depression	5.9±3.9	4.6±2.8	0.08
Pittsburgh Sleep Quality Index (PSQI)	9.2±3.6	8.5±4.5	0.07
Short Form McGill Pain Questionnaire (SF-MPQ)			
Total (Sensory+Affective) Pain Rating Index	7.1±9.5	3.8±7.7	0.06
Evaluative overall intensity	1.0±1.1	0.4±0.7	0.04
Perceived exertion	14.5±3.3	12.9±2.2	0.07
Weight (kg)	75.4±17.4	73.6±16.9	0.01
Waist circumference (cm)	90.8±16.4	88.0±15.2	0.01