

## Effectiveness of rehabilitation based on recreational activities: A systematic review

Hiroharu Kamioka, Kiichiro Tsutani, Minoru Yamada, Hyuntae Park, Hiroyasu Okuizumi, Takuya Honda, Shinpei Okada, Sang-Jun Park, Jun Kitayuguchi, Shuichi Handa, Yoshiteru Mutoh

Hiroharu Kamioka, Faculty of Regional Environment Science, Tokyo University of Agriculture, Tokyo 156-8502, Japan  
Kiichiro Tsutani, Department of Drug Policy and Management, Graduate School of Pharmaceutical Sciences, University of Tokyo, Tokyo 113-0033, Japan

Minoru Yamada, Human Health Sciences, Kyoto University Graduate School of Medicine, Kyoto 606-8507, Japan

Hyuntae Park, Department of Functioning Activation, National Center for Geriatrics and Gerontology, Aichi 474-8511, Japan

Hiroyasu Okuizumi, Shuichi Handa, Mimaki Onsen (Spa) Clinic, Nagano 389-0402, Japan

Takuya Honda, Japan Society for Promotion of Science, Kyoto 619-0288, Japan

Shinpei Okada, Sang-Jun Park, Physical Education and Medicine Research Foundation, Nagano 389-0402, Japan

Jun Kitayuguchi, Physical Education and Medicine Research Center Unnan, Shimane 690-2404, Japan

Yoshiteru Mutoh, Research Institute of Nippon Sport Science University, Tokyo 158-0081, Japan

Author contributions: Kamioka H, Okuizumi H, Okada S, Park SJ, Honda T, Handa S, and Mutoh Y conceived the study and take responsibility for the quality assessment and summary of included studies and data extraction; Tsutani K and Mutoh Y are the guarantors; Kamioka H, Okada S, Okuizumi H and Handa S designed the study; Honda T conducted the statistical analyses; Park SJ, Honda H and Kamioka H assessed the quality of articles; all authors critically revised the manuscript for important intellectual content.

Supported by Grant-in-Aid for Scientific Research (C) from the Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan, No. 23500817

Correspondence to: Hiroharu Kamioka, PhD, Professor, Faculty of Regional Environment Science, Tokyo University of Agriculture, 1-1-1 Sakuragaoka, Setagaya-ku, Tokyo 156-8502, Japan. [h1kamiok@nodai.ac.jp](mailto:h1kamiok@nodai.ac.jp)

Telephone: +81-3-54772587 Fax: +81-3-54772587

Received: March 1, 2013 Revised: April 16, 2013

Accepted: May 9, 2013

Published online: May 26, 2013

trolled trials (RCTs) on the rehabilitation effects of recreational activities.

**METHODS:** Studies were eligible if they were RCTs. Studies included one treatment group in which recreational activity was applied. We searched the following databases from 1990 to May 31, 2012: MEDLINE *via* PubMed, CINAHL, Web of Science, and Ichushi-Web. We also searched all Cochrane Databases and Campbell Systematic Reviews up to May 31, 2012.

**RESULTS:** Eleven RCTs were identified, which included many kinds of target diseases and/or symptoms such as stroke, dementia, Parkinson's disease, acquired brain injury, chronic non-malignant pain, adolescent obesity, high-risk pregnancy, and the frail elderly. Various intervention methods included gaming technology, music, dance, easy rider wheelchair biking, leisure education programs, and leisure tasks. The RCTs conducted have been of relatively low quality. A meta-analysis (pooled sample;  $n = 44$ , two RCTs) for balance ability using tests such as "Berg Balance Scale" and "Timed Up and Go Test" based on game intervention revealed no significant difference between interventions and controls. In all other interventions, there were one or more effects on psychological status, balance or motor function, and adherence as primary or secondary outcomes.

**CONCLUSION:** There is a potential for recreational activities to improve rehabilitation-related outcomes, particularly in psychological status, balance or motor function, and adherence.

© 2013 Baishideng. All rights reserved.

**Key words:** Recreation activities; Randomized controlled trial; Rehabilitation effect

**Core tip:** This is the first systematic review of the effectiveness of rehabilitation based on recreational ac-

### Abstract

**AIM:** To summarize the evidence from randomized con-

tivities. There is a potential for recreational activities to improve rehabilitation-related outcomes, particularly in psychological status (depression, mood, emotion, and power), balance or motor function, and adherence (feasibility and attendance). To most effectively assess the potential benefits of recreational activities for rehabilitation, it will be important for further research to utilize (1) randomized controlled trials methodology (person unit or cluster unit) when appropriate; (2) an intervention dose; (3) a description of adverse effects and withdrawals; and (4) the cost of recreational activities.

Kamioka H, Tsutani K, Yamada M, Park H, Okuizumi H, Honda T, Okada S, Park SJ, Kitayuguchi J, Handa S, Mutoh Y. Effectiveness of rehabilitation based on recreational activities: A systematic review. *World J Meta-Anal* 2013; 1(1): 27-46 Available from: URL: <http://www.wjgnet.com/2308-3840/full/v1/i1/27.htm> DOI: <http://dx.doi.org/10.13105/wjma.v1.i1.27>

## INTRODUCTION

Recreational activity is anything that is stimulating and rejuvenating for an individual. Some people may enjoy nature hikes, others may enjoy playing the guitar. The idea behind these activities is to expand the mind and body in a positive, healthy way. The best reason to take part in these activities is that they will slow the aging process by helping to lessen or eliminate stress<sup>[1]</sup>. A dictionary describes “recreation” as “the fact of people doing things for enjoyment, when they are not working”<sup>[2]</sup>. However, there are various views about what constitutes a recreational activity and there is no fixed consensus.

A systematic review (SR) of randomized controlled trials (RCTs) based on recreational and leisure activity reported some beneficial effects such as improvement in quality of life, as well as health-promoting, educational and therapeutic effects<sup>[3]</sup>. Three RCTs adopted for this review evaluated appreciation of performed music<sup>[4]</sup>, entertainment using an easy rider wheelchair bike<sup>[5]</sup>, and leisure tasks<sup>[6]</sup> as the intervention method. In the present study, we assumed that recreational activity is defined broadly as a physical activity with a strong element of pleasure or enjoyment.

Stroke is a disease that typically requires rehabilitation and has been described as a worldwide epidemic<sup>[7]</sup>. Many stroke patients suffer from sensory, motor and cognitive impairment as well as a reduced ability to perform self care and to participate in social and community activities<sup>[8]</sup>. Standardized repetitive task training has been shown to be effective in some aspects of rehabilitation, such as improving walking distance and speed<sup>[9]</sup>. Over the years, virtual reality (VR) and interactive video gaming (IVG) have emerged as new treatment approaches in stroke rehabilitation. In particular, commercial gaming consoles are being rapidly adopted in clinical and nursing settings. A recent SR of stroke rehabilitation studies reported that

the use of VR and IVG may be beneficial in improving arm function and activities of daily living (ADL) function when compared with the same dose of conventional therapy, although there was insufficient evidence to reach a conclusion about the effect of VR and IVG on grip strength or gait speed<sup>[10]</sup>.

The current study has shown that even a short duration of Wii play can provide an effective adjunct to standard rehabilitation for fall prevention, although a “Wii only” training approach is not being advocated<sup>[11]</sup>. The “enjoyment” factor is an important one that may aid adherence to training for rehabilitation<sup>[12]</sup>.

Low back pain is also a disease that requires rehabilitation and is the most common reason for use of complementary and alternative medicine in the United States<sup>[13]</sup>. A SR of RCTs into alternative therapy (*i.e.*, spa and balneotherapy) targeting the relief of lower back pain reported that even though the data are scarce, there was encouraging evidence suggesting that these therapies may be effective<sup>[14]</sup>.

Over the years, recreational activity and relaxation in a forest environment called “forest therapy” or “Shinrin-yoku” (forest-air bathing and forest-landscape watching, walking, *etc.*), have become a kind of climate therapy or nature therapy and are popular methods for many urban people with mentally stressful situations<sup>[15]</sup>. The fields of preventive and alternative medicine have also shown an interest in the therapeutic effects of forest therapy<sup>[16]</sup>. A study reported that forest environments may contribute to the maintenance of health and well-being by, for example reducing hostility and depression which are risk factors for coronary heart diseases, or by improving overall emotions, particularly among populations with poor mental health<sup>[17]</sup>. In addition, a recent study reported that forest bathing trips increase natural killer (NK) cell activity, which was mediated by increases in the number of NK cells and by the levels of intracellular anti-cancer proteins and phytoncides released from trees. The decreased production of stress hormones may also partially contribute to the increased NK cell activity<sup>[18]</sup>.

It is well known in research design that evidence grading is highest for a SR with meta-analysis of RCTs. Although many studies have reported the rehabilitation effects of recreational activities, there is no SR of evidence based on RCTs. The objective of this review was to summarize the evidence from RCTs on the rehabilitation effects of recreational activities.

## MATERIALS AND METHODS

### Criteria for considering studies included in this review

**Types of studies:** Studies were eligible if they were RCTs.

**Types of participants:** There was no restriction on patients.

**Types of intervention and language:** Studies included

at least one treatment group in which recreation activity was applied. The definition of the recreational activity is complex, but, in this study, it describes a specific exercise item. Specifically, any kind of recreational activity (not only dynamic activities but also musical appreciation or playing, painting, hand-craft, *etc.*) was permitted and defined as an intervention. However, we excluded comprehensive exercise interventions such as walking, jogging, Tai chi, Yoga, stretching, and strength training. There was no restriction on the basis of language.

**Types of outcome measures:** We focused on rehabilitation effects. The World Health Organization states that rehabilitation of people with disabilities is a process aimed at enabling them to reach and maintain their optimal physical, sensory, intellectual, psychological and social functional levels<sup>[19]</sup>. Rehabilitation provides disabled people with the tools they need to attain independence and self-determination. In this study, beneficial outcome measures included cognitive function, physical function, and pain-relief. We did not specify secondary outcomes but instead estimated items as primary outcomes if an article treated them as rehabilitation effects.

### Search methods for studies identification

**Bibliographic database:** We searched the following databases from 1990 to May 31, 2012: MEDLINE *via* PubMed, CINAHL, Web of Science, Ichushi Web (in Japanese), and the Western Pacific Region Index Medicus (WPRIM). The International Committee of Medical Journal Editors (ICMJE) recommended uniform requirements for manuscripts submitted to biomedical journals in 1993. We selected articles published (that included a protocol) since 1990, because it appeared that the ICMJE recommendation had been adopted by the relevant researchers and had strengthened the quality of reports.

We also searched the Cochrane Database of Systematic Reviews (Cochrane Reviews), the Database of Abstracts of Reviews of Effects (Other Reviews), the Cochrane Central Register of Controlled Trials (Clinical Trials or CENTRAL), the Cochrane Methodology Register (Methods Studies), the Health Technology Assessment Database (Technology Assessments), the NHS Economic Evaluation Database (Economic Evaluations), About The Cochrane Collaboration databases (Cochrane Groups) and Campbell Systematic Reviews (the Campbell Collaboration), and the All Cochrane all up to May 31, 2012.

All searches were performed by two specific searchers (hospital librarians) who were qualified in medical information handling, and who had sophisticated skills in the searching of clinical trials.

**Search strategies:** The special search strategies contained the elements and terms for MEDLINE, CINAHL, Web of Science, Ichushi Web, WPRIM, All Cochrane databases, and Campbell Collaboration (Table 1). Only keywords about interventions were used for the searches. First,

titles and abstracts of identified published articles were reviewed in order to determine the relevance of the articles. Next, references in relevant studies and identified RCTs were screened.

**Registry checking:** We searched the International Clinical Trials Registry Platform (ICTRP), Clinical Trials.gov, the University Hospital Medical Information Network-Clinical Trials Registry (UMIN-CTR), the Japan Pharmaceutical Information Center-Clinical Trials Information (Japic CTI), and the Japan Medical Association-Center for Clinical Trials (JMACCT CTR), all up to May 31, 2012. ICTRP and the WHO Registry Network meet specific criteria for content, quality and validity, accessibility, unique identification, technical capacity and administration. Primary registries meet the requirements of the ICMJE. Clinical Trials.gov is a registry of federally and privately supported clinical trials conducted in the United States and around the world. UMIN-CTR, Japic CTI, and JMACCT CTR are registries of clinical trials conducted in Japan and around the world.

**Handsearching, reference checking, *etc.*:** We hand-searched abstracts published on recreation activities in relevant journals in Japan. We checked the references of included studies for further relevant literature.

### Review methods

**Selection of trials:** In order to make the final selection of studies for the review, all criteria were applied independently by five authors (*e.g.*, Honda T, Kitayuguchi J, Okada S, Park SJ) to the full text of articles that had passed the first eligibility screening (Figure 1). Disagreements and uncertainties were resolved by discussion with other authors (*e.g.*, Mutoh Y, Okuizumi H, Park H).

Studies were selected when (1) the design was an RCT; and (2) one of the interventions was a form of recreational activity. Rehabilitation effects were used as a primary outcome measure. Trials that were excluded are presented with reasons for their exclusion (Table 2).

### Quality assessment of included studies

In order to ensure that variation was not caused by systematic errors in the study design or execution, seven review authors (Okuizumi H, Mutoh Y, Okada S, Park SJ, Honda T, Handa S, and Honda T) independently assessed the quality of articles. A full quality appraisal of these papers was made using the combined tool based on the “CONSORT 2010”<sup>[20]</sup> and the “CONSORT for non-pharmacological trials”<sup>[21]</sup>, developed to assess the methodological quality of non-pharmacological RCTs. These checklists were not originally developed to use as a quality assessment instrument, but we used them because they are the most important tools related to the internal and external validity of trials.

Each item was scored as “present” (p), “absent” (a), “unclear or inadequately described” (?), or “not appli-

**Table 1** The special search strategies

- 1 MEDLINE
  - #1 Search "Recreation" [MeSH Major Topic]
  - #2 Search "Recreation Therapy" [MeSH Major Topic]
  - #3 Search "Rehabilitation" [MeSH Major Topic]
  - #4 Search "Treatment Outcome" [MeSH Terms]
  - #5 Search (#1) OR #2
  - #6 Search (#3) OR #4
  - #7 Search (#5) AND #6
  - #8 Search (#5) AND #6 Filters: Publication date from 1990-01-01 to 2012-04-30
  - #9 Search (#5) AND #6 Filters: Publication date from 1990-01-01 to 2012-04-30; Humans
  - #10 Search (#5) AND #6 Filters: Publication date from 1990-01-01 to 2012-04-30; Humans; Randomized Controlled Trial
- 2 CINAHL
  - #1 TX recreation
  - #2 (MH "Recreation+") OR (MH "Recreational Therapy")
  - #3 #1 or #2
  - #4 TX rehabilitation
  - #5 (MH "Rehabilitation+")
  - #6 (MH "Treatment Outcomes+") OR (MH "Outcome Assessment")
  - #7 #4 or #5 or #6
  - #8 #3 and #7
  - #9 #3 and #7
  - #10 #3 and #7
  - #11 #3 and #7
- 3 Web of Science
  - #1 Recreation
  - #2 Leisure
  - #3 #1 OR #2
  - #4 Rehabilitation
  - #5 "Quality of life"
  - #6 Outcome
  - #7 #4 OR #5 OR #6
  - #8 #3 AND #7
  - #9 Randomized OR randomised
  - #10 (#8 AND #9) AND Article time span = 1990-2012
- 4 Ichushi Web (Originally in Japanese)
  - #1 Recreation/TH or recreation/AL or recreational/AL or recreation/AL or Rikuryeshon/AL or recreation/AL
  - #2 Rehabilitation/HL or rehabilitation/AL or rehabilitation/ALAL
  - #3 #1 and #2
  - #4 (#3) and (DT = 1990:2012 PT = original papers CK = person)
  - #5 (#4) and (RD = randomized controlled trials, quasi-randomized controlled trials, comparative studies)
  - #6 (#4) and (RD = randomized controlled trials)
- 5 WPRIM
  - #1 recreation
- 6 All Cochrane
  - #1 MeSH descriptor Recreation explode all trees
  - #2 (recreation): ti, ab, kw
  - #3 MeSH descriptor Rehabilitation explode all trees
  - #4 MeSH descriptor Randomized Controlled Trials as Topic explode all trees
  - #5 (Randomized controlled trial): ti, ab, kw
  - #6 (#1 OR #2)
  - #7 (#4 OR #5)
  - #8 (#3 AND #6 AND #7), from 1990 to 2012
- 7 Campbell Collaboration
  - #1 Recreation
- 8 ICTRP
  - #1 Recreation
- 9 Clinical Trials.gov
  - #1 Recreation OR recreational
- 10 UMIN-CTR (Originally in Japanese)
  - #1 Recreation
- 11 Japic CTI (Originally in Japanese)
  - #1 Recreation

12 JMACCT CTR (Originally in Japanese)  
#1 Recreation

ICTRP: International Clinical Trials Registry Platform; UMIN-CTR: University Hospital Medical Information Network-Clinical Trials Registry; Japic CTI: Japan Pharmaceutical Information Center-Clinical Trials Information; JMACCT CTR: Japan Medical Association-Center for Clinical Trials.

cable" (n/a). Depending on the study design, some items were not applicable. The "n/a" studies were excluded from calculation for quality assessment. We displayed the percentage of present description in all 47 checked items for the quality assessment of articles. Then, based on the percentage of risk of poor methodology and/or bias, each item was assigned to the following categories: good description (80%-100%), poor description (50%-79%), very poor description (0%-49%). Disagreements and uncertainties were resolved by discussion with other authors (*e.g.*, Okuizumi H, Okada S and Kamioka H). Inter-rater reliability was calculated on a dichotomous scale using percentage agreement and Cohen's  $\kappa$  coefficient ( $\kappa$ ).

**Summary of studies and data extraction:** Seven review authors (Okuizumi H, Mutoh Y, Okada S, Park SJ, Honda T, Handa S and Kamioka H) described the summary from each article based on the recommended structured abstracts<sup>[22,23]</sup>.

### Benefit, harm, and withdrawals

The GRADE Working Group<sup>[24]</sup> reported that the balance between benefit and harm, quality of evidence, applicability, and the certainty of the baseline risk were all considered in judgments about the strength of recommendations. Adverse events, withdrawals, and cost for intervention were especially important information for researchers and users of clinical practice guidelines, and we have presented this information with the description of each article.

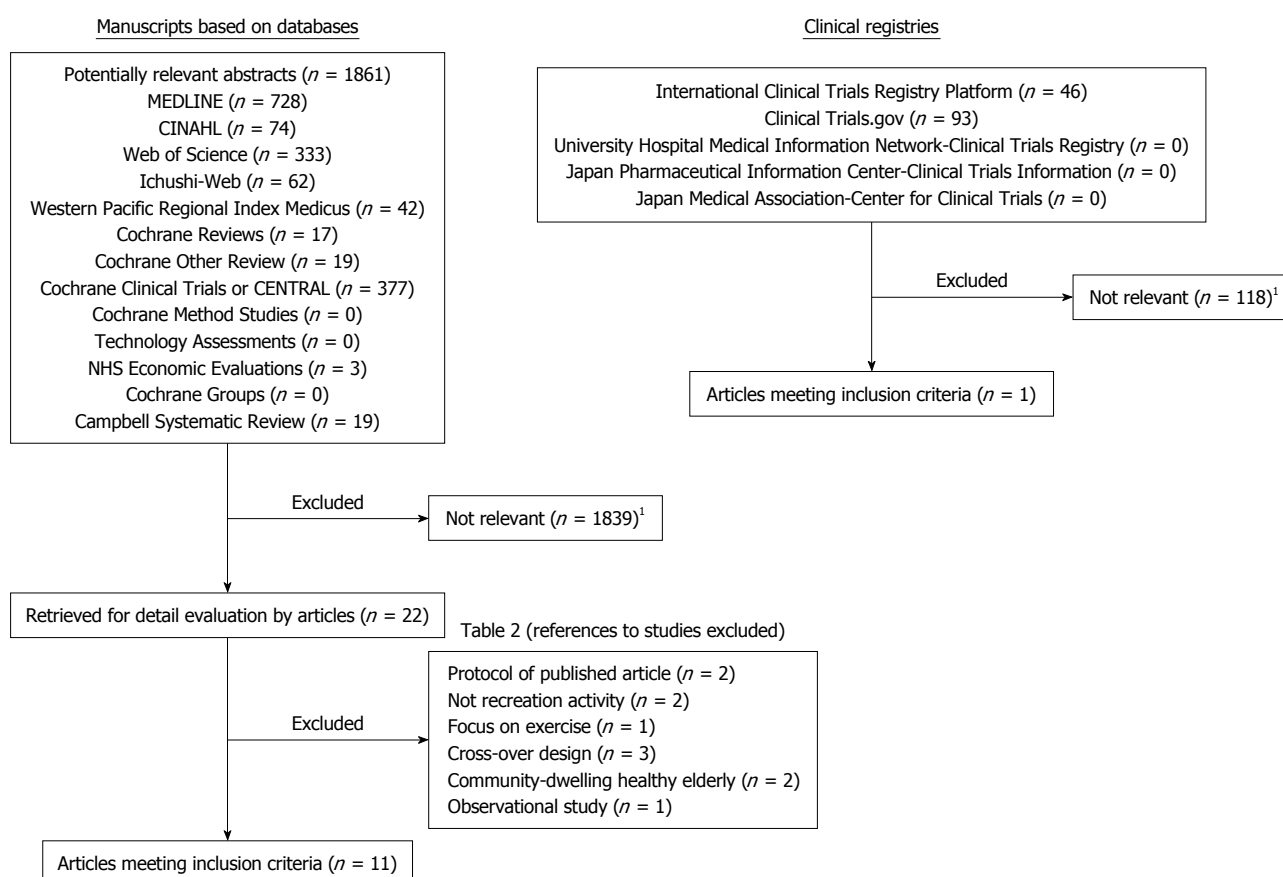
### Analysis

Pre-planned stratified analyses were: (1) trials comparing recreational activities with no treatment or waiting list controls; (2) trials comparing different types of general rehabilitation method [*e.g.*, physical therapy, occupational therapy (OT), *etc.*]; and (3) trials comparing recreational activities with other intervention(s) (*e.g.*, musical appreciation *vs* singing). We planned to express the results of each RCT, when possible, as relative risk with corresponding 95%CI for dichotomous data, and as standardized or weighted mean differences (SMD) with 95%CI for continuous data. However, heterogeneous results of studies that met inclusion criteria were not combined. All analyses were computed with the "R version 2.15.1", a free software environment for statistical computing and graphics (URL:<http://www.r-project.org/>), which compiles and runs on a wide variety of UNIX platforms, Windows.



**Table 2** References to studies excluded in this review

Excursion No.	Ref.	Title	Reason of exclusion
1	Green <i>et al</i> <sup>[48]</sup>	Physiotherapy for patients with mobility problems more than 1 year after stroke: a randomised controlled trial	Not recreation activity
2	Kobayashi <i>et al</i> <sup>[49]</sup>	Effects of a fall prevention program on physical activities of elderly people living in a rural region: an interventional trial	Community-dwelling healthy elderly
3	Das <i>et al</i> <sup>[50]</sup>	The efficacy of playing a virtual reality game in modulating pain for children with acute burn injuries: A randomized controlled trial	Cross-over design
4	Hurwitz <i>et al</i> <sup>[51]</sup>	Effects of recreational physical activity and back exercises on low back pain and psychological distress: Findings from the UCLA low back pain study	Observational study
5	Matsuo <sup>[52]</sup>	The influence of the exercise using a video game on the physical function and brain activities	Cross-over design
6	Saposnik <i>et al</i> <sup>[53]</sup>	Effectiveness of virtual reality exercises in stroke rehabilitation: rationale, design, and protocol of a pilot randomized clinical trial assessing the Wii gaming system	Research protocol
7	Mitsumura <i>et al</i> <sup>[54]</sup>	Effect on physical and mental function of a group rhythm exercise for elderly persons certified under the less severe grades of long-term care insurance	Exercise training
8	Fraga <i>et al</i> <sup>[55]</sup>	Aerobic resistance, functional autonomy and quality of life of elderly women impacted by a recreation and walking program	Community-dwelling healthy elderly
9	Watanabe <i>et al</i> <sup>[56]</sup>	Effects of cognitive rehabilitation with computer training on neuropsychological function in schizophrenia	Not recreation activity
10	Hsu <i>et al</i> <sup>[57]</sup>	A "Wii" bit of fun: The effects of adding Nintendo Wii Bowling to a standard exercise regimen for residents of long-term care with upper extremity dysfunction	Cross-over design
11	Kwok <i>et al</i> <sup>[58]</sup>	Evaluation of the Frails' Fall Efficacy by Comparing Treatments on reducing fall and fear of fall in moderately frail older adults: study protocol for a randomised control trial	Research protocol

**Figure 1** Flowchart of trial process. <sup>1</sup>Reduplication.**Research protocol registration**

We submitted and registered our research protocol to the PROSPERO database (No. CRD42012002381)<sup>[25]</sup>. This is an international database of prospectively registered SRs

in health and social care. Key features from the review protocol are recorded and maintained as a permanent record in PROSPERO. This will provide a comprehensive listing of SRs registered at inception, and enable compar-

ison of reported review findings with what was planned in the protocol. PROSPERO is managed by CRD and funded by the UK National Institute for Health Research. Registration was recommended because it encourages full publication of the review's findings and transparency in changes to methods that could bias findings<sup>[26]</sup>.

## RESULTS

### Study selection

The literature searches based on databases included 1861 potentially relevant articles (Figure 1). Abstracts from those articles were assessed and 22 papers were retrieved for further evaluation (checks for relevant literature). Eleven publications were excluded because they did not meet the eligibility criteria (Table 2). Eleven studies<sup>[4-6,27-34]</sup> met all inclusion criteria (Figure 1).

### Study characteristics

The language of all eligible publications was English. Target diseases and/or symptoms (Table 3) were stroke,<sup>[6,29,33,34]</sup> depression<sup>[5]</sup>, Parkinson's disease<sup>[32]</sup>, acquired brain injury<sup>[28]</sup>, chronic non-malignant pain (CNMP)<sup>[4]</sup>, adolescent obesity<sup>[31]</sup>, high-risk pregnancy<sup>[30]</sup>, and the frail elderly<sup>[27]</sup>. Intervention methods were gaming technology<sup>[27-29,31,33]</sup>, music<sup>[4,30]</sup>, dance<sup>[32]</sup>, easy rider wheelchair biking<sup>[5]</sup>, leisure education programs<sup>[34]</sup>, and leisure tasks<sup>[6]</sup>.

For gaming technology intervention, Szturm *et al.*<sup>[27]</sup> reported that dynamic balance exercises on fixed and compliant sponge surfaces could be coupled to interactive video game-based tasks in frail community-dwelling older adults. Gil-Gómez *et al.*<sup>[28]</sup> reported that virtual treatment with game exercises promotes improvement in the dynamic balance of patients with acquired brain injury. Saposnik *et al.*<sup>[29]</sup> reported that VR Wii gaming technology represents a safe, feasible, and potentially effective alternative to facilitate rehabilitation therapy and promote motor recovery after stroke. Adamo *et al.*<sup>[31]</sup> reported that cycling to music was superior to interactive video game cycling in promoting attendance and intensity of exercise expenditure for obese adolescent people, indicating that investment in the more expensive GameBike may not be worth the cost. Yavuzer *et al.*<sup>[33]</sup> reported that Playstation EyeToy Games combined with a conventional stroke rehabilitation program have the potential to enhance upper extremity-related motor functioning in subacute stroke patients.

Siedliecki *et al.*<sup>[4]</sup> reported that nurses could help patients with CNMP identify and use music they enjoy as a self-administered complementary intervention to facilitate feelings of power, and to decrease perceptions of pain, depression and disability. Bauer *et al.*<sup>[30]</sup> reported that single session music and recreational therapy interventions effectively alleviate antepartum-related distress among high-risk women experiencing antepartum hospitalization and should be considered as valuable additions to any comprehensive antepartum program.

Concerning dance intervention, Hackney *et al.*<sup>[32]</sup> reported that the tango may target deficits associated with Parkinson's disease more than the waltz/foxtrot, but both dances may benefit balance and locomotion.

Fitzsimmons<sup>[5]</sup> reported that easy rider wheelchair biking contributed to the body of knowledge regarding options for the treatment of depression in older adults, and provided encouraging findings that psychosocial interventions might be effective in reducing depression.

Desrosiers *et al.*<sup>[34]</sup> reported that the results for leisure education programs indicated their effectiveness in improving participation in leisure activities, improving satisfaction with leisure and reducing depression in people with stroke.

Parker *et al.*<sup>[6]</sup> reported that additional OT treatments did not show a clear beneficial effect on mood, leisure activity or independence in ADL measured at 6 or 12 mo.

### Quality assessment

We evaluated 47 items from the CONSORT 2010 and the "CONSORT for non-pharmacological trials" checklists in more detail (Table 4). Inter-rater reliability metrics for the quality assessment indicated substantial agreement for all 517 items (percentage agreement 97% and  $k = 0.953$ ).

This assessment evaluated the quality of how the main findings of the study were summarized in the written report. There was a remarkable lack of description in the studies of the methods, results, discussion, and other information in general. The items for which the description was lacking (very poor; < 50%) in many studies were as follows (present ratio; %): "in the abstract, description of the experimental treatment, comparator, care providers, centers, and blinding status" (36%); "important changes to methods after trial commencement" (36%); "details of how the interventions were standardized" (40%); "details of how adherence of care providers with the protocol was assessed or enhanced" (11%); "any changes to trial outcomes after the trial outcomes after the trial commenced" (25%); "how sample size was determined" (45%); "when applicable, explanation of any interim analyses and stopping guidelines" (22%); "when applicable, details of whether and how the clustering by care providers or centers was addressed" (11%); "type of randomization" (29%); "when applicable, how care providers were allocated to each trial group" (29%); "who generated the random allocation sequence, who enrolled participants, and who assigned participants to intervention" (45%); "whether or not those administering co-interventions were blinded to group assignment" (0%); "if blinded, method of blinding and description of the similarity of interventionist" (18%); "methods for additional analyses, such as subgroup analyses and adjusted analyses" (38%); "when applicable, details of whether and how the clustering by care providers or centers was addressed" (38%); "for binary outcomes, presentation of both absolute and relative effect sizes is recommended"

**Table 3** Brief summary of articles based on structured abstracts and additional elements

Ref.	Szturm <i>et al</i> <sup>[27]</sup>	Gil-Gómez <i>et al</i> <sup>[28]</sup>	Saposnik <i>et al</i> <sup>[29]</sup>
Citation	<i>Phys Ther</i> 2011; 91: 1449-1462	<i>J Neuroeng Rehabil</i> 2011; 8: 30	<i>Stroke</i> 2010; 41: 1477-1484
Title	Effects of an interactive computer game exercise regimen on balance impairment in frail community-dwelling older adults: a randomized controlled trial	Effectiveness of a Wii balance board-based system (eBaViR) for balance rehabilitation: a pilot randomized clinical trial in patients with ABI	Effectiveness of virtual reality using Wii gaming technology in stroke rehabilitation: a pilot randomized clinical trial and proof of principle
Aim/objective	To examine the feasibility and benefits of physical therapy based on a task-oriented approach delivered <i>via</i> an engaging, interactive video game paradigm. The intervention focused on performing targeted dynamic tasks, which included reactive balance controls and environmental interaction	To evaluate the efficacy of the eBaViR system as a rehabilitation tool for balance recovery in patients with ABI	To examine the feasibility and safety the VR Nintendo Wii gaming system (VRWii) compared with RT in facilitating motor function on the upper extremity required for activities of daily living among patients with subacute stroke receiving standard rehabilitation
Setting/place	A geriatric day hospital (Winnipeg, Manitoba, Canada)	Hospital NISA Valencia al Mar y Sevilla A ljarafe, Spain	Toronto Rehabilitation Institute
Participants	Thirty community-dwelling and ambulatory older adults. Inclusion Criteria; age: 65-85 yr, MMSE score > 24, English-speaking with the ability to understand the nature of the study and provide informed consent, independent in ambulatory functions, with or without an assistive device (cane or walker). without a disability and medical conditions (cancer, kidney disease, fracture, uncontrolled diabetes or seizure disorder, cardiovascular-related problems, stroke, multiple sclerosis, late-stage Parkinson disease, fainting, or dizzy spells)	Twenty participants. Inclusion criteria were: (1) age $\geq$ 16 yr and < 80 yr; (2) chronicity > 6 mo; (3) absence of cognitive impairment (MMSE > 23); (4) able to follow instructions; and (5) ability to walk 10 m indoors with or without technical orthopaedic aids	Participants ( $n = 22$ ) who are 18 to 85 yr of age (mean age 61.3 yr) having a first-time ischemic or hemorrhagic stroke
Intervention	The control group received the typical rehabilitation program such as strengthening and balance exercise at the day hospital. The experimental group received a program of dynamic balance exercises coupled with computer-based video game play, using a center-of-pressure position signal as the computer mouse. The tasks were performed while standing on a fixed floor surface, with progression to a compliant sponge pad. Each group received 16 sessions, scheduled 2/wk, with 45 min	Each patient participated in a total of 20 1-h-sessions of rehabilitation and accomplished a minimum of 3 sessions and a maximum of 5 sessions per week. During control sessions, traditional rehabilitation exercises that focused on balance training were practiced either individually or in a group. The sessions of the trial group were programmed according to the three games of the system (Simon, Balloon Breaker and Air Hockey) with a system based on the eBaViR. The eBaViR using Nintendo system had a significant improvement in static and/or standing balance (BBS and Anterior Reaches Test) compared to patients who underwent traditional therapy. The patients reported having had fun during the treatment without suffering from cyber side effects, which implies additional motivation and adhesion level to the treatment	Participants received an intensive program consisting of 8 interventional sessions of 60 min each over a 14-d period. Intervention group conducted a virtual reality Wii gaming, and the control group did a RT such as card game
Main and secondary outcomes	BBS, TUG, ABC	BBS, Brunel Balance Assessment, and ART	Feasibility and safety were set as the main outcome, and the efficiency was a secondary outcome in this study
Randomisation	Group assignment codes were placed in envelopes and sealed. Each individual who agreed to enter the study randomly selected an envelope	The randomization schedule was computer generated using a basic random number generator	The randomization schedule was computer generated using a basic random number generator
Blinding/masking	Assessors were blinded to the participant group assignments. The participant names of the GaitRite data files were coded	Program specialists and assessors were blinded to the patients group assignments	Only caregivers were blinded (single blinding)
Numbers randomised	Experimental group ( $n = 15$ ) and Control group ( $n = 15$ )	Trial group ( $n = 10$ ) and Control group ( $n = 10$ )	Virtual Reality Therapy ( $n = 11$ ) and Recreation Therapy ( $n = 11$ )

Recruitment	Thirty community-dwelling and ambulatory older adults who were attending the Riverview Health Center Day Hospital for treatment of limitations were recruited to participate in this study	"Seventy-nine hemiparetic patients who had sustained an ABI and were attending a rehabilitation program were potential candidates for participation in this study"	110 potential candidates were screened to participate in EVREST (the Effectiveness of Virtual Reality Exercises in Stroke Rehabilitation), and a total of 88 patients were excluded
Numbers analysed	Experimental group ( $n = 14$ ) and Control group ( $n = 13$ )	Trial group ( $n = 9$ ) and Control group ( $n = 8$ )	Virtual Reality Therapy ( $n = 10$ ) and Recreation Therapy ( $n = 10$ ) on the primary end point
Outcome	Finding demonstrated significant improvements in posttreatment balance performance scores for both group, and change scores were significantly greater in the experimental group compared with the control group (BBS; $P = 0.001$ , ABC; $P = 0.02$ ). No significant treatment effect was observed in either group for the TUG or spatiotemporal gait variables	Patients using eBaViR had a significant improvement in static balance ( $P = 0.011$ in BBS and $P = 0.011$ in ART) compared to patients who underwent traditional therapy. Regarding dynamic balance, the results showed significant improvement over time in all these measures, but no significant group effect or group-by-time interaction was detected for any of them, which suggest that both groups improved in the same way	Feasibility (time tolerance) and safety (intervention-related adverse event) did not show significant difference between groups. In contrast, the intervention group showed a significant improvement in mean motor function (Wolf Motor Function Test) compared to the control group ( $-7.4$ s; 95%CI: $-14.5$ – $-0.2$ )
Harm	No description	No adverse events	No adverse events
Conclusion	Dynamic balance exercises on fixed and compliant sponge surfaces were feasibly coupled to interactive video game-based exercise. This coupling, in turn, resulted in a greater improvement in dynamic standing balance control compared with the typical exercise program. However, there was no transfer of effect to gait function	The results suggest that eBaViR represents a safe and effective alternative to traditional treatment to improve static balance in the ABI population	Virtual reality Wii gaming technology represents a safe, feasible, and potentially effective alternative to facilitate rehabilitation therapy and promote motor recovery after stroke
Trial registration	Clinical Trials.gov (NCT01381237)	No registration	No description
Found	Grant from the Riverview Health Centre Foundation, Winnipeg, Manitoba, Canada: The Fund provided the space at their facility and access to their day hospital program clients for assessment and treatment of the control group	Ministerio de Educación y Ciencia Spain, Projects Consolider-C (SEJ2006-14301/PSIC), "CIBER of Physiopathology of Obesity and Nutrition, an initiative of ISCIII" and the Excellence Research Program PROMETEO	This study was supported by a grant from the Ministry of Health and Long Term Care through the Ontario Stroke System, administered by Heart and Stroke Foundation of Ontario
Cost of intervention	No description	No description	No description
Ref.	Bauer <i>et al</i> <sup>[30]</sup>	Adamo <i>et al</i> <sup>[31]</sup>	Hackney <i>et al</i> <sup>[32]</sup>
Citation	<i>J Womens Health</i> (Larchmt) 2010; 19: 523-531	<i>Appl Physiol Nutr Metab</i> 2010; 35: 805-815	<i>J Rehabil Med</i> 2009; 41: 475-481
Title	Alleviating distress during antepartum hospitalization: a randomized controlled trial of music and recreation therapy	Effects of interactive video game cycling on overweight and obese adolescent health	Effects of dance on movement control in PD: a comparison of Argentine tango and American ballroom
Aim/objective	To examine the efficacy of a single session music or recreation therapy intervention to reduce antepartum-related distress among women with high-risk pregnancies extended antepartum hospitalizations	To examine the efficacy of interactive video game stationary cycling (GameBike) in comparison with stationary cycling to music on adherence, energy expenditure measures, submaximal aerobic fitness, body composition, and cardiovascular disease risk markers in overweight and obese adolescents, using a randomized controlled trial design	To compare the effects of tango, waltz/foxtrot and no intervention on functional motor control in individuals with PD
Setting/place	Midwestern, suburban teaching hospital with a regional Perinatal Center with 26 private rooms on the antepartum unit	The Endocrinology clinic at the Children's Hospital of Eastern Ontario	No description
Participants	Participants ( $n = 80$ ) were hospitalized with various high-risk obstetric health issues, including preterm labor, premature rupture of membranes, preeclampsia, and multiple gestations. They were all over the age of 18 (mean age 31 yr), between 24 and 38 wk of gestation	Thirty obese adolescents between ages of 12-17 yr	Fifty-eight participants with idiopathic PD participated. They were at least 40 yr of age, could stand for at least 30 min, and walk independently for $\geq 3$ m with or without an assistive device



Intervention	Participants were received a 1-h music or recreation therapy intervention. Music therapists offered a range of interventions for patients, all within the current standards of care of these therapies, included music-facilitated relaxation, active music listening, song writing, music for bonding, and clinical improvisation. Recreation therapy interventions offered included adaptive leisure activities, creative arts, community resource education, and leisure awareness activities	In the experimental group (interactive video game cycling), participants ( $n = 15$ ) were required to exercise on a GameBike interactive video gaming system that was interfaced with a Sony Play Station 2. Participants were allowed to select from variety of choices, video games to play while cycling and were permitted to switch games during the exercise session. In control group (stationary cycling to music), participants were allowed to listen to music of their choice <i>via</i> radio, CD, or personal music device. The instructions given participants and the general protocol for this condition was the same as for video game condition. The 10-wk program consisted of twice weekly sessions lasting a maximum of 60 min per session, respectively	The both dance classes were taught by the same instructor who was an experienced professional ballroom dance instructor and an American Council on Exercise certified personal trainer. Those in the dance groups attended 1-h classes twice a week, completing 20 lessons in 13 wk. Both genders spent equal time in leading and following dance roles. Healthy young volunteers, recruited from physical therapy, pre-physical therapy and pre-medical programs at Washington University and St. Louis University, served as dance partners for those with PD. Volunteers were educated about posture and gait problems associated with PD
Main and secondary outcomes	Antepartum Bedrest Emotional Impact Inventory Scores	Adherence, submaximal aerobic fitness (Peak workload, Time to exhaustion, Peak heart rate), exercise behaviour, body composition, and blood parameters	The Unified Parkinson's Disease Rating Scale Motor Subscale 3 (UPDRS), BBS, TUG, 6MWT, FOG questionnaire, and forward and backward gait (gait velocity, stride length, and single support time)
Randomisation	The groups were assigned by the research coordinator (using a Random Numbers Statistical Table and opaque envelopes containing group membership) to an intervention condition (either a music or recreation therapy) or waitlist control condition	The randomization schedule was computer generated using a basic random number generator	Randomly selecting one of the 3 conditions from a hat
Blinding/masking	Only participants were blinded (single blinding)	No blinding	The first author was not blinded to group assignment. The evaluations were videotaped for a rater who was a specially trained physiotherapy student otherwise not involved in the study (blinded assessor). Participants were not informed of the study hypotheses
Numbers randomised	Music therapy group ( $n = 19$ ), recreation therapy group ( $n = 19$ ), and control group ( $n = 42$ )	Video game cycling ( $n = 15$ ) and Music cycling ( $n = 15$ )	Waltz/foxtrot ( $n = 19$ ), Tango ( $n = 19$ ), and Control ( $n = 20$ )
Recruitment	Identified eligible patients through chart review and nursing report during 2003-2005. A total of 136 patients; once enrolled, however, 56 patients were unable to complete the study	Participants were recruited between May 2007 and January 2009 and the final subject assessment was completed in March 2009. A total of 150 families were screened through the Endocrinology clinic at the Children's Hospital of Eastern Ontario to determine Assessed for eligibility. Thirty families met the all inclusion criteria	Participants were recruited from the St. Louis community through advertisement at local support groups and local community events. Most were directly recruited <i>via</i> telephone from the Washington University Movement Disorders Center database
Numbers analysed	Music therapy group ( $n = 19$ ), recreation therapy group ( $n = 19$ ), and control group ( $n = 42$ )	Video game cycling ( $n = 13$ ) and Music cycling ( $n = 13$ )	Waltz/foxtrot ( $n = 17$ ), Tango ( $n = 14$ ), and Control ( $n = 17$ )
Outcome	Significant association were found between the delivery of music and recreation therapy and reduction of antepartum-related distress in women hospitalized with high-risk pregnancies. These statistically significant reductions in distress persisted over a period of up to 48-72 h (each $P < 0.05$ )	The music group had a higher rate of attendance compared with the video game group (92% <i>vs</i> 86%, $P < 0.05$ ). Time spent in minutes per session at vigorous intensity (80%-100% of predicted peak heart rate) ( $24.9 \pm 20$ min <i>vs</i> $13.7 \pm 12.8$ min, $P < 0.05$ ) and average distance (km) pedaled per session ( $12.5 \pm 2.8$ km <i>vs</i> $10.2 \pm 2.2$ km, $P < 0.05$ ) also favoured the music group. However, both interventions produced significant improvements in submaximal indicators of aerobic fitness as measured by a graded cycle ergometer protocol	Significant improvements were noted in tango and waltz/foxtrot on the BBS, 6MWT and backward stride length when compared with controls ( $P < 0.05$ ). Control group worsened significantly with respect to disease severity, as measured by the UPDRS, and on time spent in single support during forward and backward walking
Harm	No description	No adverse events	No description

Conclusion	Single session music and recreation therapy interventions effectively alleviate antepartum-related distress among high-risk women experiencing antepartum hospitalization and should be considered as valuable additions to any comprehensive antepartum program	The results supported the superiority of cycling to music and indicated investing in the more expensive GameBike may not be worth the cost	Tango may target deficits associated with PD more than waltz/foxtrot, but both dances may benefit balance and locomotion
Trial registration	No description	Clinical Trials.gov (NCT00983970)	No description
Found	No description	The Canadian Diabetes Association	The American Parkinson's Disease Association and NIH grant K01-048437
Cost of intervention	No description	Participants and their families were reimbursed CAN\$10 per visit to the laboratory for parking and transportation costs, and the participants were given a CAN\$20 movie theatre gift certificate following trial completion	No description
Ref.	Yavuzer <i>et al</i> <sup>[33]</sup>	Desrosiers <i>et al</i> <sup>[34]</sup>	Siedliecki <i>et al</i> <sup>[4]</sup>
Citation	<i>Eur J Phys Rehabil Med</i> 2008; 44: 237-244	<i>Arch Phys Med Rehabil</i> 2007; 88: 1095-1100	<i>J Adv Nurs</i> 2006; 54: 553-562
Title	"Playstation eyetoy games" improve upper extremity-related motor functioning in subacute stroke: a randomized controlled clinical trial	Effect of a home leisure education program after stroke: a randomized controlled trial	Effect of music on power, pain, depression and disability
Aim/objective	To evaluate the effects of "Playstation EyeToy games" on upper extremity motor recovery and upper extremity-related motor functioning of patients with subacute stroke	To evaluate the effect of a leisure education program on participation in and satisfaction with leisure activities (leisure-related outcomes), and well-being, depressive symptoms, and quality of life (primary outcomes) after stroke	To test the effect of music levels of power, pain, depression, and disability; to compare the effect of researcher-provided relaxing music choices with subject-preferred music, selected daily based on self-assessment; and to test the relationship between power and the combined dependent variable of pain, depression and disability
Setting/place	Twenty inpatients with hemiparesis after stroke in rehabilitation center from the general hospital, Turkey	Home and community	Pain clinics and chiropractic office in northeast Ohio, United States
Participants	Twenty hemiparetic inpatients with post-stroke. Eligible criteria: (1) first hemiparesis within 12 mo; (2) Brunnstrom stage 1-4 for upper extremity; and (3) no severe cognitive disorders	Sixty-two people (mean age 70 yr) with stroke	Participation of 60 African American and Caucasian people aged 21-65 yr (mean age 49.7 yr) with chronic non-malignant pain CNMP
Intervention	Both the intervention group and the control group participated in a conventional stroke rehabilitation program, 5 d a week, 2-5 h/d for 4 wk. The conventional program is patient-specific and consists of neurodevelopmental facilitation techniques, physiotherapy, OT, and speech therapy. For the same 4-wk of period, the EyeToy group received an additional 30 min of VR therapy program	The experimental participants ( <i>n</i> = 33) received the leisure education program (leisure awareness, self-awareness, and competence development) at home once a week for 8 to 12 wk. The recreational therapist was responsible for the intervention whereas the occupational therapist acted as a consultant. The control participants ( <i>n</i> = 29) were also visited by the recreation therapist but the topics discussed were unrelated to leisure ( <i>e.g.</i> , family, cooking, politics, news, everyday life)	Patterning Music (PM; subject-preferred music) group were asked to select upbeat, familiar, instrumental or vocal music to ease muscle tension and stiffness. Standard Music (SM; researcher-provided music) group were offered a choice of one 60-min relaxing instrumental music tape from a collection of five tapes (piano, jazz, orchestra, harp and synthesizer) used in several music and acute pain studies. Each group received their assigned intervention for 1-h a day for 7 consecutive days. Control group received standard care that did not include music intervention, and all participants kept a diary for 7 d
Main and secondary outcomes	Brunnstrom stages and FIM	Minutes of leisure activity per day, number of leisure activities, the Leisure Satisfaction Scale, the Individualized Leisure Profile, the GWBS, the Center for Epidemiological Studies Depression Scale, and the SA-SIP30	Power (characterize power: awareness, choices, freedom, and a personal involvement in creating change), pain, depression, and disability
Randomisation	The randomization schedule was computer generated using a basic random number generator	The randomization schedule was computer generated using a basic random number generator	The random allocation sequence using the Min-8 program
Blinding/masking	Assessor was blinded to the group allocation of the subject. Patients and physical therapist were not blinded	Only assessor was blinded	No description
Numbers randomised	Intervention group ( <i>n</i> = 10) and Control group ( <i>n</i> = 10)	Experimental participants ( <i>n</i> = 33) and Control participants ( <i>n</i> = 29)	PM group ( <i>n</i> = 18), SM group ( <i>n</i> = 22), and Control group ( <i>n</i> = 20)

Recruitment	"Inpatients with hemiparesis after stroke"	A total of 62 people entered the trial carried out in 2002 and 2003. Authors recruited them after a review of medical charts of people ( $n = 230$ ) who were previously admitted with stroke to a rehabilitation or acute care facility up to 5 yr before the study	64 patients with CNMP was recruited over a 24-mo period from 2001 to 2003 from pain clinics and a chiropractic office in northeast Ohio
Numbers analysed	Intervention group ( $n = 10$ ) and Control group ( $n = 10$ )	Experimental participants ( $n = 29$ ) and Control participants ( $n = 27$ )	PM group ( $n = 18$ ), SM group ( $n = 22$ ), and Control group ( $n = 20$ ),
Outcome	The mean change score (95%CI) of the FIM self-care score [(5.5 (2.9-8.0) vs 1.8 (0.1-3.7), $P = 0.018$ ] showed significantly more improvement in the EyeToy group compared to the control group. No significant differences were found between the groups for the Brunnstrom stages for hand and upper extremity	There was a statistically significant difference in change scores between the groups for satisfaction with leisure with a mean difference of 11.9 points (95%CI: 4.2-19.5) and participation in active leisure with a mean difference of 14.0 min (95%CI: 3.2-24.9). There was also a statistically significant difference between groups for improvement in depressive symptoms with a mean difference of -7.2 (95%CI: -12.5--1.9). Differences between groups were not statistically significant on the SA-SIP30 (0.2; 95%CI: -1.3-1.8) and GWBS (2.2; 95%CI: -5.6-10.0)	The music groups had more power and less pain ( $P = 0.002$ ), depression ( $P = 0.001$ ) and disability ( $P = 0.024$ ) than the control group, but there were no statistically significant differences between the two music interventions. The model predicting both a direct and indirect effect for music was supported
Harm	No adverse events	No description	No description
Conclusion	"Playstation EyeToy Games" combined with a conventional stroke rehabilitation program have a potential to enhance upper extremity-related motor functioning in subacute stroke patients	The results indicate the effectiveness of the leisure education program for improving participation in leisure activities, improving satisfaction with leisure and reducing depression in people with stroke	Nurses can help patients with CNMP identify and use music they enjoy as a self-administered complementary intervention to facilitate feelings of power, and to decrease perceptions of pain, depression and disability
Trial registration	No description	No description	No description
Found	No description	The Canadian Institutes of Health Research (MOP-49526)	The Frances Payne Bolton Alumni Association, Case Western Reserve University, Cleveland Ohio; Sigma Theta Tau, Delta Omega Research Grant; NRSa (NINR; NIH#1F31nro7565)
Cost of intervention	No description	No description	No description
Ref.	Fitzsimmons <sup>[5]</sup>	Parker <i>et al</i> <sup>[6]</sup>	
Citation	<i>J Gerontol Nurs</i> 2001; 27: 14-23	<i>Clin Rehabil</i> 2001; 15: 42-52	
Title	Easy rider wheelchair biking. A nursing-recreation therapy clinical trial for the treatment of depression	A multicentre randomized controlled trial of leisure therapy and conventional occupational therapy after stroke. TOTAL Study Group. Trial of Occupational Therapy and Leisure	
Aim/objective	To determine if participation in a therapy biking program had an effect on the degree of depression in older adults living in a long-term facility in upstate New York	To evaluate the effects of leisure therapy and conventional OT on the mood, leisure participation and independence in ADL of stroke patients 6 and 12 mo after hospital discharge	
Setting/place	The New York State Home for Veterans (Veterans' Home)	Five UK centres: Aintree Fazakerley Hospital, Bristol Southmead Hospital, Edinburgh Western General Hospital, Glasgow Royal Infirmary and Nottingham University Hospital	
Participants	Thirty-nine older adults (mean age 80 yr) with depression living a long-term facility	Four hundred and sixty-six stroke patients (mean age 72 yr)	
Intervention	Ease rider Program (Therapy program) intervention. The experimental groups received the therapeutic biking program for 1 h a day, 5 d a week, for 2 wk	Two treatment groups (ADL group and Lisure group) received OT interventions at home for up to 6 mo after recruitment. The protocol specified a minimum of 10 sessions lasting not less than 30 min each. The treatment goals set in the ADL group were in term of improving independence in self-care tasks and therefore treatment involved practising these task (such as preparing a meal or walking outdoor). For the leisure group, goals were set in term of leisure activity and so interventions included practising the leisure task as well as any ADL tasks necessary achieve the leisure objective. Control group received no OT treatment within the trial	

Main and secondary outcomes	The short-form Geriatric Depression Scale	For mood, the GHQ/For leisure activity, the Nottingham Leisure Questionnaire/For independence in ADL, the Nottingham Extended ADL Scale
Randomisation	No description	The Collaborative Stroke Audit and Research telephone randomization service was used to allocate patients to one of three group: leisure, ADL and control
Blinding/masking	No description	Only participants were blinded
Numbers randomised	Treatment group ( <i>n</i> = 20) and Control group ( <i>n</i> = 20)	Leisure group ( <i>n</i> = 153), ADL group ( <i>n</i> = 156), and Control group ( <i>n</i> = 157)
Recruitment	The target population ( <i>n</i> = 90) was residents with a diagnosis of or symptoms of depression in the New York State Home for Veterans	Recruitment was conducted at five UK centres: Aintree Fazakerley Hospital, Bristol Southmead Hospital, Edinburgh Western General Hospital, Glasgow Royal Infirmary and Nottingham University Hospital. 1750 patients was registered
Numbers analysed	Treatment group ( <i>n</i> = 19) and Control group ( <i>n</i> = 20)	Leisure group ( <i>n</i> = 113), ADL group ( <i>n</i> = 106), and Control group ( <i>n</i> = 112)
Outcome	The control groups' GDS pretest means of 7.95 increased slightly at the posttest to 8.65, indicating a slight increase (+0.70) in depression. The treatment groups' pretest 7.68 decreased to 4.21 (-3.47) at the posttest, denoting a marked decrease in depression ( <i>P</i> < 0.001)	At 6 mo and compared to the control group, those allocated to leisure therapy had nonsignificantly better GHQ scores (-1.2; 95% CI: -2.9-0.5), leisure scores (+0.7; 95% CI: -1.1-2.5) and Extended ADL scores (+0.4; 95% CI: -3.8-4.5); the ADL group had nonsignificantly better GHQ scores (-0.1; 95% CI: -1.8-1.7) and Extended ADL scores (-1.4; 95% CI: -2.9-5.6) and nonsignificantly worse leisure scores (-0.3; 95% CI: -2.1-1.6). The results at 12 mo were similar
Harm	No adverse events	No description
Conclusion	This study contributes to the body of knowledge of nursing regarding options for the treatment of depression in older adults, and is an encouraging that psychosocial interventions may be effective in reducing depression	In contrast to the findings of previous smaller trials, neither of the additional OT treatments showed a clear beneficial effect on mood, leisure activity or independence in ADL measured at 6 or 12 mo
Trial registration	No description	No description
Found	The New York State Dementia Research Grant 2000	NHS Research and Development Programme
Cost of intervention	The cost of a basic bike is approximately \$3600 plus shipping	No description

ABI: Acquired brain injury; PD: Parkinson's disease; BBS: Berg Balance Scale; RT: Recreational therapy; MMSE: Mini-Mental State Examination; TUG: Timed "Up and Go" Test; ABC: Activities-specific Balance Confidence Scale; ART: Anterior Reach Test; 6MWT: 6-min walk test; CNMP: Chronic non-malignant pain; OT: Occupational therapy; GWBS: General Well-Being Schedule; SA-SIP30: Stroke-Adapted Sickness Impact Profile; FIM: Functional Independence Measure; ADL: Activities of daily living; GHQ: General Health Questionnaire.

(11%); "results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing pre-specified from exploratory" (14%); "all important harmful or unintended effects in each group" (27%); "generalizability (external validity) of the trial findings according to the intervention, comparators, patients, and care providers and centers involved in the trial" (27%); "registration number and name of trial registry" (18%); and "where the full trial protocol can be accessed, if available" (18%).

### Meta-analysis of balance ability

Results from RCTs with control groups<sup>[27,28]</sup> were pooled in a meta-analysis to establish the overall effect of balance ability interventions compared with no-interventions controls (Figures 2 and 3). For the Berg Balance Scale (BBS), the included interventions were sufficiently

homogenous ( $I^2 = 62.8\%$ ,  $P = 0.101$ ), so the fixed effects model was used. This revealed a non-significant difference in balance ability favoring interventions over controls at the last reported assessment (SMD = 3.75; 95%CI: 1.82-5.69;  $n = 44$ ). For the Timed "Up and Go" (TUG), the interventions were homogenous ( $I^2 = 69.5\%$ ,  $P = 0.070$ ), so the fixed effects model was also used. This revealed a no significant difference in balance ability favoring interventions over controls (SMD = 0.19; 95%CI: -4.09-4.47;  $n = 44$ ). A funnel plot to assess publication bias was not generated as fewer than 10 interventions were included in the meta-analysis<sup>[35]</sup>.

### Withdrawals and adverse events

Five studies<sup>[5,28,29,31,33]</sup> reported no adverse events during all interventions but there were no descriptions of adverse events in the other studies (Table 3). Two stud-



Table 4 Evaluation of the quality of randomized controlled trials by using the CONSORT 2010 checklist and the checklist for reporting trials nonpharmacologic treatments

Paper Section/ Topic	ID	CONSORT 2010; items	Checklist for reporting trials of nonpharmacologic treatment: items	Ref.											Present description <sup>1</sup>	
				[27]	[28]	[29]	[30]	[31]	[32]	[33]	[34]	[4]	[5]	[6]	No/sum	Rate (%)
Title and abstract	1a	Identification as a randomised trial in the title		p	p	p	p	a	?	p	p	a	a	p	7/11	64
	1b	Structured summary of trial design, methods, results, and conclusions (for specific guidance see CONSORT for abstracts)		n/a	n/a	p	p	p	p	p	p	?	?	p	7/9	78
Introduction Background and objectives Methods Trial design			In the abstract, description of the experimental treatment, comparator, care providers, centers, and blinding status	p	p	p	?	?	?	?	p	?	?	?	4/11	36
	2a	Scientific background and explanation of rationale		p	p	p	p	p	p	?	p	p	p	p	10/11	91
	2b	Specific objectives or hypotheses		p	p	p	p	p	p	p	p	p	p	p	11/11	100
	3a	Description of trial design (such as parallel, factorial) including allocation ratio		p	?	p	p	p	p	p	p	p	p	p	10/11	91
	3b	Important changes to methods after trial commencement (such as eligibility criteria), with reasons		p	p	?	p	a	?	p	a	a	a	a	4/11	36
Participants	4a	Eligibility criteria for participants		p	p	p	p	p	p	p	p	p	p	p	11/11	100
	4b	Settings and locations where the data were collected	When applicable, eligibility criteria for centers and those performing the interventions	p	?	p	p	p	?	p	p	p	p	p	9/11	82
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	Precise details of both the experimental treatment and comparator	p	p	p	p	?	p	p	?	p	p	p	9/11	82
			Description of the different components of the interventions and, when applicable, descriptions of the procedure for tailoring the interventions to individual participants	a	a	p	p	a	p	a	a	p	p	p	6/11	55
Outcomes			Details of how the interventions were standardized	a	a	a	p	a	p	n/a	a	p	?	p	4/10	40
			Details of how adherence of care providers with the protocol was assessed or enhanced	a	?	a	n/a	a	p	n/a	a	?	?	?	1/9	11
	6a	Completely defined pre-specified primary and secondary outcome measures, including how and when they were assessed		p	p	p	p	p	p	p	p	?	?	p	9/11	82
	6b	Any changes to trial outcomes after the trial commenced, with reasons		p	p	a	n/a	a	n/a	n/a	a	a	a	a	2/8	25
Sample size	7a	how sample size was determined		p	p	a	?	a	?	p	a	a	p	p	5/11	45
	7b	when applicable, explanation of any interim analyses and stopping guidelines		p	a	a	n/a	a	n/a	?	a	a	p	p	3/9	33
Randomisation: Sequence generation			When applicable, details of whether and how the clustering by care providers or centers was addressed	p	a	a	n/a	a	n/a	?	a	?	?	p	2/9	22
	8a	Method used to generate the random allocation sequence		?	p	?	p	p	p	p	p	p	a	p	8/11	73

8b	Type of randomisation; details of any restriction (such as blocking and block size)	n/a	n/a	p	n/a	?	n/a	?	n/a	p	?	a	a	a	a	2/7	29
	When applicable, how care providers were allocated to each trial group	n/a	n/a	a	n/a	?	n/a	?	n/a	a	?	p	?	p	p	2/7	29
9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	a	a	p	p	?	p	?	p	p	?	p	a	p	a	6/11	55
10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	a	a	p	p	?	p	?	p	p	?	a	a	p	a	5/11	45
	Details of the experimental treatment and comparator as they were implemented	a	a	p	p	?	p	?	p	p	?	p	?	p	p	6/11	55
11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how	p	p	p	p	a	p	a	p	p	p	a	a	a	a	7/11	64
	Whether or not those administering co-interventions were blinded to group assignment	?	?	a	?	a	?	a	?	a	?	a	a	a	a	0/11	0
11b	If relevant, description of the similarity of interventions	?	?	a	p	a	p	a	p	a	a	a	a	a	a	2/11	18
12a	Statistical methods used to compare groups for primary and secondary outcomes	?	?	p	p	p	p	p	p	p	p	p	p	p	p	9/11	82
12b	Methods for additional analyses, such as subgroup analyses and adjusted analyses	a	a	n/a	n/a	a	n/a	a	n/a	p	a	p	a	p	a	3/8	38
	when applicable, details of whether and how the clustering by care providers or centers was addressed	a	a	n/a	n/a	a	n/a	a	n/a	a	a	p	p	p	p	3/8	38
13a	For each group, the numbers of participants who were randomly assigned, received intended treatment, and were analysed for the primary outcome	a	a	p	p	p	p	?	p	p	p	p	p	p	p	8/11	73
13b	For each group, losses and exclusions after randomisation, together with reasons	?	?	p	p	p	p	p	p	p	p	p	p	p	p	9/11	82
14a	Dates defining the periods of recruitment and follow-up	?	?	p	?	p	?	p	?	p	p	p	p	p	p	7/11	64
14b	Why the trial ended or was stopped	?	?	p	n/a	p	n/a	p	n/a	p	p	p	a	p	a	6/9	67
15	A table showing baseline demographic and clinical characteristics for each group	p	p	p	p	a	p	a	p	p	a	a	a	a	a	7/11	64
	When applicable, a description of care providers (case volume, qualification, expertise, etc.) and centers (volume) in each group	p	p	p	p	p	p	p	p	p	p	p	p	p	p	11/11	100
16	For each group, number of participants (denominator) included in each analysis and whether the analysis was by original assigned groups	p	p	p	p	p	p	p	p	p	p	p	p	p	p	10/11	91
17a	For each primary and secondary outcome, results for each group, and the estimated effect size and its precision (such as 95% confidence interval)	p	p	p	p	p	p	p	p	p	p	p	p	p	p	10/11	91

17b	For binary outcomes, presentation of both absolute and relative effect sizes is recommended	?	?	p	n/a	a	n/a	a	a	a	a	1/9	11
Ancillary analyses	18 Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing prespecified from exploratory	a	a	n/a	n/a	a	n/a	n/a	a	p	a	1/7	14
Harms	19 All important harms or unintended effects in each group (for specific guidance see CONSORT for harms)	a	p	a	?	p	?	p	a	a	a	3/11	27
Discussion	20 Trial limitations, addressing sources of potential bias, imprecision, and, if relevant, multiplicity of analyses	p	p	p	p	a	p	p	p	p	p	9/11	82
Generalisability	21 Generalisability (external validity, applicability) of the trial findings	p	p	p	p	?	p	?	?	p	a	6/11	55
Interpretation	22 Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence	p	p	p	p	?	p	p	?	p	?	8/11	73
Other information	23 Registration number and name of trial registry	?	?	p	p	?	?	?	?	p	?	3/11	27
Registration Protocol	24 Where the full trial protocol can be accessed, if available	p	a	?	?	p	?	?	?	?	?	2/11	18
Funding	25 Sources of funding and other support (such as supply of drugs), role of funders	p	p	?	p	?	a	p	p	p	p	8/11	73

<sup>1</sup>Present description means present No. and sum except "n/a" and its percentage. a: Absent; ? : Unclear or inadequately described.

ies<sup>[29,32]</sup> reported no withdrawals (dropouts), nine studies showed some dropouts because of mainly death, hospitalization, and injuries due to other causes. The reasons preventing patients from recreational activities were not shown.

## Costs of intervention

Two studies<sup>[5,31]</sup> described the costs of intervention (Table 3). Adamo *et al*<sup>[31]</sup> showed parking and transportation costs, as well as movie theatre gift certificates following the trial completion. Fitzsimmons<sup>[5]</sup> showed the cost of an easy rider wheelchair bike. There was no information regarding costs of intervention in the other studies.

## DISCUSSION

This is the first SR of the effectiveness of rehabilitation based on recreational activities. Eleven RCTs were identified, target diseases and/or symptoms included stroke, dementia, Parkinson's disease, acquired brain injury, CNMP, adolescent obesity, high-risk pregnancy, and the frail elderly. The intervention methods included various approaches such as gaming technology, music, dance, easy rider wheelchair biking, leisure education programs, and leisure tasks. Primary or secondary outcomes were generally psychological status

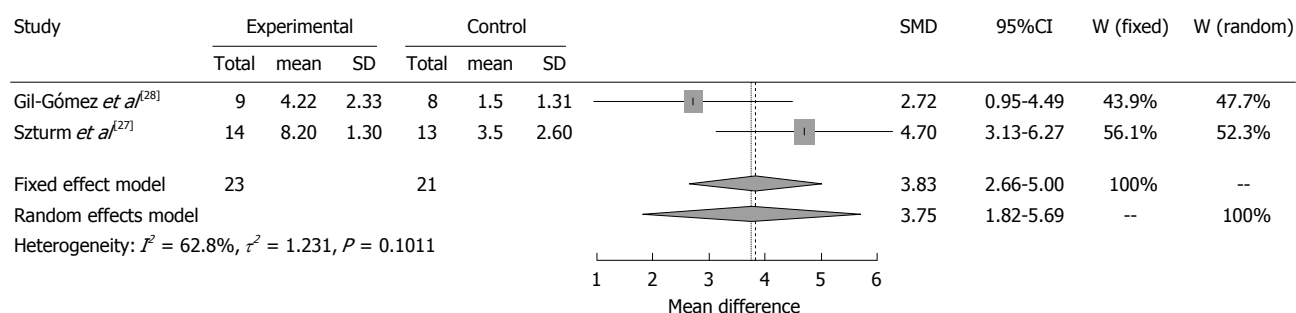


Figure 2 A meta-analysis on the effect of the Berg Balance Scale by gaming intervention. SMD: Standardized mean difference.

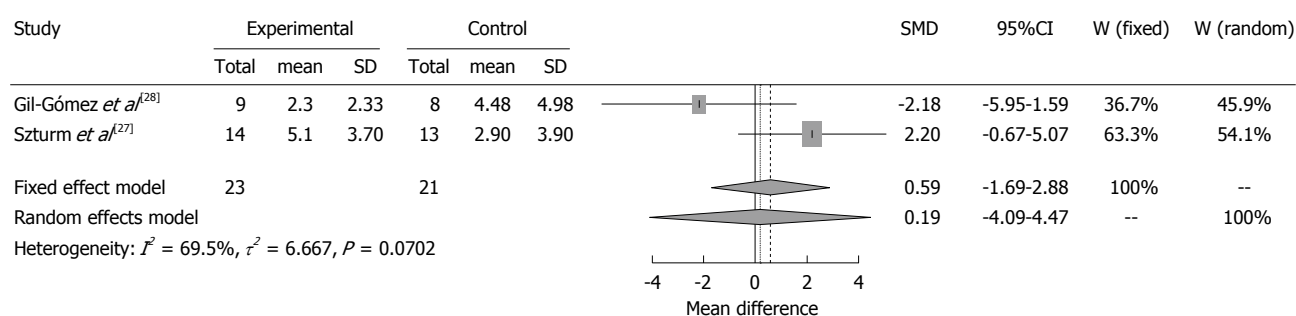


Figure 3 A meta-analysis on the effect of the Timed "Up and Go" Test by gaming intervention. SMD: Standardized mean difference.

(depression, mood, emotion, and power), balance or motor function, and adherence (feasibility and attendance).

### Video gaming as new trend of rehabilitation

The trend over the past 10 years towards game interventions by VR is particularly interesting. Basically, sedentary screen time has been shown to be associated with obesity<sup>[36]</sup> as well as negative health outcomes such as premature death<sup>[37,38]</sup>, independent of physical activity levels<sup>[39]</sup>. However, one strategy, the term "active video gaming" or "virtual gaming" has been used to describe games in which body movement is necessary or encouraged by the control scheme of each game. Typically, active games use a motion-sensing or motion-encouraging controller rather than a traditional handheld game pad controller. Lyons *et al*<sup>[40]</sup> reported that dance simulation and fitness games seemed to have the potential to produce moderate-intensity physical activity in physiological experiments. A recent SR<sup>[41]</sup> without meta-analysis, based on video games reported that there is potential for video games to improve health-related outcomes, particularly in the area of psychological and physical therapy. However, the included RCTs were of relatively low quality. A discussion, including a meta-analysis to clearly demonstrate an effect of the video game, was required.

### Meta-analysis of balance ability based on video games

For BBS and TUG as an indicator of balance ability, the interventions were not identical, but the results for both revealed no significant differences in balance ability between interventions and controls. One reason for this was that the pooled sample size was very small (two studies,

44 participants) and we could not, therefore, calculate and describe a funnel plot to assess publication bias. It may be difficult to recruit many patients as participants in rehabilitation studies, although studies (cluster- or multicenter-RCTs depending on the case) with sufficient numbers of subjects are necessary. The second problem may be that the dose-regimen, such as period and frequency of the interventions, was inadequate. The mental and physical burden on participants is increased when there is substantial intervention, although it is expected that the effect of balance ability would rise in a positive relationship with the quantity of intervention. Because a gradual increase in load with recovery is necessary in rehabilitation programs, it is easy to assign settings like "Level" or "Stage" for the game, such as first, second level, *etc.* Therefore, we also expect to understand correctly the results and detailed descriptions of "pragmatic trials"<sup>[42]</sup> as well as "explanatory trials" for the rehabilitation effects of game intervention.

### Non-meta-analysis of other recreation activities

In all other interventions, there was at least one effect on psychological status, balance or motor function, and adherence as the primary or secondary outcomes. However, it was impossible to perform a meta-analysis and integrate the results since the main outcome measures and interventions were different. Therefore, we recognize the potential for recreational activities to improve rehabilitation effects, but could not provide conclusive evidence of these rehabilitation effects.

### Overall evidence and quality assessment

The CONSORT 2010 and the CONSORT for non-phar-



**Table 5 Overall evidence and future research agenda to build evidence**

Overall evidence in the present	Research agenda
There is potential for effects such as psychological status, balance or motor function, and adherence but overall evidence remains unclear	Structural description of papers based on the CONSORT 2010 and the CONSORT for nonpharmacological trials 1 Satisfactory description and methodology (Method used to generate the random allocation sequence, blinding, care provider, estimated effect size and its precision, harm, external validity, and trial registry with protocol) 2 Description of intervention dose (if pragmatic intervention) 3 Adequate sample size to perform a meta-analysis 4 Description of adverse effects ( <i>e.g.</i> , dizziness by watching screen) 5 Description of withdrawals 6 Description of cost ( <i>e.g.</i> , gaming equipment) 7 Development of the original check item in recreation activity

macological trials checklists were not originally developed for use as quality assessment instruments, but we used them as such because they are the most important tools related to the internal and external validity of trials. There were serious problems with the conduct and reporting of the target studies. In particular, our review detected omissions in the following descriptions: methods used to generate the random allocation sequence, blinding, care provider, estimated effect size and its precision, harm, external validity, and trial registry with protocol. Descriptions of these items were lacking (very poor; < 50%) in many studies.

In the Cochrane Review, the eligibility criteria for a meta-analysis are strict, and for each article, heterogeneity and low quality of reporting must first be excluded. Because there was insufficient evidence in the studies of recreational intervention, due to poor methodological and reporting quality as well as heterogeneity, we are unable to offer any conclusions about the effects of rehabilitation by recreational intervention based on RCTs. Both the CONSORT 2010 and the CONSORT for non-pharmacological trials checklists are relatively new, but it was shown that the study protocol description and implementation for recreational studies could be subjected to these checklists.

### **Overall evidence and future research agenda to build evidence**

The results of this study suggest that few RCTs have been conducted in this area, and that the RCTs conducted have been of relatively low quality. Table 5 shows the future research agenda for studies of the rehabilitation effect by recreational activity. There is potential for effects on psychological status, balance or motor function, and adherence, but the overall evidence remains unclear. Therefore, researchers should use the appropriate checklists for research design and intervention method, as this would lead to improvement in the quality of the study, and would contribute to the accumulation of evidence. Researchers should also present not only the efficacy data, but also description of any adverse events or harmful phenomena and withdrawals. Many studies in this review did not describe these factors.

A recent study<sup>[43]</sup> suggested that public health is moving toward the goal of implementing evidence based intervention. However, the feasibility of possible interventions and whether comprehensive and multilevel evaluations are needed to justify them must be determined. It is at least necessary to show the cost of such interventions. We must choose to introduce an interventional method based on its cost-benefit, cost-effectiveness, and cost-utility. In addition, recreational activities as intervention are unique and completely different than pharmacological or traditional rehabilitation methods. Therefore it may be necessary to add some original items such as herbal intervention<sup>[44]</sup>, aquatic exercise<sup>[45]</sup>, and balneotherapy<sup>[46]</sup> to the CONSORT checklist as alternative or complementary medicines.

### **Strength and limitations**

This review had several strengths: (1) the methods and implementation registered high on the PROSPERO database; (2) it was a comprehensive search strategy across multiple databases with no data restrictions; (3) there were high agreement levels for quality assessment of articles; and (4) it involved detailed data extraction to allow for collecting all of an article's content into a recommended structured abstract. The conduct and reporting of this review also aligned with the PRISMA statement<sup>[47]</sup> for transparent reporting of SRs and meta-analyses.

This review also had several limitations that should be acknowledged. Firstly, although some selection criteria were common across studies, as described above, bias remained due to differences in eligibility for participation in each study. Secondly, publication bias was a limitation. Although there was no linguistic restriction in the eligibility criteria, we searched studies with only English and Japanese key words. In addition, this review reported on a relatively small and heterogeneous sample of studies. Moreover we could not follow standard procedures for estimating the effects of moderating variables. Finally, although we used an original definition of recreation activity because of the lack of a clear worldwide definition, our definition was not universal.

In conclusion, this comprehensive SR demonstrates that recreational activities may have the potential for im-

proving rehabilitation in a wide variety of areas, and for a variety of patients and elderly people. To most effectively assess the potential benefits of recreational activities for rehabilitation, it will be important for further research to utilize (1) RCT methodology (person unit or cluster unit) when appropriate; (2) an intervention dose; (3) a description of adverse effects and withdrawals; and (4) the cost of recreation activities.

## ACKNOWLEDGMENTS

We would like to express our appreciation to Ms. Rie Higashino and Ms. Yoko Ikezaki (paperwork), Ms. Satoko Sayama and Ms. Mari Makishi (all searches of studies) for their assistance in this study.

## COMMENTS

### Background

Recreational activity is anything that is stimulating and rejuvenating for an individual. "Enjoyment" is an important factor that may aid adherence to training for rehabilitation.

### Research frontiers

Although many studies have reported the rehabilitation effects of recreational activities, there is no systematic review (SR) of the evidence based on randomized controlled trials.

### Innovations and breakthroughs

This is the first SR of the effectiveness of rehabilitation based on recreational activities. There were serious problems with the conduct and reporting of the target studies. In particular, this review detected omissions in the following descriptions: methods used to generate the random allocation sequence, blinding, care provider, estimated effect size and its precision, harm, external validity, and trial registry with protocol. Descriptions of these items were lacking (very poor; < 50%) in many studies.

### Applications

There is a potential for recreational activities to improve rehabilitation-related outcomes, particularly in psychological status (depression, mood, emotion, and power), balance or motor function, and adherence (feasibility and attendance).

### Terminology

For rehabilitation, the World Health Organization explains that rehabilitation of people with disabilities is a process aimed at enabling them to reach and maintain their optimal physical, sensory, intellectual, psychological and social functional levels. The definition of the recreational activity is complex but, in this study, it distinguishes the specific exercise item. Specifically, any kind of recreation activity (not only dynamic activities but also musical appreciation or play, painting, hand-craft, etc.) was permitted and defined as an intervention.

### Peer review

The authors have done an excellent job in presenting results, with a format different than that normally employed in works of meta-analysis. This did not include the usual estimates of effect size based on meta-analytical indicators but is likely that this did not lead to major complications, given the number of studies analyzed. It is a good descriptive work, very systematic and ordered.

## REFERENCES

- 1 **Pan W.** Examples of Recreational Activities - Fun Things to Do. Available from: URL: <http://ezinearticles.com/?Examples-of-Recreational-Activities---Fun-Things-to-Do&id=1566968>. Accessed July 29, 2012
- 2 **Veal AJ.** Research methods for leisure and tourism: a practical guide. London: Pearson Education, 2006
- 3 **Kamioka H,** Tsutani K, Takahashi M, Honda T, Moriyama S, Mutoh Y, Yamada Y, Makishi M, Shimojima H. A systematic review of randomized controlled trials concerning leisure activity and recreation. *J Leisure Recreation Studies* 2008; **60**: 29-37
- 4 **Siedliski SL,** Good M. Effect of music on power, pain, depression and disability. *J Adv Nurs* 2006; **54**: 553-562 [PMID: 16722953 DOI: 10.1111/j.1365-2648.2006.03860.x]
- 5 **Fitzsimmons S.** Easy rider wheelchair biking. A nursing-recreation therapy clinical trial for the treatment of depression. *J Gerontol Nurs* 2001; **27**: 14-23 [PMID: 11915269]
- 6 **Parker CJ,** Gladman JR, Drummond AE, Dewey ME, Lincoln NB, Barer D, Logan PA, Radford KA. A multicentre randomized controlled trial of leisure therapy and conventional occupational therapy after stroke. TOTAL Study Group. Trial of Occupational Therapy and Leisure. *Clin Rehabil* 2001; **15**: 42-52 [PMID: 11237160 DOI: 10.1191/026921501666968247]
- 7 **Donnan GA,** Fisher M, Macleod M, Davis SM. Stroke. *Lancet* 2008; **371**: 1612-1623 [PMID: 18468545 DOI: 10.1016/S0140-6736(08)60694-7]
- 8 **Mayo NE,** Wood-Dauphinee S, Ahmed S, Gordon C, Higgins J, McEwen S, Salbach N. Disablement following stroke. *Disabil Rehabil* 1999; **21**: 258-268 [PMID: 10381238]
- 9 **French B,** Thomas LH, Leathley MJ, Sutton CJ, McAdam J, Forster A, Langhorne P, Price CI, Walker A, Watkins CL. Repetitive task training for improving functional ability after stroke. *Cochrane Database Syst Rev* 2007; CD006073 [PMID: 17943883 DOI: 10.1002/14651858]
- 10 **Laver KE,** George S, Thomas S, Deutsch JE, Crotty M. Virtual reality for stroke rehabilitation. *Cochrane Database Syst Rev* 2011; CD008349 [PMID: 21901720 DOI: 10.1002/14651858.CD008349.pub2]
- 11 **Griffin M,** McCormick D, Taylor MJ, Shawis T, Impson R. Using the Nintendo Wii as an intervention in a falls prevention group. *J Am Geriatr Soc* 2012; **60**: 385-387 [PMID: 22332691 DOI: 10.1111/j.1532-5415.2011.03803.x]
- 12 **Padala KP,** Padala PR, Burke WJ. Wii-Fit as an adjunct for mild cognitive impairment: clinical perspectives. *J Am Geriatr Soc* 2011; **59**: 932-933 [PMID: 21568963]
- 13 **Barnes PM,** Powell-Griner E, McFann K, Nahin RL. Complementary and alternative medicine use among adults: United States, 2002. *Adv Data* 2004; 1-19 [PMID: 15188733]
- 14 **Pittler MH,** Karagülle MZ, Karagülle M, Ernst E. Spa therapy and balneotherapy for treating low back pain: meta-analysis of randomized trials. *Rheumatology (Oxford)* 2006; **45**: 880-884 [PMID: 16449365 DOI: 10.1093/rheumatology/kel018]
- 15 **Frumkin H.** Beyond toxicity: human health and the natural environment. *Am J Prev Med* 2001; **20**: 234-240 [PMID: 11275453]
- 16 **Ulrich RS.** Natural versus urban scenes: Some psychophysiological effects. *Environ Behav* 1981; **13**: 523-556 [DOI: 10.1177/0013916581135001]
- 17 **Morita E,** Fukuda S, Nagano J, Hamajima N, Yamamoto H, Iwai Y, Nakashima T, Ohira H, Shirakawa T. Psychological effects of forest environments on healthy adults: Shinrin-yoku (forest-air bathing, walking) as a possible method of stress reduction. *Public Health* 2007; **121**: 54-63 [PMID: 17055544 DOI: 10.1016/j.puhe.2006.05.024]
- 18 **Li Q.** Effect of forest bathing trips on human immune function. *Environ Health Prev Med* 2010; **15**: 9-17 [PMID: 19568839 DOI: 10.1007/s12199-008-0068-3]
- 19 World Health Organization. Available from: URL: <http://www.who.int/topics/rehabilitation/en/>. Accessed September 25, 2012
- 20 **Moher D,** Hopewell S, Schulz KF, Montori V, Gøtzsche PC, Devereaux PJ, Elbourne D, Egger M, Altman DG. CONSORT 2010 explanation and elaboration: updated guidelines for reporting parallel group randomised trials. *BMJ* 2010; **340**: c869 [PMID: 20332511]
- 21 **Boutron I,** Moher D, Altman DG, Schulz KF, Ravaud P. Methods and processes of the CONSORT Group: example of an extension for trials assessing nonpharmacologic treatments. *Ann Intern Med* 2008; **148**: W60-W66 [PMID: 18283201]
- 22 **Hopewell S,** Clarke M, Moher D, Wager E, Middleton P, Alt-

- man DG, Schulz KF. CONSORT for reporting randomised trials in journal and conference abstracts. *Lancet* 2008; **371**: 281-283 [PMID: 18221781 DOI: 10.1016/S0140-6736(07)61835-2]
- 23 **Hopewell S**, Ravaud P, Baron G, Boutron I. Effect of editors' implementation of CONSORT guidelines on the reporting of abstracts in high impact medical journals: interrupted time series analysis. *BMJ* 2012; **344**: e4178 [PMID: 22730543]
- 24 **Atkins D**, Best D, Briss PA, Eccles M, Falck-Ytter Y, Flottorp S, Guyatt GH, Harbour RT, Haugh MC, Henry D, Hill S, Jaeschke R, Leng G, Liberati A, Magrini N, Mason J, Middleton P, Mrukowicz J, O'Connell D, Oxman AD, Phillips B, Schünemann HJ, Edejer T, Varonen H, Vist GE, Williams JW, Zaza S. Grading quality of evidence and strength of recommendations. *BMJ* 2004; **328**: 1490 [PMID: 15205295 DOI: 10.1136/bmj.328.7454.1490]
- 25 International Prospective Register of Systematic Reviews. Available from: URL: <http://www.crd.york.ac.uk/prospero/>
- 26 **Booth A**, Clarke M, Ghera D, Moher D, Petticrew M, Stewart L. An international registry of systematic-review protocols. *Lancet* 2011; **377**: 108-109 [PMID: 20630580 DOI: 10.1016/S0140-6736(10)60903-8]
- 27 **Szturm T**, Betker AL, Moussavi Z, Desai A, Goodman V. Effects of an interactive computer game exercise regimen on balance impairment in frail community-dwelling older adults: a randomized controlled trial. *Phys Ther* 2011; **91**: 1449-1462 [PMID: 21799138 DOI: doi: 10.2522/ptj.20090205]
- 28 **Gil-Gómez JA**, Lloréns R, Alcañiz M, Colomer C. Effectiveness of a Wii balance board-based system (eBaViR) for balance rehabilitation: a pilot randomized clinical trial in patients with acquired brain injury. *J Neuroeng Rehabil* 2011; **8**: 30 [PMID: 21600066 DOI: 10.1186/1743-0003-8-30]
- 29 **Sapostnik G**, Teasell R, Mamdani M, Hall J, McIlroy W, Cheung D, Thorpe KE, Cohen LG, Bayley M. Effectiveness of virtual reality using Wii gaming technology in stroke rehabilitation: a pilot randomized clinical trial and proof of principle. *Stroke* 2010; **41**: 1477-1484 [PMID: 20508185 DOI: 10.1161/STROKEAHA.110.584979]
- 30 **Bauer CL**, Victorson D, Rosenbloom S, Barocas J, Silver RK. Alleviating distress during antepartum hospitalization: a randomized controlled trial of music and recreation therapy. *J Womens Health (Larchmt)* 2010; **19**: 523-531 [PMID: 20141383 DOI: 10.1089/jwh.2008.1344]
- 31 **Adamo KB**, Rutherford JA, Goldfield GS. Effects of interactive video game cycling on overweight and obese adolescent health. *Appl Physiol Nutr Metab* 2010; **35**: 805-815 [PMID: 21164552 DOI: 10.1139/H10-078]
- 32 **Hackney ME**, Earhart GM. Effects of dance on movement control in Parkinson's disease: a comparison of Argentine tango and American ballroom. *J Rehabil Med* 2009; **41**: 475-481 [PMID: 19479161 DOI: 10.2340/16501977-0362]
- 33 **Yavuzer G**, Senel A, Atay MB, Stam HJ. "Playstation eyetoy games" improve upper extremity-related motor functioning in subacute stroke: a randomized controlled clinical trial. *Eur J Phys Rehabil Med* 2008; **44**: 237-244 [PMID: 18469735]
- 34 **Desrosiers J**, Noreau L, Rochette A, Carbonneau H, Fontaine L, Viscoglioni C, Bravo G. Effect of a home leisure education program after stroke: a randomized controlled trial. *Arch Phys Med Rehabil* 2007; **88**: 1095-1100 [PMID: 17826452 DOI: 10.1016/j.apmr.2007.06.017]
- 35 **Higgins JPT**, Green S, editors. Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. Available from: URL: <http://www.cochrane.org/training/cochrane-handbook>
- 36 **Sugiyama T**, Healy GN, Dunstan DW, Salmon J, Owen N. Joint associations of multiple leisure-time sedentary behaviours and physical activity with obesity in Australian adults. *Int J Behav Nutr Phys Act* 2008; **5**: 35 [PMID: 18590570 DOI: 10.1186/1479-5868-5-35]
- 37 **Dunstan DW**, Barr EL, Healy GN, Salmon J, Shaw JE, Balkau B, Magliano DJ, Cameron AJ, Zimmet PZ, Owen N. Television viewing time and mortality: the Australian Diabetes, Obesity and Lifestyle Study (AusDiab). *Circulation* 2010; **121**: 384-391 [PMID: 20065160 DOI: 10.1161/CIRCULATIONAHA.109.894824]
- 38 **Mark AE**, Janssen I. Relationship between screen time and metabolic syndrome in adolescents. *J Public Health (Oxf)* 2008; **30**: 153-160 [PMID: 18375469 DOI: 10.1093/pubmed/fdn022]
- 39 **Healy GN**, Dunstan DW, Salmon J, Shaw JE, Zimmet PZ, Owen N. Television time and continuous metabolic risk in physically active adults. *Med Sci Sports Exerc* 2008; **40**: 639-645 [PMID: 18317383 DOI: 10.1249/MSS.0b013e3181607421]
- 40 **Lyons EJ**, Tate DF, Ward DS, Bowling JM, Ribisl KM, Kalyararaman S. Energy expenditure and enjoyment during video game play: differences by game type. *Med Sci Sports Exerc* 2011; **43**: 1987-1993 [PMID: 21364477]
- 41 **Primack BA**, Carroll MV, McNamara M, Klem ML, King B, Rich M, Chan CW, Nayak S. Role of video games in improving health-related outcomes: a systematic review. *Am J Prev Med* 2012; **42**: 630-638 [PMID: 22608382 DOI: 10.1016/j.amepre.2012.02.023]
- 42 **Schwartz D**, Lellouch J. Explanatory and pragmatic attitudes in therapeutical trials. *J Clin Epidemiol* 2009; **62**: 499-505 [PMID: 19348976 DOI: 10.1016/j.jclinepi.2009.01.012]
- 43 **Bowen DJ**, Kreuter M, Spring B, Cofta-Woerpel L, Linnan L, Weiner D, Bakken S, Kaplan CP, Squiers L, Fabrizio C, Fernandez M. How we design feasibility studies. *Am J Prev Med* 2009; **36**: 452-457 [PMID: 19362699 DOI: 10.1016/j.amepre.2009.02.002]
- 44 **Gagnier JJ**, Boon H, Rochon P, Moher D, Barnes J, Bombardier C. Reporting randomized, controlled trials of herbal interventions: an elaborated CONSORT statement. *Ann Intern Med* 2006; **144**: 364-367 [PMID: 16520478 DOI: 10.7326/0003-4819-144-5-200603070-00013]
- 45 **Kamiooka H**, Tsutani K, Okuizumi H, Mutoh Y, Ohta M, Handa S, Okada S, Kitayuguchi J, Kamada M, Shiozawa N, Honda T. Effectiveness of aquatic exercise and balneotherapy: a summary of systematic reviews based on randomized controlled trials of water immersion therapies. *J Epidemiol* 2010; **20**: 2-12 [PMID: 19881230 DOI: 10.2188/jea.JE20090030]
- 46 **Kamiooka H**, Kuroyanagi R, Komatsu T, Kaminai T, Takahashi M, Mutoh Y, Tsutani K. A systematic review of randomized controlled trials on the therapeutic and health-promoting effects of spas. *J Jpn Assoc Balneol Climatol Phys Med* 2006; **69**: 155-166
- 47 **Liberati A**, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche PC, Ioannidis JP, Clarke M, Devereaux PJ, Kleijnen J, Moher D. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *Ann Intern Med* 2009; **151**: W65-W94 [PMID: 19622512]
- 48 **Green J**, Forster A, Bogle S, Young J. Physiotherapy for patients with mobility problems more than 1 year after stroke: a randomised controlled trial. *Lancet* 2002; **359**: 199-203 [PMID: 11812553 DOI: 10.1016/S0140-6736(02)07443-3]
- 49 **Kobayashi R**, Ishigami K, Tukano M, Anezaki S, Nakadaira H. Effects of a fall prevention program on physical abilities of elderly people living in a rural region: an intervention trial. *Niigata Iryo Fukushi Gakkaishi* 2006; **5**: 18-26
- 50 **Das DA**, Grimmer KA, Sparron AL, McRae SE, Thomas BH. The efficacy of playing a virtual reality game in modulating pain for children with acute burn injuries: a randomized controlled trial [ISRCTN87413556]. *BMC Pediatr* 2005; **5**: 1 [PMID: 15745448]
- 51 **Hurwitz EL**, Morgenstern H, Chiao C. Effects of recreational physical activity and back exercises on low back pain and psychological distress: findings from the UCLA Low Back Pain Study. *Am J Public Health* 2005; **95**: 1817-1824 [PMID: 16186460]

- 52 **Matsuo A**, Morioka S, Hiyamizu M, Maeoka H, Shomoto K. The influence of the exercise using a video game on the physical function and brain activities. *Physical Fitness Research Institute Research Aid Report* 2010; **25**: 82-90
- 53 **Saposnik G**, Mamdani M, Bayley M, Thorpe KE, Hall J, Cohen LG, Teasell R. Effectiveness of Virtual Reality Exercises in STroke Rehabilitation (EVREST): rationale, design, and protocol of a pilot randomized clinical trial assessing the Wii gaming system. *Int J Stroke* 2010; **5**: 47-51 [PMID: 20088994 DOI: 10.1111/j.1747-4949.2009.00404.x]
- 54 **Mitsumura M**, Someya F. A comparative study of ADL at home and at care facilities: differences between system of elderly daycare administration. *J Tsuruma Health Sci Soc Kanazawa Univ* 2011; **35**: 11-18
- 55 **Fraga MJ**, Cader SA, Ferreira MA, Giani TS, Dantas EH. Aerobic resistance, functional autonomy and quality of life (QoL) of elderly women impacted by a recreation and walking program. *Arch Gerontol Geriatr* 2011; **52**: e40-e43 [PMID: 20554333 DOI: 10.1016/j.archger.2010.04.021]
- 56 **Watanabe Y**. Effects of cognitive rehabilitation with computer training on neurophysiological function in schizophrenia. *Seishin Igaku* 2011; **53**: 865-874
- 57 **Hsu JK**, Thibodeau R, Wong SJ, Zukiwsky D, Cecile S, Walton DM. A "Wii" bit of fun: the effects of adding Nintendo Wii(®) Bowling to a standard exercise regimen for residents of long-term care with upper extremity dysfunction. *Physiother Theory Pract* 2011; **27**: 185-193 [PMID: 20698793 DOI: 10.3109/09593985]
- 58 **Kwok BC**, Mamun K, Chandran M, Wong CH. Evaluation of the Frails' Fall Efficacy by Comparing Treatments (EFFECT) on reducing fall and fear of fall in moderately frail older adults: study protocol for a randomised control trial. *Trials* 2011; **12**: 155 [PMID: 21682909 DOI: 10.1186/1745-6215-12-155]

**P-Reviewer** Guardia-Olmos J **S-Editor** Zhai HH

**L-Editor** Hughes D **E-Editor** Zheng XM

