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Exergaming, a new frontier for PRM?

Prof. Vincenzo Perciavalle

Exergaming (word formed by "*exercise*" and "*gaming*") is a term used for video games that are also a form of exercise.

Exergaming relays on technology that tracks body movement or reaction and is seen as evolving from technology aimed at making exercise more fun and useful.



EXERGAMING HISTORY

The **Exergaming**'s roots can be found in game peripherals released in the eighties, including the **Joyboard** by Atari (1982), the **Power Pad** by Nintendo (1986), and the **Foot Craz** by Atari (1987), although all three had limited success.



EXERGAMING HISTORY

Dance Dance Revolution by Konami (1998) was one of the first major Exergaming tool; when it was ported from the arcade to PlayStation, it sold over three million copies.

The **EyeToy camera** by Logitech (2003) has sold over ten million units, while **Wii Fit** by Nintendo (2007) has sold more than 21 million copies. Of **Kinect** by Microsoft (2012), developed for the Xbox 360 and Xbox One platforms, as many as 250 million copies have been sold.



Exergaming engages players physically, requiring movements such as jumping, push-ups, and running in place. **These movements can be tracked through cameras or wearable devices**, but there are also games that promote physical activity without the use of advanced technologies.

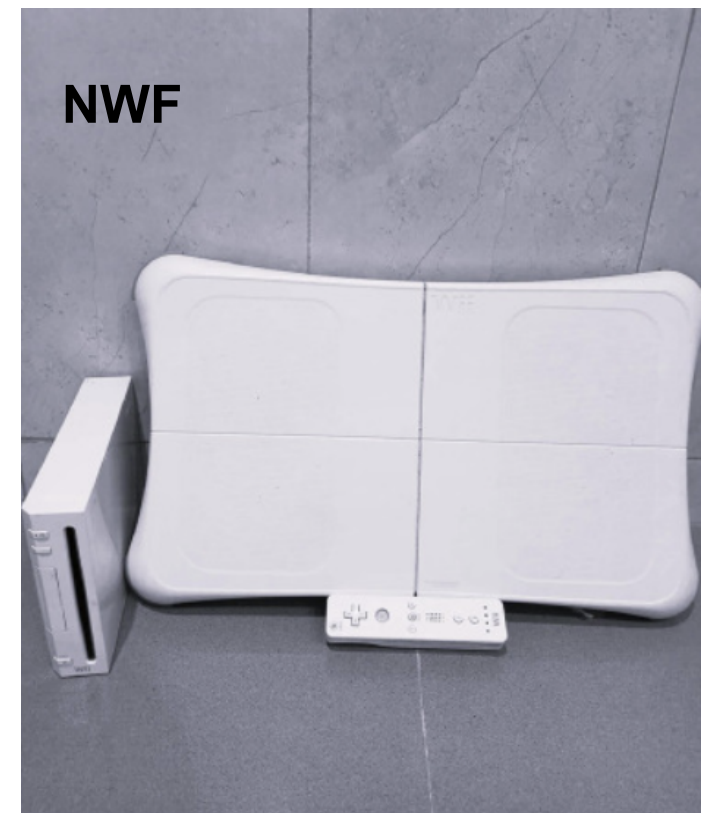
For example, **Pokémon Go** by Niantic (2016) encouraged players to explore the real world to catch virtual Pokémon with their smartphones.



Two commercial devices widely used in the rehabilitation are **Nintendo Ring Fit Adventure©** (NRFA) and **Nintendo Wii Fit©** (NWF).

NRFA integrates Joy-Con© controllers with gyroscopic and accelerometric sensors for the leg and the Ring-Con©, a resistance-based Pilates ring that controls the applied pressure and force during physical exercise.

In contrast, **NWF** incorporates a Wiimote© game controller and the Wii Balance Board©, which functions as a force plate to monitor the center of gravity throughout physical activity.



From the beginning, Exergaming has been promoted as a way to improve users' health through exercise.

In 2007, during the 5th International Conference on Computer Graphic and Interactive Techniques in Perth (Australia), it was approved the request of an improvement of the methods used in Exergaming to make it usable also in areas that are not exclusively recreational.

GRAPHITE '07: Proceedings of the 5th international conference on Computer graphics and interactive techniques in Australia and Southeast Asia



2007 Proceeding

ARTICLE

Considerations for the design of exergames

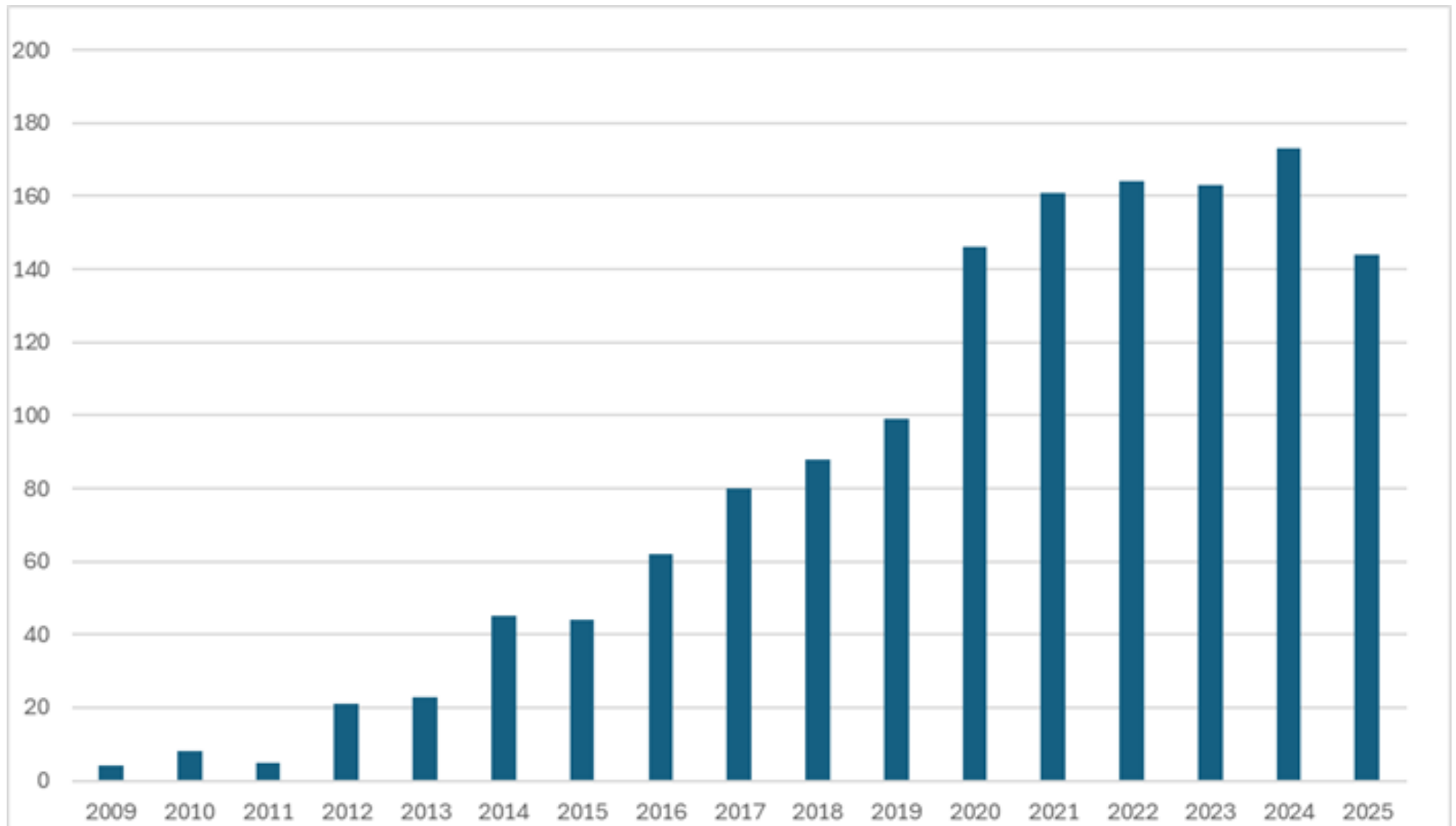
Authors:  [Jeff Sinclair](#),  [Philip Hingston](#),  [Martin Masek](#) | [Authors Info & Claims](#)

Exergaming and Rehabilitation

The State of the Art



Until 15 October 2025, on PubMed there are 988 papers about “Exergaming and Rehabilitation”, of which 252 are reviews and 74 are meta-analyses.



The first paper on PubMed

Published in final edited form as:

Int J Exerc Sci. 2009 ; 2(3): 165–174.

Active Video/Arcade Games (Exergaming) and Energy Expenditure in College Students

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This study has shown that interactive video game/exergame type exercise is effective in requiring sufficient energy expenditure to meet ACSM recommendations for intensity of exercise bouts. Both males and females were in the 150-400 kcals range recommended for healthy adults (2). Despite the BMI designated status of overweight in this sample, the participants did work hard when they were given access to the three exergames. Given the popularity of video gaming in general in the US population today, and the issues associated with overweight and obesity and inactivity, the importance of the energy expenditure associated with the use of these active video games cannot be ignored. The use of interactive games to improve energy expenditure in college age individuals has many implications. Whether college age students are more likely to be active and remain so if interactive games are available to them is a direction for future research.

METHODOLOGICAL PROBLEM

The analysis of papers in PubMed for “*Exergaming and Rehabilitation*” highlight an extreme variety of tools used. About 65% of the papers present research that used commercial devices, while the remaining 35% used home-made tools or modifications of commercial products.

This makes it virtually impossible to compare the results of different researches.

Main reviews and meta-analyses concerning “Exergaming and Rehabilitation” on PubMed in 2024 and 2025





The efficacy of physical activity or exercise among individuals with
cerebral palsy: An umbrella review of systematic reviews

Majed M. Alhumaid^{a,b,*} , Faris Yahya I. Asiri^c , Mohamed A. Said^a , Justin A. Haegele^{d,e} 

Results

Exergaming significantly improved fine motor dexterity (SMD = 3.12) but not gross manual dexterity. Progressive resistance and general physical activity increased muscle strength (SMD = 0.59), while aerobic exercise showed mixed results. Task-oriented training led to large improvements in gross motor function (SMD = 6.04–11.05) and functional independence (SMD = 6.44). VR-based and aerobic interventions had modest or nonsignificant effects on mobility, balance, and walking. Adverse events were infrequently reported and generally mild. Task-oriented and VR-assisted training showed the most consistent benefits, though heterogeneity and incomplete reporting limit conclusions.

Conclusion

Physical exercises, particularly task-oriented and VR-assisted training, improve motor and limb functions in CP. Future research with longer follow-up, larger samples, and better safety reporting is needed to confirm clinical impact.

Technology-Based Physical Rehabilitation for Balance in Patients With Multiple Sclerosis: A Systematic Review and Meta-analysis

Cristina Lirio-Romero, PhD ^{a,b} · Sara Reina-Gutiérrez, PhD ^{c,d,e,f} ✉ · Purificación López-Muñoz, PhD ^{a,b} · Elisabeth Bravo-Esteban, PhD ^{a,g} · Ana Torres-Costoso, PhD ^{a,c} · María José Guzmán-Pavón, PhD ^{a,h}

REVIEW ARTICLE (META-ANALYSIS) · Volume 106, Issue 9, P1437-1446, September 2025



Data Synthesis

A total of 24 studies involving 985 participants were included. The meta-analysis revealed that compared with conventional physical therapy, technology-based physical rehabilitation significantly improved balance outcomes by 0.16 ... with moderate heterogeneity ($I^2=39.1\%$). Subgroup analyses were performed by intervention modality (robotic assistive gait training, exergaming, and telerehabilitation), and only exergaming interventions had a medium effect on balance in this population of 0.29 ...

Conclusions

Among technology-based physical rehabilitation approaches, **exergaming interventions have shown promising effectiveness in improving balance in people with multiple sclerosis**. Despite the moderate heterogeneity, the findings support the use of exergaming as a viable option. Further high-quality randomized controlled trials are needed to confirm these results.



Is exergaming really effective in improving participation in people with multiple sclerosis? A systematic review

Ugur Ovacik^{a,b} ✉ · Pelin Vural^{a,c} ✉ · Irem Nur Sener^{a,b} ✉ · Kubra Nur Menengic^{a,d} ✉ · Gokcen Erol^{a,e} ✉ · Yonca Zenginler Yazgan^f ✉

Results. Seventeen randomized controlled trials with a total of 942 participants were included. The outcome measures used in the studies were not specific to the participation component of the ICF. It was observed that participation was most frequently evaluated through quality-of-life questionnaires, as well as mood, motivation/satisfaction, technology acceptance, or adherence assessments were used. Seven studies assessing quality of life reported statistically significant differences after exergaming.

Conclusion. Exergame interventions have been shown to improve participation-related factors including quality of life, mood, and treatment adherence in PwMS. However, future studies should prioritize increasing participation and assess improvements using targeted outcome measures.



Review

Neurobiological effects of exergame interventions in older adults with or without a neurocognitive disorder: A systematic review

Elpidio Attoah-Mensah^{a,*}, Jean-François Bel^b, Karim El Ayoubi^a, Arnaud Boujut^{a,c},
Stephen Ramanoël^d, Anaïck Perrochon^a

Findings revealed that **EG interventions induced structural and functional brain changes, accompanied by improved cognitive and motor performance, as well as neuroplastic adaptations, such as elevated BDNF levels and enhanced neurovascular coupling**, in healthy older adults. Similar findings were reported in older adults with neurocognitive disorders, though only in two studies, one showing increased frontal and temporal activity at rest, and the other reporting an increase in brain volume. Notably, methodological limitations in some studies, particularly those involving neuroimaging, underline the preliminary nature of the findings. Furthermore, the small number of studies included, especially those focusing on older adults with neurocognitive disorders, who often present with diverse clinical profiles, emphasizes the need for further research to validate these encouraging but currently low-evidence findings.

Esports Interventions for **Dementia** and Mild Cognitive Impairment: A Rapid Scoping Review

Kohei Okuyama^a Yuichi Isaji^a Katsuyoshi Tanaka^a Kosuke Suzuki^b
Yasuyuki Kurasawa^c Takao Kaneko^d Takashi Kitagawa^e

Results: Six studies, including three randomized controlled trials (intervention group: n = 84), were included. All interventions utilized exergames delivered via commercial gaming consoles (Nintendo Wii or Switch, Microsoft Xbox Kinect). Samples were small (n = 3–23). ... **Across the limited quantitative data, no trial demonstrated significant gains in global cognition, and findings for physical performance were inconsistent.** No serious adverse events were reported; however, safety monitoring was inconsistently described.

Conclusion: Current evidence is insufficient to support esports as a therapeutic approach for dementia or MCI. Although participants consistently enjoyed the sessions, these subjective benefits alone do not establish clinical efficacy. Larger, well-controlled trials with validated cognitive and physical outcomes are needed before esports can be considered for routine care.

Digital assistive technologies for community-dwelling people with dementia: A systematic review of systematic reviews by the INTERDEM AI & assistive technology taskforce

[David Neal](#)^{1,✉}, [Michael P Craven](#)^{2,3}, [Jane Cross](#)⁴, [Shirley Evans](#)⁵, [Christopher Fox](#)^{6,7,8}, [Laila Oksnebjerg](#)⁹, [Isabel Alexandre](#)^{10,11}, [Aidin Aryankhesal](#)¹², [Arlene Astell](#)¹³, [Ahmet Begde](#)¹⁴, [Annabel Ditton](#)¹⁵, [Thomas Engelsma](#)^{16,17,18}, [Rikke Gregersen](#)¹⁹, [Pascale Heins](#)²⁰, [Eef Hogervorst](#)²¹, [Aysegul Humeyra Kafadar](#)²², [Jackie Poos](#)²³, [Louise Robinson](#)²⁴, [Duygu Sezgin](#)²⁵, [Hanneke JA Smaling](#)^{26,27}, [Dorota Szczesniak](#)²⁸, [Josephine Rose Orejana](#)²⁹, [Marjolein de Vugt](#)³⁰, [Franka JM Meiland](#)^{31,32}

Results

A total of 112 reviews were included, covering various applications such as smart homes, care robots, exergaming and everyday technologies. ... The challenges included personalization of applications (development); **limited use of standardized methods (usability); insufficient quantity and quality of randomized controlled trials (cost-effectiveness); overly high expectations of assistive technologies (implementation); and the need for more equitable access to technologies (ethics).**

Conclusion

Much research has been conducted since the 2017 state of the art position paper. While some challenges identified at that time remain relevant, others have been addressed, and new challenges have emerged. **Future research should prioritize emerging artificial intelligence applications; ...**



Ageing Research Reviews

Volume 109, July 2025, 102785

Review article

Effectiveness of virtual reality interventions on quality of life, cognitive function and physical function in older people with **Alzheimer's disease**: A systematic review





Edgar Vásquez-Carrasco ^{a b c}✉, Jordan Hernandez-Martinez ^{d e}✉,
María Sepúlveda-Ramírez ^a✉, Florencia Carmine ^f✉, Cristian Sandoval ^{g h i}✉,
Hadi Nobari ^j✉, Pablo Valdés-Badilla ^{k l}✉

This review included 517 older people with AD (mean age 76.5 years; 57.5 % female). Due to the heterogeneity of the assessment tools, a meta-analysis could not be performed. **Although no consistent significant differences were found between the experimental and control groups, several individual studies reported improvements.** Specifically, two studies showed improvements in quality of life and cognitive function, while three reported enhancements in physical function. The interventions included immersive cognitive training, exergaming, Kinect-based systems, and Physiomat platforms, with durations ranging from 4 to 16 weeks and frequencies of 2–5 sessions per week. **Analysis of the reviewed studies suggests that VR interventions may benefit cognitive function, physical function, and, to a lesser extent, quality of life in older people with AD.**



2025 Mar 6;59(12):e108589.

Effectiveness of exercise for improving cognition, memory and executive function: a systematic umbrella review and meta-meta-analysis

Ben Singh ¹, Hunter Bennett ¹, Aaron Miatke,¹ Dorothea Dumuid ¹, Rachel Curtis,¹ Ty Ferguson,¹ Jacinta Brinsley,¹ Kimberley Szeto,¹ Jasmine M Petersen,¹ Claire Gough,² Emily Eglitis,¹ Catherine EM Simpson,¹ Christina L Ekegren ³, Ashleigh E Smith,¹ Kirk I Erickson,^{4,5} Carol Maher¹

Results. 133 systematic reviews (2,724 RCTs and 258 279 participants) were included. **Exercise significantly improved general cognition (SMD=0.42), memory (SMD=0.26) and executive function (SMD=0.24). Memory and executive function improvements from exercise were greater for children and adolescents than for adults and older adults. --.** Effects were generally larger for low- and moderate-intensity interventions. Shorter interventions (1–3 months) and exergames (video games that require physical movement) had the largest effects on general cognition and memory. Findings remained statistically significant after excluding reviews rated as low and critically low quality.

Conclusions. These findings provide strong evidence that exercise, even light intensity, benefits general cognition, memory and executive function across all populations, reinforcing exercise as an essential, inclusive recommendation for optimising cognitive health.

Main results

We included 11 studies ... Seven studies involved 308 participants with mild cognitive impairment, and five studies included 228 individuals with dementia. One of the studies presented data for both MCI and dementia separately. Most comparisons exhibited a high risk or some concerns of bias. **We have only low or very low certainty about all the results presented below.**

Authors' conclusions

Overall, the evidence is very uncertain about the effects of exergaming on global physical and cognitive functioning, and ADL. There may be an improvement in global cognitive functioning at the end of treatment for both people with dementia and people with MCI, but the evidence is very uncertain.

Effectiveness of virtual reality rehabilitation with exergames on functional rehabilitation in Parkinson's disease: a systematic review of chronic randomized controlled trials

João Lucas Lima, Pedro Augusto Inacio, Alberto Sá Filho , Flávia Paes, Rafael Ferreira-Garcia, Lucio Lage, ...show all

Received 06 Jun 2025, Accepted 05 Sep 2025, Published online: 17 Sep 2025

Results

Eighteen RCTs ($n = 699$; 341 exergaming, 358 control) met inclusion criteria; Typical programs spanned 4–12 weeks with 15–60-min sessions, most commonly 6 weeks, delivered predominantly under supervision. **The outcomes that improved most consistently were mobility/locomotion (TUG, 6MWT/10MWT, gait speed) and balance.** When exergames were compared with active, non-exergaming therapy, effects were generally comparable. Adverse events were rare, and adherence was documented as high where reported; most trials were facility-based with professional supervision. Only three trials included follow-up (≈ 1 –2 months), suggesting short-term retention (~ 30 days), whereas one 60-day assessment showed return to baseline.

Conclusion

Exergame is a safe, feasible, and effective adjunct for short-term improvement of mobility and balance in PD. However, scarce follow-up limit inferences on long-term maintenance.

Impact of Virtual Reality Alone and in Combination with Conventional Therapy on Balance in Parkinson's Disease: A Systematic Review with a Meta-Analysis of Randomized Controlled Trials

[Giorgio De Natale](#)^{1,2}, [Erda Qorri](#)³, [Jasemin Todri](#)^{2,*}, [Orges Lena](#)²

Results: From an initial screening of 100 studies, 58 underwent title and abstract screening. ...The pooled analysis demonstrated a significant improvement in the balance scores for the experimental groups compared to the controls, with a standardized mean difference (SMD) of 0.58 [95% CI: 0.07, 1.09, $p = 0.03$]. However, the heterogeneity was substantial ($I^2 = 77\%$). The analysis of the six-minute walking test (6 MWT), as another outcome of four articles, revealed a mean difference of 32.99 m [95% CI: -8.02, 74.00], but the effect was not statistically significant ($p = 0.11$). ...

Conclusions: VR-based interventions offer promise for improving balance in Parkinson's disease, enhancing rehabilitation engagement. Their integration into clinical practice could complement conventional therapy. However, further research is needed to optimize protocols, standardize parameters, and maximize their impact on mobility, independence, and quality of life.

Effectiveness, Feasibility, Acceptability, and Safety of Digital Interventions in **Post-Stroke Rehabilitation**: A Systematic Review and Meta-analysis of Randomized Controlled Trials

Shuangyue Liu, MD ^a · Min Li, MD ^b · Jilin Ding, MD ^a · Qipei Ji, MD ^c · Yanning Niu, MD ^d · Xiao Yang, MD ^e · Shuangchun Ai, PhD ^{a,c} · Siyuan Li, PhD ^f · Show less

Data Synthesis

Sixty-three studies (3297 participants) **demonstrated significant improvements in overall cognition ...($P<.001$), and specific domains (global cognition, language, visuospatial; ...** Exergaming and computer cognitive training significantly improved overall cognition and memory compared to other digital interventions. Medical sites-based interventions significantly enhanced overall/global cognition versus home-based protocols. Shorter sessions (≤ 30 min) demonstrated superior efficacy in overall cognition to longer durations. Robot-assisted and computer cognitive training maximized ADL gains. ...

Conclusions

Digital interventions significantly enhance cognition when delivered via clinic-based exergaming or computer cognitive training (≤ 30 min/session), while maximizing ADL improvements through robot-assisted or computer cognitive training in stroke patients. Robust feasibility, acceptability, and favorable safety supports clinical integration.

EVIDENCE SYNTHESIS: Fifty-five papers have been included into this review, namely, 38 original studies and 17 reviews. The total number of children and adolescents is 573, with 58% of them being affected by cerebral palsy. **Despite a wide variability in the adopted protocols, devices, assessment tools, and a more frequent focus on motor aspects than on cognitive ones, the results of the majority of the analyzed studies support the safety (i.e., absence of severe adverse effects) and efficacy of the videogame-based therapy.**

CONCLUSIONS: Videogames, when administered by means of commercial consoles or ad-hoc digital systems, **seem to be a valid support for physical therapy.** Further researchers are needed to deeply investigate the role of this approach in cognitive therapy and cognitive outcomes.

Virtual Reality for Patients With Chronic Musculoskeletal Pain and Disability: An Umbrella Review of Systematic Reviews

Fahad Salman Alotibi^{1,2}  | Walid Mohammed² | Paul Hendrick² | Fiona Moffatt²

Results

Seven SRs were included. The overall confidence in the SRs ranged from low to critically low, whereas the certainty in the body of evidence ranged from moderate to very low. Whilst the majority of the SRs suggested that VR, standalone or adjunctive to other interventions, had a significant short-term positive effect on patient-reported outcomes for pain in patients with chronic primary MSKP, **results on patient-reported outcomes for disability and kinesiophobia were inconsistent.** Adverse events included motion sickness, nausea, and vertigo.

Conclusions

Although the current evidence indicates that VR may hold promise in patients with chronic primary MSKP, **the included studies suffered from critical weaknesses that precluded this review from drawing a conclusive conclusion.** ...







Serious Gaming for Upper Limbs Rehabilitation – Game Controllers Features: A Scoping Review

Authors: Andrés Cela, Edwin Oña, and Alberto Jardón | AUTHORS INFO & AFFILIATIONS

Publication: Games for Health Journal • <https://doi.org/10.1089/o4h.2024.0122>

We conducted a comprehensive search of Scopus and PubMed databases, encompassing articles published between February 2013 and February 2023. ... Stroke (55.4%) and cerebral palsy (6.3%) were the most frequently addressed medical conditions in the exergame-based rehabilitation. ... Randomized controlled trial (RCT) studies consistently featured a controlled number of sessions (ranging from 6 to 40) lasting an average of 20 minutes, while non-RCT studies displayed more variability. Commercial platforms were favored, accounting for 74.3% of GCs, with physical controllers (57.1%) surpassing virtual ones. Cameras were the predominant sensors (50.3%), although a wide array of sensor types including IMUs, push buttons, and force sensors were also used. Rehabilitation focuses 68% on general UL, 20.6% on hands, 4% on elbows, and 3.4% on arms and shoulders. Notably, only 26.3% of the studies considered ergonomics in the rehabilitation system. **Although exergame systems are advancing rehabilitation treatments, there remains a need for further development and research on various aspects, such as ergonomics, controller design, and sensor integration, to enhance their suitability for patient use.**

Virtual and Augmented Reality for **Chronic Musculoskeletal Rehabilitation: A Systematic Review and Exploratory Meta-Analysis**

Theodora Plavoukou ^{1,*}, Pantelis Staktopoulos ¹, Georgios Papagiannis ², Dimitrios Stasinopoulos ¹
and George Georgoudis ³

Results: Thirteen RCTs (n = 881 participants) met the inclusion criteria. Interventions spanned immersive VR, AR overlays, exergaming platforms (e.g., Kinect, Wii), and motion-tracking systems. **Pain, function, and quality of life improved in most studies.** An exploratory meta-analysis of eight RCTs (n = 610) yielded a significant pooled effect favoring VR/AR interventions for pain reduction (SMD = −1.14; 95% CI: −1.63 to −0.75; I² = 0%). **Exergaming showed consistent improvements in physical performance, while immersive VR was more effective for kinesiophobia and psychological outcomes.** AR was underrepresented, with only one study. Risk of bias was generally low; however, publication bias could not be excluded due to limited funnel plot power (n < 10).

Conclusions: VR, AR, and exergaming are effective adjuncts to conventional rehabilitation for CMDs, improving pain and function with high patient adherence. Nevertheless, gaps in long-term data, economic evaluation, and modality comparison persist. Future RCTs should address these limitations through standardized, inclusive, and longitudinal design.



Fun and games: a scoping review of enjoyment and intensity assessment in studies of game-based interventions for gait rehabilitation in neurological disorders

Laura Duval, Marie-Claire Smith, Stacey A. Reading, Winston D. Byblow & Cathy M. Stinear

Pages 1893-1911 | Received 13 Dec 2023, Accepted 03 Aug 2024, Published online: 01 Sep 2024

Results

1060 records were identified with 58 included in this review. There were 34 articles on stroke, 11 on multiple sclerosis, and 13 on Parkinson's disease. Participant enjoyment and greater training intensity were important rationales but were only evaluated in 12 and seven of the included studies, respectively.

Conclusion

Results highlight that participant enjoyment and heightened training intensity are commonly cited rationales for using exergames in gait rehabilitation, but these effects are assumed and not routinely measured or analysed. **Greater consistency is needed in the design and execution of exergaming studies for neurological disorders.**

Effects of exergames on rehabilitation outcomes in patients with osteoarthritis. A systematic review

Francisco Guede-Rojas , Bárbara Andrades-Torres, Natalia Aedo-Díaz, Constanza González-Koppen, Mirkko Muñoz-Fuentes, Diego Enríquez-Enríquez , ...show all

Pages 1100-1113 | Received 19 Dec 2023, Accepted 11 Jun 2024, Published online: 15 Jun 2024

Results

Eight studies were included (total of participants = 401). The mean PEDro score was 6.1, and seven studies had high RoB. Seven studies involved knee OA and one cervical OA. The most frequent duration for interventions was four weeks. **Exergames were more effective than controls in at least one outcome in all studies.** The outcomes for which exergames were most effective were functional disability, postural balance, muscle strength, proprioception, gait, range of motion, pain, quality of life, depression, and kinesiophobia.

Conclusion


Non-immersive exergames constitute an effective strategy for optimizing several relevant outcomes in rehabilitation. However, more RCTs with high methodological quality are required to deepen the knowledge about the multidimensional effects of exergames in OA patients.



Volume 62: 1-17 2025

Meta-analysis

Benefits of Exergaming Regarding to Conventional Physical Therapies on Balance and Fall Risk in Prefrail and Frail Older People: A Meta-Analysis of Randomized Controlled Trials

Jordan Hernandez-Martinez, MSc^{1,2}, Izham Cid-Calfucura, MSc³, Edgar Vásquez-Carrasco, PhD⁴, Braulio Henrique Magnani Branco, PhD⁵, Tomás Herrera-Valenzuela, PhD⁶, and Pablo Valdés-Badilla, PhD^{7,8} 

From 2434 records, 10 RCTs (n=400; mean and standard deviation age 75.7±5.9years) met inclusion criteria. ... No statistically significant change was found for the Berg Balance Scale (BBS; P=.05). When stratifying by dosage, EXG outperformed controls in TUG specifically for protocols with fewer than 3 sessions/week and under 50min/session (P<.01). Dosage did not significantly influence FES-I outcomes.

EXG is an alternative therapy that improves balance by reducing the fall risk, as measured by the Mini-BESTest, TUG, and FES-I, compared with conventional physical therapies (ie, physiotherapy, balance training, strength training, aerobic training, multicomponent training). Notably, protocols with <3 weekly sessions of <50min each yielded the most pronounced TUG improvements.



Geriatric Nursing

60 (2024) 593–601

Featured Article

Early rehabilitation using virtual reality-based therapy can enhance hip function and self-perception of improvement following total hip arthroplasty: A systematic review and meta-analysis

Manuel García-Sánchez, PT, MSc^a, Esteban Obrero-Gaitán, PT, PhD^{a,*}, Marina Piñar-Lara, PT, MSc^b, María Catalina Osuna-Pérez, PT, PhD^a, Ángeles Díaz-Fernández, PT, MSc^a, Irene Cortés-Pérez, PT, PhD^a

Results

This systematic review included 5 randomized controlled trials with 287 patients. Meta-analyses showed that VRBT (physical and cognitive videogames), specifically non-immersive virtual reality (NIVR), combined with physiotherapy can be effective in reducing hip disability (SMD=-0.46; P = 0.018) and increasing hip function (SMD = 0.6;P = 0.002) after total hip arthroplasty (THA). **The qualitative synthesis suggested that cognitive exercises using NIVR can improve disability, physical function, cognitive abilities and subjective perception of improvement. In contrast, passive immersive VRBT did not seem to have an impact on pain and hip function.**

Conclusion

Combining VRBT (mainly NIVR) with physiotherapy could be effective in early rehabilitation after THA.

The Role of Virtual Reality, Exergames, and Digital Technologies in Knee Osteoarthritis Rehabilitation Before or After **Total Knee Arthroplasty**: A Systematic Review of the Interventions in Elderly Patients

Ludovica Di Curzio ^{1,†}, Teresa Paolucci ², Sandra Miccinilli ^{1,3,*}, Marco Bravi ^{1,3}, Fabio Santacaterina ^{1,3},
Lucrezia Giorgi ^{3,†}, Silvia Sterzi ³, Loredana Zollo ¹, Andrea Bernetti ⁴ and Federica Bressi ^{1,3}

Results: Fourteen randomized controlled trials (RCTs) (1123 participants; mean age 68.2 years) were included. VR and telerehabilitation generally outperformed conventional rehabilitation for pain (8/13 studies, −0.9 to −2.3 VAS points) and functionality (7/13 studies, WOMAC improvement 8–15%, TUG −1.2 to −2.8 s). Compliance was higher in most technology-assisted programs (6/7 studies, 70–100% adherence). Stability outcomes were less consistent, with only 1/4 studies showing clear benefit. One study favored conventional rehabilitation for functionality. ...

Conclusions: Structured telerehabilitation, non-immersive VR, and interactive online exercise programs, especially those offering real-time feedback, **show comparable or superior benefits to conventional rehabilitation in older adults with knee OA or after TKA, particularly for pain reduction, functional gains, and adherence.** These approaches enhance accessibility and home-based care, supporting their integration into clinical practice when in-person therapy is limited.

Data Synthesis

A random effects meta-analysis and meta-regression were conducted. In total, 89 RCTs involving 122 exercise arms in 3.702 people with fibromyalgia were included. ...The lowest dropout was observed in exergaming, compared with other exercise types ($P=.014$), and in lower-intensity exercises, compared with high intensity exercise ($P=.03$). ... Continuous supervision by an exercise expert (eg, physiotherapist) resulted in the lowest dropout rates ($P<.001$).

Conclusions

Exercise dropout in RCTs is comparable with control conditions, suggesting that exercise is a feasible and accepted treatment modality; however, interventions are ideally supervised by an expert (eg, physiotherapist) to minimize the risk of dropout. Experts should consider a high BMI and the effect of the illness as risk factors for dropout.

Remote Delivery of Vestibular Rehabilitation for Vestibular Dysfunction: A Systematic Review

Perez-Heydrich, Carlos A.*; Creary-Miller, Ilahi*; Spann, Marcus†; Agrawal, Yuri*

Results

The search identified 1,358 unique articles and 14 articles matched the search criteria. Study samples size ranged from 20 to 337, with mean ages ranging from 29.3 to 77.7 years. Interventions included telephone and online communication, **exergaming devices**, web-based applications, and head-mounted devices to deliver vestibular rehabilitation. Outcomes included validated questionnaires, objective clinical tests, and physical examinations.

Conclusions

The studies reviewed in this article reported greater or equivalent outcomes when incorporating remote care options as supplements or alternatives to standard care for patients with vestibular dysfunction. Further research is required to address limitations in these studies such as heterogeneity of control groups and cost-effectiveness of these interventions.

Exergames in exercise-based cardiac rehabilitation for patients with heart failure: a systematic review

Leo, Donato Giuseppe^{a,b}; Scalona, Emilia^c; Lopomo, Nicola Francesco^d; Massussi, Mauro^{c,e}; Proietti, Riccardo^{a,b}

Results

Two studies (in four reports) were included. Included studies reported only data on functional capacity (6-min walking test) and on physical activity level (accelerometers). Due to the low number of included studies, no meta-analysis was performed, and results were discussed narratively.

Conclusion


Exergames may potentially be a promising tool for exercise-based cardiac rehabilitation in patients with heart failure; however, the low number of included studies was insufficient to draw proper conclusions. Benefits of exergames compared with traditional interventions could be the possibility of it being delivered at home, reducing some of the barriers that patients with heart failure must face. Further studies are required to assess the efficacy of exergame interventions in patients with heart failure, and to define proper guidelines to deliver exergame interventions in this population.

A New Player in the Game: Can Exergame Be of Support in the Management of Atrial Fibrillation?

Donato Giuseppe Leo^{1 2}, Riccardo Proietti^{1 2}

In this paper, we summarise the current literature on the role of traditional exercise in atrial fibrillation (AF) and how it affects the pathophysiology of this condition. We also review the current literature on **exergame and its employment in cardiac rehabilitation** and suggest its potential role in the management of AF patients. A review of the evidence suggests that traditional exercise (of light-to-moderate intensity) is beneficial in patients with AF. Additionally, exergame seems to be a promising approach for delivering exercise interventions in patients with cardiovascular diseases. **Exergame may be a promising tool to improve the quality of life and exercise capacity in patients with AF, with the additional advantage of being remotely delivered, and the potential to increase patients' engagement.** Proper guidelines are required to prescribe exergame interventions, considering the principles of traditional exercise prescription and applying them to this new e-health approach. Further studies are needed to validate the use of exergame in patients with AF.

Technological resources in the rehabilitation of **adult burn patients**: A scoping review

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Results

A total of 19 articles published between 2000 and 2024 were included. The technological resources analyzed included virtual reality (10 studies), **exergames** (6 studies), exoskeletons (4 studies), and augmented reality (1 study). These resources primarily aimed to promote motor functionality, increase muscle strength, and enhance joint range of motion.

Conclusion

The technologies applied to the rehabilitation of burn patients represent a promising advancement, with the potential to transform the paradigm of rehabilitation, making it more interactive. Future research should focus on a detailed analysis of the long-term benefits and on integrating these technologies into standard rehabilitation protocols.

The Impact of Gamified Interventions on the Management of Chronic Obstructive Pulmonary Disease: Systematic Literature Review

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Results:

A total of 29 studies met the inclusion criteria: 11 (38%) RCTs; 7 (24%) pilot studies; 5 (17%) observational studies (including qualitative studies); and 6 (21%) other studies using gamified technologies such as virtual reality, exergames, and mobile apps. ... Gamification features such as real-time feedback, adaptive challenges, and personalized goals increased patient adherence and motivation, with high engagement seen in virtual reality and exergame-based interventions, and showed notable improvements in COPD management, enhancing exercise tolerance, self-management, and symptom control. ...

Conclusions:

Gamified COPD management tools offer flexibility and empower patients to self-manage their condition, potentially reducing the need for clinic visits. **Gamified interventions show promise in COPD management, although current studies have methodological limitations.** ...



Virtual Reality-Based Therapy Can Enhance Balance and Muscular Endurance in Children and Adolescents with Down Syndrome: A Systematic Review with a Meta-Analysis

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We screened in PubMed Medline, SCOPUS, WOS, CINAHL, and PEDro studies that assessed the effectiveness of virtual reality-based therapy (VRBT), compared to conventional therapy (CT) or usual care (UC), in improving balance and muscular endurance in DS. Methodological quality was assessed using the PEDro scale. ... Nine studies providing data from 424 participants with good methodological quality (PEDro: 6.3 ± 1.2 points) were included.

Our meta-analysis showed that VRBT is more effective than controls in increasing function (SMD = 1.22; 95% CI 0.64 to 1.81; $p < 0.001$), dynamic balance (SMD = -2.2; 95% CI -3.1 to -1.25; $p < 0.001$), and muscular endurance (SMD = 1.37; 95% CI 0.58 to 2.2; $p < 0.001$). This is the first meta-analysis to exclusively focus on children and adolescents with DS, demonstrating the effectiveness of VRBT in enhancing balance and muscular endurance.

Conclusion

Exergaming seems to represent a useful tool in Rehabilitation, but to evaluate its efficiency more rigorous methodological studies are needed both in terms of the used tools and in terms of evaluation's methods.

