J Rehabil Med 2013; 45: 599–602

CASE REPORT

AN IN-DEPTH, LONGITUDINAL EXAMINATION OF THE DAILY PHYSICAL ACTIVITY OF A PATIENT WITH HEART FAILURE USING A NINTENDO WII AT HOME: A CASE REPORT

Leonie Verheijden Klompstra, MSc[1], Tiny Jaarsma, RN, PhD[1] and Anna Strömberg, RN, PhD[2]

From the [1]Department of Social and Welfare Studies, Faculty of Health Science and [2]Department of Medical and Health Science, Faculty of Health Science, Linköping University, Linköping, Sweden

Objective: **To explore the influence of the Nintendo Wii on the daily physical activity of a patient with chronic heart failure at home.**

Methods: **A 74-year-old Swedish patient with heart failure had access to a Nintendo Wii at home for 12 weeks. Exercise motivation, exercise self-efficacy and exercise capacity were assessed before and after the intervention. Data on perceived physical effort, global well-being and expended energy were collected every day during the intervention.**

Results: **During the 12 weeks of access to the Nintendo Wii, daily physical activity increased by 200% on weekdays and 57% on weekends, compared with baseline. The patient's exercise motivation and exercise self-efficacy increased during the study, whereas perceived physical effort and global well-being did not change. The patient had no difficulties in using the system and did not suffer any major harm.**

Discussion: **The results of this case study suggest that providing patients with heart failure access to a Nintendo Wii is a promising and safe intervention. The energy expended by the patient per day increased, as did exercise capacity. Playing the Nintendo Wii did not increase the perceived physical effort, but increased motivation to exercise and decreased barriers to exercising.**

Key words: heart failure; exergame; virtual reality; physical activity & elderly.

J Rehabil Med 2013; 45: 599–602

Correspondence address: Leonie Verheijden Klompstra, Department of Social and Welfare Studies, Linköping University, SE-601 74 Norrköping, Sweden. E-mail: leonie.klompstra@liu.se

Accepted Jan 14, 2013; Epub ahead of print May 22, 2013

INTRODUCTION

The number of chronically ill patients in society is increasing, and a considerable proportion is patients with cardiac conditions. Heart failure (HF) is a chronic condition, often the end stage of different cardiac diseases. HF is a syndrome in which patients experience symptoms such as shortness of breath and tiredness. Due to the poor prognosis, high incidence (1) and costs in connection with HF (2), it is important to search for opportunities to improve outcomes. Several studies have shown that exercise is safe and beneficial (3–5) for HF patients, both home-based and hospital-based (6–8). However, it is known that it is difficult for HF patients to maintain and adhere to exercise recommendations long-term (9). Non-adherence with exercise has a negative effect on clinical outcomes and there are many factors that influence adherence to exercise (9, 10). Therefore, it is important to search for alternative approaches to motivate patients with HF. Exergaming (physically active video gaming) has been shown to be a possible way to increase physical activity in different age groups (11), and might be a promising solution to improve patients' adherence. It is not known if exergames are applicable to patients with HF. The aim of this study was to introduce Nintendo Wii Sports to an older patient with HF at home and determine whether this influenced his daily physical activity, as well as to describe his experiences and assess the practical issues.

METHODS

Case history

We selected a patient with chronic HF (HF with preserved ejection fraction) who had mild symptoms. We chose a patient who worked full-time, as this is an extra barrier to becoming more physically active. The present study describes an intervention in a Swedish 74-year-old married man with no depressive symptoms. The patient was comfortable at rest, but ordinary physical activity resulted in mild to moderate symptoms of tiredness, palpitation, or dyspnoea (New York Heart Association Functional Class II). The patient had been diagnosed with HF approximately 1 year previously, with hypertension and overconsumption of alcohol as underlying aetiology. At the time of study inclusion, he had a left ventricular ejection fraction (LVEF) between 50% and 55%, established by echocardiography, and his heart was in sinus rhythm. On examination his pulse was 61 beats/min, blood pressure was 135/85 mmHg, and he had a body mass index of 31. The patient did not have further co-morbidity. He used standard HF medication, Angiotensin II receptor blockers and beta-blockers, but he did not use diuretics at the time of inclusion. His amount of active energy expenditure during the baseline measurement 1 week before the installation of the Nintendo Wii was 2881 kJ/day during the week and 1704 kJ/day during the weekend.

Nintendo Wii

The Nintendo Wii is an exergame platform with a wireless controller, the Wii Remote, which is connected to the computer via Bluetooth. The Nintendo Wii remote enables players to interact with the computer through movements. The game Nintendo Wii Sports (bowling, tennis, baseball, golf and boxing), was provided with the Nintendo Wii.

Intervention

The patient learned to use the Nintendo Wii during an introductory session at the local hospital. The HF nurse advised the patient on being active with the virtual reality application for 15 min every day. The Nintendo Wii was installed in the patient's home 1 week after the introduction and an instructor explained once more how to use it. The patient was then encouraged to play exergames on his own for 12 weeks.

Safety guidelines were discussed and provided in writing after the installation. During the 12 weeks of Nintendo Wii access, the instructor was available for questions and guidance for 2 h a day during workdays. In case of medical problems or if there was an increase in symptoms, the patient was instructed to call the HF nurse.

After installation of the Nintendo Wii, the instructor made follow-up visits appointments after 4 and 8 weeks. During these visits practical issues were observed and possible problems discussed. There was a follow-up visit at the hospital after 12 weeks' access to the Nintendo Wii.

Measurements

Daily physical activity was measured using the activity monitor DirectLife Triaxial Accelerometer for Movement Registration (TracmorD) (Philips New Wellness Solutions, Lifestyle Incubator, Eindhoven, The Netherlands) (12), which measured daily physical activity by registering body acceleration in 3 directions: up and down, side to side and front to back. These registered body accelerations were translated into kilojoules, taking age, gender, height and weight into account. In case of missing data from more than 2 days in a week, the week was extracted from the data analyses. When data from 2 days or fewer were missing in 1 week, these missing values were replaced by the mean daily physical activity of the remaining days in that specific week. To assess exercise capacity in HF, the patient also performed a 6-min walking test (6MWT) (13) at baseline and after 12 weeks' access to the Nintendo Wii.

The patient was asked to complete a daily diary for 12 weeks to assess the experience of HF symptoms, global well-being (14), daily physical activity with the Nintendo Wii and perceived physical effort (15). The patient also completed a questionnaire assessing exercise self-efficacy (16) and exercise motivation (17) at baseline and after 12 weeks' access to the Nintendo Wii (Table I).

RESULTS

Patient experiences

The patient experienced the *perceived physical effort* playing the Nintendo Wii as being between "light" and "very light". During the 12 weeks of access to the Nintendo Wii, the patient experienced no *shortness of breath* and he felt no *tiredness*, as recorded in the diary. Global well-being remained stayed approximately the same during the 12-week follow-up period.

The patient reported high exercise self-efficacy and high motivation to exercise at baseline, which increased over the 12 weeks of access to the Nintendo Wii. Exercise self-efficacy increased from "confident" to "very confident". The patient rated social and psychological motivation to exercise as "important" at baseline and as "enormously important" after 12 weeks of access to the Nintendo Wii. Physical motivation to exercise changed from "very important" to "enormously important".

Due to myalgia in week 2 after the installation of the Nintendo Wii, the patient decided to play bowling with both hands instead of only using his right hand. As a result, he experienced myalgia in both arms in week 3. However, this did not stop him from playing every day that week as well. The patient experienced no myalgia for the rest of the study. Another possible negative effect was that the patient gained 5 kg in weight during the 12 weeks of access to the Nintendo Wii.

Practical issues

Playing the Nintendo Wii did not cause any major harm; no injuries occurred during the study period in this case study. The patient had no difficulties exergaming (Wii Bowling being the preferred option) and there was enough space around the television to be active with the Nintendo Wii, according to safety guidelines. The patient played exergames for approximately 45 min before going to work every morning, either alone or with his wife or grandchildren.

Daily physical activity

As shown in Fig. 1, the amount of daily physical activity increased when the patient had access to the Nintendo Wii, compared with the baseline measurement, and also increased over time during the 12 weeks of access to the Nintendo Wii. Due to holidays in the 4th week of the study, the patient was not able to play Wii for 4 days. Midsummer day, an important holiday for Swedish people, resulted in the lowest amount of energy expended in a day (1876 kJ/day) during the 12 weeks of access to the Nintendo Wii (see number 1 in Fig. 1). In order to collect the TracmorD data, the patient was not able to wear the activity monitor for a week. Since no data was available for a whole week, we did not replace the missing values (see Fig. 1, week 5). In week 8 the patient reached the highest daily physical activity level during the intervention, which was 110% more energy expenditure (6033 kJ/day) compared with the baseline measurement (see number 2 in Fig. 1). This day, besides playing on the Wii, the patient did gardening for 2 h. In week 10 the patient reached the second lowest daily physical activity level during the intervention and the second highest daily physical activity level during the intervention. No data is available as to why the patient reached a low daily physical

Table I. *Outcome measurements*

Variables	Measurements	Baseline	12 weeks
Exercise capacity	6-min walking test (13)	585 m	627 m
Exercise self-efficacy	Exercise self-efficacy questionnaire (16)	Confident	Very confident
Exercise motivation	Exercise motivation index (17)		
	Social exercise motivation	Important	Enormously important
	Psychological motivation	Important	Enormously important
	Physical motivation	Very important	Enormously important

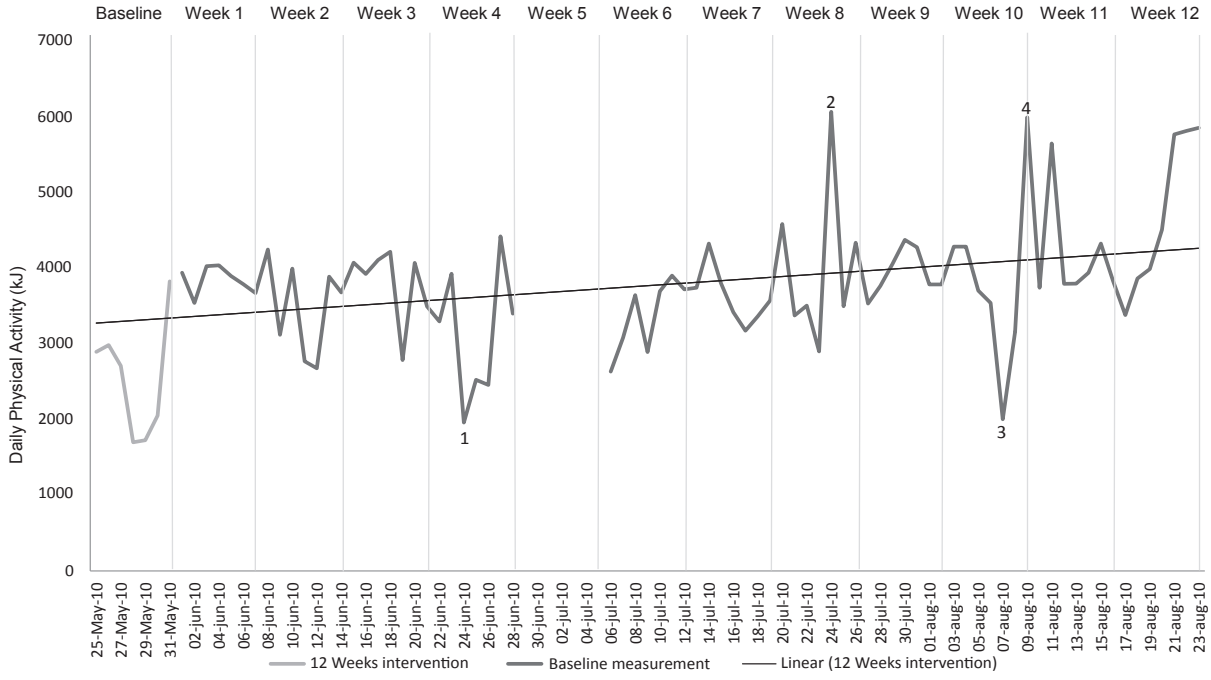

Fig. 1. Physical activity (amount of energy in kilojoules) per day expended by a single patient with heart failure; number 1: daily physical activity Midsummer day; number 2: in addition to playing on the Nintendo Wii, the patient did gardening; number 3: no data on why the patient expended a low daily physical activity; number 4: in addition to playing on the Wii the patient was walking outside.

activity level (see number 3 in Fig. 1), but the day with the high amount of physical activity was due to walking outside for 45 min in addition to playing Wii for 45 min (see number 4 in Fig. 1). In week 11 and 12 the patient had the highest daily physical activity level during the intervention. In week 11 he expended 33% more energy (3819 kJ/day) compared with baseline and in week 12 he expended 57% more energy during the week (4522 kJ/day), compared with baseline (2881 kJ/day). At the weekend of week 11 he expended 121% more energy (3764 kJ/day) than at baseline and in week 12 he expended 200% more energy (5112 kJ/day) during the weekend compared with baseline (1704 kJ/day).

Exercise capacity (6MWT) improved compared with the baseline measurement. At baseline, the patient walked 585 m in 6 min and after 12 weeks' access to the Nintendo Wii, the patient walked 627 m in 6 min.

DISCUSSION

This case study indicates that the Nintendo Wii is a promising exergame platform to help increase daily physical activity in patients with HF. In this patient, playing the Nintendo Wii did not cause major harm and did not increase the perceived physical effort. The patient did not experience shortness of breath or tiredness when playing the Nintendo Wii. Exercise self-efficacy increased from "confident" to "very confident", which indicated that the patient was very confident exercising even when barriers occurred. This could be because the Nintendo Wii was installed at home and, according to the patient, made it easier (fewer barriers) to exercise than, for example, in a gym or at the rehabilitation department in the hospital. In particular, the social motivation to exercise increased during the intervention. One explanation is that the patient was playing the Nintendo Wii with his wife every morning and that his grandchildren also liked being active with the patient this way. The daily physical activity level increased during the intervention. His exercise capacity also improved over the 12 weeks: he could walk 42 m further during the 6MWT after 12 weeks' access to the Nintendo Wii, compared with baseline, which is a clinically relevant difference (13). Our case study illustrates that installing the Nintendo Wii in a HF patient's home increases the amount of energy expended each day, increases exercise capacity, does not increase perceived physical effort, increases motivation to exercise and decreases barriers to exercise.

The patient experienced myalgia during the intervention; thus, patients in such interventions should be informed that this is a possible occurrence. Myalgia could be a barrier to HF patients becoming more physically active.

In this case study the patient gained weight. The weight gain exceeded 2 kg in 1 week. As instructed, he called the HF nurses and attended a consultation. After the examination the nurses concluded that the weight gain was not due to fluid retention. A possible explanation could be the increase of muscle volume and/or maybe changed eating habits. Patients should always contact their HF specialist if they experience a weight gain, due to the possibility of oedema, which could indicate worsening of HF (1).

It is difficult to draw causal conclusions from a case study, and we cannot generalize our findings. Further research is

needed into the use of the Nintendo Wii as a possible home intervention to increase daily physical activity in patients with HF. This study was conducted during the summer, and the patient was able to do gardening and take walks outside in addition to playing the Nintendo Wii. In Sweden, winter can be a barrier to physical activity outdoors. As the results of this case study were promising, we are conducting an intervention using the Nintendo Wii, in order to examine possible effects on daily physical activity in a larger group of patients with HF.

ACKNOWLEDGEMENTS

The project has been supported by 'New Tools For Health' and European Commission Grant Agreement Homecare 222954.

REFERENCES

1. McMurray JJ, Adamopoulos S, Anker SD, Auricchio A, Böhm M, Dickstein K, et al. ESC guidelines for the diagnosis and treatment of acute and chronic heart failure 2012: the Task Force for the Diagnosis and Treatment of Acute and Chronic Heart Failure 2012 of the European Society of Cardiology. Developed in collaboration with the Heart Failure Association (HFA) of the ESC. Eur J Heart Fail 2012; 14: 803–869.
2. Braunschweig F, Cowie MR, Auricchio A. What are the costs of heart failure? Europace 2011; 13 Suppl 2: ii13–ii17.
3. Adams V, Linke A, Gielen S, Erbs S, Hambrecht R, Schuler G. Modulation of Murf-1 and MAFbx expression in the myocardium by physical exercise training. Eur J Cardiovasc Prev Rehabil 2008; 15: 293–299.
4. Rees K, Taylor RS, Singh S, Coats AJ, Ebrahim S. Exercise based rehabilitation for heart failure. Cochrane Database Syst Rev 2004; CD003331.
5. Pihl E, Cider A, Strömberg A, Fridlund B, Mårtensson J. Exercise in elderly patients with chronic heart failure in primary care: effects on physical capacity and health-related quality of life. Eur J Cardiovasc Nurs 2011; 10: 150–158.
6. Corvera-Tindel T, Doering LV, Woo MA, Khan S, Dracup K. Effects of a home walking exercise program on functional status and symptoms in heart failure. Am Heart J 2004; 147: 339–346.
7. Dracup K, Evangelista LS, Hamilton MA, Erickson V, Hage A, Moriguchi J, et al. Effects of a home-based exercise program on clinical outcomes in heart failure. Am Heart J 2007; 154: 877–883.
8. Jolly K, Lip GY, Taylor RS, Raftery J, Mant J, Lane D, et al. The Birmingham Rehabilitation Uptake Maximisation study (BRUM): a randomised controlled trial comparing home-based with centre-based cardiac rehabilitation. Heart 2009; 95: 36–42.
9. van der Wal MH, van Veldhuisen DJ, Veeger NJ, Rutten FH, Jaarsma T. Compliance with non-pharmacological recommendations and outcome in heart failure patients. Eur Heart J 2010; 31: 1486–1493.
10. Conraads VM, Deaton C, Piotrowicz E, Santaularia N, Tierney S, Piepoli MF, et al. Adherence of heart failure patients to exercise: barriers and possible solutions: a position statement of the Study Group on Exercise Training in Heart Failure of the Heart Failure Association of the European Society of Cardiology. Eur J Heart Fail 2012; 14: 451–458.
11. Kharrazi H, Shirong A, Gharghabi F, Coleman W. A Scoping review of health game research: past, present, and future. Games Health 2012; 1: 153–164.
12. Bonomi AG, Plasqui G, Goris AH, Westerterp KR. Estimation of free-living energy expenditure using a novel activity monitor designed to minimize obtrusiveness. Obesity 2010; 18: 1845–1851.
13. Guyatt GH, Sullivan MJ, Thompson PJ, Fallen EL, Pugsley SO, Taylor DW, et al. The 6-minute walk: a new measure of exercise capacity in patients with chronic heart failure. Can Med Assoc J 1985; 132: 919–923.
14. Cantril H. The pattern of human concerns. New Brunswick, NJ: Rutgers University Press; 1965.
15. Borg G. Borg's perceived exertion and pain scales. Champaign: Human Kinetics; 1998.
16. Dzewaltowski D. Toward a model of exercise motivation. J Sport Exercise Psychol 1989; 11: 251–269.
17. Stenström CH, Boestad C, Carlsson M, Edström M, Reuterhäll A. Why exercise?: a preliminary investigation of an exercise motivation index among individuals with rheumatic conditions and healthy individuals. Physiother Res Int 1997; 2: 7–16.