

# Recent Developments regarding Exergames and Individuals with Disabilities

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**Abstract:** Exergames are digital interactive games that require physical movements of upper and lower limbs by the users to achieve simulation with the game screen. Their effects regarding the maintenance of fitness levels and the improvement of their overall health, is proven to be positive. Due to attractiveness, they offer an innovative way to increase physical activity levels of individuals with disabilities. Exergaming may provide both entertainment and multiple benefits for the users while their engagement with the games may produce a positive mood state, socialization, improvement of well-being and good outcomes. Digital environment provides the possibility for the users to participate at the games on equal terms, regardless of academic performance and type of disability. Individuals with disabilities are less physically active compared to individuals without disabilities. As a result, their fitness levels appear to be lower compared to general population and that may cause cardiovascular diseases, diabetes, obesity and depression. The main reason for this is the absence of motivation to participate in physical education programs. Therefore, it might be meaningful to increase their physical activity levels using exergames. The purpose of this study was to explore the possible benefits of exergames on individuals with disabilities. To achieve this, an extensive research and record of relevant publications in recent years took place. Results indicate that exergames had positive effects on individuals with disabilities and although they should not replace their participation at exercise programs in real environments, they can be used in combination with exercise programs adapted to their needs. More specifically, results suggest that exergames are useful, attractive, and efficient tools for enhancing physical activity levels and attitudes. Additionally, studies reveal social, emotional, and motor benefits as well as improvements in communication skills contributing positively to the quality of their life.

**Keywords:** Exergames, Physical Activity, Exercise, Mood, Motivation, Disability

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## 1. Introduction

Exergames are innovative games developed within an interactive environment for the user. They combine exercise with gaming, hence their name, exergames (exercise and games) (Sinclair et al., 2007). The term exergames or exergaming first appears in Collins dictionary (2007) and is used to determine the combination of gaming with exercise (Di Tore & Raiola, 2012). Exergames demand physical activity aiming to be part of virtual sports or interactive physical activities. The user is asked to achieve body movements according to the simulation game shown on the screen (Vernadakis et al., 2012).

According to Tan et al. (2016), exergames can be divided into three categories: 1) Living-room exergames such as Nintendo Wii (Kyoto, Japan) that require the user to perform exercise routines including dancing, aerobics, yoga, 2) Cardio machine exergames like Fish Game played on a rowing machine, with specific training equipment. Some exergames in this category contain virtual reality. 3) Mobile exergames with accelerometers, global positioning systems to track physical activity of the user and affect gameplay.

Individuals with disabilities usually embrace a sedentary lifestyle that can lead to the appearance of health problems such as cardiovascular diseases, diabetes, obesity, and depression. The main reason for this is the lack of motivation to participate in physical activity programs since they do not fully understand the benefits of exercise. Additionally, they enjoy participating in several activities like dancing, walking, bowling, training with weights combining in this sense exercise with the element of enjoyment, music, or goal-oriented games (Torrado, Jaccheri, Pelagatti & Wold, 2022).

A solution to this problem could be the investigation of successful methods for their encouragement to participate at physical activity programs (Millana et al., 2022). Technology may support individuals for self-managing chronic conditions. Exergames are challenging for individuals with disabilities and can be possibly used as an alternative exercise program for the improvement of their fitness levels and motor function (Silva et al., 2017).

According to the above discussion, the main goal of the present study was to scan and review related studies regarding exergame technology and their effects on individuals with disabilities. The results of this study are expected to offer literature review regarding recent developments in exergames technology and their applications on interactive interventions for individuals with disabilities.

## **2. Research Method**

Articles that met the following criteria were selected for the review: a) Should be published in English; b) Should be dated during the decade 2013- 2021; and c) Participants should be limited to individuals with disabilities and the use of exergames. Person, concept, and context (PCC), as recommended by Peters et al. (2015), was used to structure the inclusion criteria as follows: person-severe mental disorder (schizophrenia), intellectual and developmental disability (autism spectrum disorder, down syndrome), motor disability-cerebral palsy); concept-exergames; and context-individuals with disabilities, English language. The inclusion and exclusion criteria were used to refine the search strategies and provided a framework for searching the literature (Table 1). A scoping review of exergames research showed a constant growth over recent years and positive progress towards adapting new technologies in special populations. The aim for conducting the scoping review was to identify and map the available evidence (Arksey & O'Malley, 2005). The stages of the framework we adopted for conducting this scoping study were the following: Stage 1: identifying the research question, Stage 2: identifying relevant studies, Stage 3: study selection, Stage 4: charting the data, Stage 5: collating, summarizing and reporting the results (Arksey & O'Malley, 2005).

### **Stage 1**

The purpose of this scoping review focuses on the effects of exergames on individuals with disabilities aiming to target certain characteristics that are important for them to become more physically active. The research question to be answered was:

- What is known from the existing literature regarding the effectiveness of exergames on individuals with disabilities?

### **Stage 2**

A literature review took place from February 2022 to April 2022 and the present study started looking at the main database research engine (i.e. ScienceDirect, PubMed, Google Scholar) to collect related articles. The selection process carefully identified the articles that focused on the related exergaming issues on individuals with disabilities. Accordingly, researchers used several key words such were exergames and disability. More specific, exergames and schizophrenia, intellectual disability, autism spectrum and cerebral palsy to identify the most relevant articles. We focused on specific disabilities that involved intellectual and motor disability, and severe mental disorder.

All selected articles were checked by the researchers to make sure that the main issue of each study was relevant to the goal of the present study. For this reason, several criteria were set for filtering the selected studies, including that the main goal of each study should include exergames and individuals with disabilities. Stage 3 This process resulted in 50 articles with a final selection of 10 articles (Table 2) that were considered for analyses in the present study.

### **Stage 4**

The data that we charted were entered into a 'data charting form' using the database program Excel. We recorded information as follows: 1) Author(s), year of publication. 2) Intervention type; duration of intervention. 3) Study populations. 4) Aims of the study. 5) Methodology. 5) Outcome measures. 6) Important results.

### **Stage 5**

The literature was organized thematically according to different types of disability. We recorded our findings and summarized basic characteristic of all studies included information such as: interventions, sample sizes, participants, research methods, outcomes, evidence relating to effectiveness.

## **3. Literature Review**

### **3.1 Autism Spectrum Disorder (ASD) and Intellectual Disability (ID)**

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder associated with deficits in social interaction, emotional reciprocity, communication, motor skills and cognitive functions accompanied by impairment in imagination and limited interests (Lima et al., 2020). Exergames for individuals with ASD have been designed to

enhance social, communicative, and narrative skills (Bernardini, Porayska-Pomsta & Smith, 2014), to learn the appropriate body postures and to support motor coordination (Caro et al., 2017). Their design follows a methodology that is user centered to support developmental skills for individuals with ASD. Additionally, they offer interaction without the need of any other device but just body movements by the user to control the game. Examples of such games are Astrojumper (Finkelstein et al., 2013) and FroggyBobby (Caro, Tentori, Martinez-Garcia & Zavala-Ibarra, 2015; Caro et al., 2017). Astrojumper is a fascinating virtual reality exergame that demands body movements (touchless interaction) to avoid obstacles, collect bonuses and fight battles. Many individuals with ASD, managed to achieve high levels of activity, participate to physical activities, and confront behavioral problems and health issues. FroggyBobby is a Kinect-based exergame, designed to support visual-motor skills for individuals with ASD (Caro et al., 2015). It is efficient for the users' participation and motivation for executing exercises aiming to improve visual-motor coordination, increase accurate aimed limb movements of children with severe ASD (Caro et al., 2017) as well as for the motivation of adults with developmental disabilities to execute exercises on visual-motor coordination (Caro et al., 2018).

In this regard, the study of Caro et al. (2020) aimed to compare two exergames for the support of visual-motor coordination of highly functioning individuals with ASD. The first exergame was designed for individuals with ASD and the second for neurorehabilitation. FroggyBobby and Kinect Monsters exergames were used on high functional individuals with ASD, ages 4- 15, including 8 children (all boys 7 years old) and 6 adolescents (5 boys and 1 girl, 12.8 years). The 12 participants had previous experience with videogames like Mario Bros, Minecraft using PC, Nintendo or Playstation consoles. To measure the users' experience with exergames, the Core Module of Game Experience questionnaire (GEO) (IJsselsteijn, Poels & de Kort, 2008) was used and for the measurement of satisfaction, Fun Toolkit instrument (Read, 2008) was used. Each participant executed specific exercises of visual-motor coordination for a total of 60 minutes (30 minutes for the right hand and 30 minutes for the left). Results indicated that there were differences between the two exergames, with the one designed for ASD to excel in comparison to the game that was commercially available. Significant differences were detected on limb movements as participants playing the exergame designed for ASD, scored higher on aimed limb movements (limb movements aimed at a visual target). In conclusion, even though both exergames can be used as possible tools for the support of visual-motor coordination on individuals with ASD, the exergame designed for individuals with ASD was reported to be more fun and could possibly motivate them for further use in the future.

Finkelstein et al. (2013) studied physical activity and motivation levels for ten individuals with ASD (ages 8- 20), ranging from low functioning to high functioning, as they played with the Astrojumper game. Participants had two separate sessions with different parameters (1<sup>st</sup> session three screens, 2<sup>nd</sup> session single screen), playing the game for 45 minutes. After the first session they completed a post-experiment questionnaire and after the second session, a short survey regarding their involvement with Astrojumper game, to compare the two versions of the game display. Results showed that most of the participants succeeded vigorous physical activity levels. Moreover, participants mentioned high levels of enjoyment and committed to exercise more frequently with such games.

Intellectual disability is characterized by significant deficits in cognitive function as well as in adaptive behaviors in social and motor skills. The level of intellectual disability varies but is always linked to cognitive impairments. The aim of the study of Syropoulou et al. (2021) was to investigate the factor structure and cross-cultural validity of the self-report questionnaire of Ho et al. (2017), on a sample of Greek elementary students with mild intellectual disability who used Virtual Reality exergames. The questionnaire included five scales: namely self-presence, mood experience, game enjoyment, attitude toward exergames and preference for future involvement with gameplay. The participants were 103 students, ages 9- 12 (boys=52.4%, girls=47.6%). The intervention program included four sessions over two weeks, where participants played with the Carnival Games (PlayStation VR platform). After the completion of the intervention, participants individually completed a self-report questionnaire with the researcher's assistance. Their results showed that the model was appropriate, and the instrument seems to have good internal consistency, appropriate convergent and discriminant validity. They supported the psychometric integrity of the questionnaire by Ho et al. (2017) on children with intellectual disability. Perceptions on the positive effects of exergames were positively linked with the participants' preferences for future involvement with gameplay. Enjoyment and positive mood state presented high scores. More specifically, participants presented high engagement with exergames (level of presence), when the element of entertainment was present, and they showed positive attitudes (joy and mood experience). In conclusion, exergames were useful and efficient tools for the improvement of attitudes and behaviors towards

physical activity, while presence, mood and enjoyment mentioned as important factors that should be investigated in future studies.

Individuals with Down Syndrome (DS) often reveal low levels of physical activity, muscle strength, motor proficiency impairments (balance and postural control) and limitations in motor function. In the same line Silva et al. (2017), investigated the benefits of an exercise program with Wii, for fitness, functional mobility, and motor proficiency for adults with DS. The sample consisted of 27 adults with DS, ages 18- 60 who were randomly separated to an experimental group who engaged with Wii (n=14) and a control group (n=13). Those in the experimental group participated at a two-month program with Wii, three times per week for 60-minute sessions. The program included games for the improvement of aerobic capacity, balance, and isometric strength through the following games: free run, heading, table tilt, snowboard slalom, tightrope tension, hula hoop, balance bubble and penguin slide. Additionally, participants completed several sports and dancing games targeting aerobic endurance (Wii Sports, Wii Sports Resort, Wii Fit and Just Dance 2), including swordplay, boxing, cycling, table tennis and Just Dance 2. Participants were assessed with anthropometric measures, fitness, functional mobility, and motor proficiency. The control group took part at the daily activities of the day care center such were rehabilitation, everyday life skills and art activities. Results showed that exercise with Wii may contribute to the improvement of functional mobility as well as offer fitness benefits, aerobic endurance, speed and agility, lower extremities and abdominal strength, speed of limb movement and flexibility. Moreover, there was significant increase in muscular strength. In conclusion researchers proposed that exercise with Wii may be efficient for individuals with DS and may become an alternative solution for their regular engagement with physical activities, since games are fun and the necessary equipment is affordable.

### **3.2 Schizophrenia**

Individuals with schizophrenia embrace a more sedentary lifestyle compared to the general population (Vancampfort et al., 2012). The sedentary lifestyle is connected to multiple cardiometabolic comorbidities (Vancampfort et al., 2013) and daily dysfunction (Kimhy et al., 2015). During recent years, many efforts were made for their participation in interventions with aerobic exercise to increase their fitness levels. Technology evolution during the last decade led to the development of games that promote physical activity that promote a more active lifestyle by transforming physical activity to recreation (Lieberman et al., 2011). Up to date, there is just a small number of studies for the assessment of the use of exergames on individuals with schizophrenia (Leutwyler et al., 2012; Patsi et al., 2012).

Patsi et al. (2016) investigated the perceptions of individuals with schizophrenia on exergames. Participants included 8 individuals with schizophrenia, ages 35- 63 (5 males, 3 females), who lived at a psychiatric hostel and were in the process of reintegration in society. Nintendo Wii exergame was used with the following games: tennis, boxing, ping pong, fencing and biking. An individual, structured interview with the participants' psychiatrist followed the completion of the study. The duration of the intervention with Nintendo Wii Sports and Wii Sports Resort exergame was 18 weeks, 3 times a week for 45 minutes. Results showed that all participants had positive perceptions toward exergames. All of them reported that they experienced positive emotions and had a good mood during game play.

According to Kimhy et al. (2016) the benefits of exergames on individuals with schizophrenia were investigated. The sample of the study included 41 individuals with schizophrenia (ages 26- 46), 16 of which were the experimental group and 17 the control group. All participants were outside patients of a mental clinic in New York. From the experimental group, 13 participants fully completed the 12 weeks program and additionally received the typical psychiatric care. The rest, 3 participants attended only the first week of the intervention. From the control group, 13 participants received the typical psychiatric therapy for 12 weeks. The rest, 4 participants quit the program. The program included three sessions of one hour per week, for 12 weeks. The exercise protocol for each session included a 10-minute warm-up, individual exercise with the game for at least 45 minutes and recovery for 10 minutes. A trainer was present during all sessions for direction and support, along with a researcher assistant to record all data. Xbox 360 Kinect console was used with the game "Your Shape Fitness Evolved 2012", which was an interactive physical activity for the whole body combined with two treadmill machines, a stationary bike, and an elliptical machine. Results indicated that the mean participation of individuals of the experimental group was 28.5 at the 36 programmed sessions of the 12 weeks (79%; 2.4 sessions per week). Most of the exercise time was dedicated to Xbox Kinect (39%), treadmill (32%), stationary bike (13%), elliptical machine (13%) and guided exercise (3%). Participants accepted the game and had fun with it since they used it more compared to other exercise tools. Therefore, the aerobic capacity of the experimental

group was increased while no benefits were found for the control group. Their results strongly supported that exergames contribute to an active lifestyle since physical activities are enriched with fun.

### **3.3 Cerebral Palsy (CP)**

The term Cerebral Palsy (CP) is used to describe a group of disorders resulting from brain injury with its main characteristic being the relation to motor dysfunctions. Sometimes, but not always it may come together with intellectual disorder. Macintosh et al. (2017) attempted to design a suite of exergames, by using especially designed recumbent bicycles that were connected online with a digital game world for young individuals with CP at Gross Motor Function Classification System (GMFCS) level III (Rosenbaum et al., 2008). Participants consisted of 10 young individuals (5 females, 5 males) with CP, age 10- 16, who enrolled in a 2-week gross motor camp, with GMFCS level II (unassisted walking) or III (mobility aids needed for walking). They all were able to use a hand-held videogame controller. Users executed cyber cycling to move their avatars within the digital world and played mini games. Exergaming sessions took place in groups of five participants each, with at least two participants at each GMFCS level per group. Data recorded for each session included Heart Rate (HR) and gaming data. Participants wore a Polar H1 HR monitor while sitting at an exergaming bicycle with a specialized seat equipped with a seatbelt and lateral supports connected to a PC Gamer Bike Mini and a computer. They played each day three adapted mini games (Wiskin Defense, Biri Brawl, Gekku Race), for 10 minutes each game and a 2--5-minute rest between games. Participants filled out questionnaires between games. Results showed that while all participants enjoyed playing with exergames, participants with GMFCS level II, scored higher and dedicated more time with above 40% Heart Rate Reserve (HRR) in relation to the participants of level III. These differences present the need for continuous refinement regarding gross motor skills and specific balance skills in exergames. Successful engagement with games may contribute to the increase of motivation and opportunities for exercise to improve cardiovascular capacity and social interaction. Researchers also mentioned improvements in cardiovascular capacity and physical wellness. In conclusion, exergames are fun tools that promote moderate intensity exercise and a rehabilitation tool assisting in a way continuous participation in the future.

A recent study (Cardenas et al., 2021) assessed the possibility to use a cycling-based exergame for children with CP, following an orthopedic operation of the lower limbs and investigated its effect on pain and wellness. For this reason, a group of clinicians and computer scientists designed the Liberi Exergame especially for children with CP, who were ambulatory and functioning at Gross Motor Functional Classification Scale (GMFCS) I-III. This interactive, multi-player exergame, included seven different mini games and was powered by pedaling on a stationary bicycle and game-controllers, giving the children the opportunity to exercise while playing all together. The engagement of children with the stationary bicycle had obvious improvement on their psychosocial health, emotional wellness, and gross motor function for non-operative ambulatory children with CP, as well as benefits for motor function, pain and daily life activities for adults following total hip replacement (Demuth, Loretta & Fowler, 2012). Participants included 10 children with CP, five of whom received physical therapy and were the control group (3 males and 2 females, 14±2.8 years) and the rest five were the experimental group (3 males and 2 females, 13.8±2.9 years). They all participated at 15 sessions with exergames and physical therapy for a total of three weeks. Two questionnaires were used to measure pain, FPS-R and Patient Reported Outcome Measurement Information System Pediatric Pain Interference (PROMIS-PI). Participants were asked to point the face that indicated the intensity of pain felt over the last seven days. (Hicks, 2001; Varni et al., 2010). Additionally, the KIDSCREEN-27, a standardized health-related quality of life questionnaire, was used for Physical Well-Being, Psychological Well-Being, Autonomy and Parents, Peers and Social Support and School and Environment (Ravens-Sieberer et al., 2014).

Results indicated that children in both groups experienced less pain over the 3-week study period. Participants in control group reported that pain increased during the study while those in the experimental group reported that pain did not increase. They also noticed significant improvements in mental and physical well-being over the period of 3 weeks. Engagement with exergames demonstrates the potential to improve pain and pain interference over the 3 weeks. In conclusion, researchers noticed that the inclusion of exergames is possible within the therapy of children with CP and that there is potential for improvements on both pain and well-being.

## **4. Discussion**

The purpose of the present study was to present a review of recently published literature on the use of exergames by individuals with disabilities. A literature review of 10 studies published from 2013 to 2021 was conducted. Results indicated that the engagement with exergames had mental and cognitive benefits on

individuals with disabilities, including the increase of social interaction and motivation. According to Staiano and Calvert (2011), the engagement with exergames may increase motivation to participate in physical activities.

There are many devices that offer assistance and easy access for individuals with physical or cognitive disabilities, to improve their skills and acquire autonomy and better quality of life. Exergames for individuals with ASD are designed to enhance social, communicative, and narrative skills (Bernardini et al., 2014), to learn proper body postures and to support motor coordination (Caro et al., 2017). Caro et al. (2020) reported that exergames could be viewed as possible tools for the support of visual-motor coordination for individuals with ASD. They supported that exergames specifically designed for individuals with ASD, provided fun experiences and may possibly motivated them to continue using them. Moreover, Syropoulou et al. (2021) noticed that exergames were useful and effective tools for the improvement of postures and attitudes of individuals with intellectual disability.

Exergames are attractive tools, motivate individuals and positively contribute to their rehabilitation. For example, exergames like Nintendo Wii and Xbox Kinect can be used to increase activity levels and be part of rehabilitation process for individuals with disability. It is possible to offer multiple benefits on patients' therapy (Taylor et al., 2011) and in this regard Patsi et al. (2016) noticed that participants with schizophrenia presented a very good mood and positive attitudes toward exergames. They reported that they would choose to participate in sports within the real environment and that their engagement with exergames motivated them to get involved with new sports. Similarly, Cardenas et al. (2021) supported that the inclusion of exergames is possible within the therapy of children with CP. In the same line, Macintosh et al. (2017) examined the use of exergames on individuals with CP and may improve pain and wellness. Results showed that the successful engagement with the games probably contributes to the increase of motivation and opportunities for exercise aiming to improve cardiovascular health and social interaction.

In conclusion, exergames are attractive tools for the improvement of daily levels of physical activity of individuals with chronic physical disabilities (Hurkmans et al., 2010). The present study presented studies regarding exergames and individuals with disabilities. Results indicated that the use of digital environment offers the possibility for individuals to participate at the games on equal terms regardless of academic performance and type of disability (Russell & Newton, 2008). Exergames can be possibly used as an alternative to exercise programs for the improvement of their fitness levels and motor function. Because of their attractiveness, the games offer the user an alternative way to increase fitness levels, contributing in this way on the improvement of their health (Lam et al., 2011). They are already used as rehabilitation tools on individuals with disabilities of all ages and could become an alternative solution for their regular engagement with physical activities. Therefore, exergames have positive effects on individuals with disabilities and even though they cannot replace exercise programs in real environments, they can be used in combination with exercise programs adapted to their needs. In this regard, studies with the long-term effectiveness of exergames may be conducted, aiming to motivate individuals with disabilities to embrace an active lifestyle with or without the incorporation of exergames.

**Table 1:** Inclusion and exclusion criteria for a scoping review of articles about studies of the use of exergames in individuals with disabilities

Criterion	Inclusion	Exclusion
Language	Published in the English language	Non English articles
Time period	January 2013-January 2022	Articles published outside this time frame
Population focus	Children and Adults experiencing some type of disability (e.g. a) mental disorder-schizophrenia, b) intellectual and developmental disability-autism spectrum disorder, down syndrome, motor disability-cerebral palsy)	Participants experiencing other conditions (e.g., depression, stroke, rehabilitation, special educational need, motor disorders, visual impairment) and typical population
Study focus	Use of exergames (some with virtual reality)	Studies not primarily focused on exergames (e.g., virtual reality games and education) or studies that utilized TV or Web technology
Literature focus	Articles about studies that used exergames as interventions in populations with individuals with disabilities, to export outcomes and benefits	Review articles including systematic reviews, meta-analyses, meta-syntheses, narrative reviews, rapid reviews, critical reviews, integrative reviews, and the gray literature such as blogs, commercial

Criterion	Inclusion	Exclusion
		Web sites, opinion articles, commentaries, and information sites

**Table 2:** Exergame studies and Individuals with Disabilities

Author(s)	Participants	Disability	Exergame(s)	Results
Caro et al., 2020	14 (ages from 4 to 15)	Autism Spectrum Disorder (ASD)	FroggyBobby, Kinect Monsters	Both exergames sustained attention, elicited positive emotional expressions, motivated participants to perform independent visual-motor coordination exercises
Caro et al., 2017	7 (ages from 7 to 10)	ASD	FroggyBobby	Maintenance of attention, reduction of aimless limb movements
Finkelstein et al., 2013	10 (ages from 8 to 20)	ASD	Astrojumper	Vigorous physical activity levels, high levels of fun
Caro et al., 2018	10 (ages from 23 to 36)	Developmental Disabilities (DD)	FroggyBobby	The exergame motivated adults with DD to perform visual-motor coordination exercises
Silva et al., 2017	27 (ages from 18- to 60)	Down Syndrome (DS)	Nintendo Wii Sports, Wii Sports Resort, Wii Fit, Just Dance 2	Improvements of functional mobility and fitness benefits
Syropoulou et al., 2021	103 (ages from 9 to 12)	Intellectual Disability (ID)	Carnival Games (PlayStation VR platform)	Enjoyment and positive mood state presented high scores
Kimhy et al. 2016	41 (ages 26 to 46)	Schizophrenia	Xbox 360 Kinect	The aerobic capacity was increased
Patsi et al., 2016	8 (ages from 35 to 63)	Schizophrenia	Nintendo Wii Sports, Wii Sports Resort	Positive perceptions toward exergames
Cardenas et al., 2021	10 (ages 11 to 17)	Cerebral Palsy (CP)	Liberi	Improvements in mental and physical well-being
Macintosh et al., 2017	10 (ages from 10 to 16)	CP	Cyber Cycling	Improvements in cardiovascular capacity and physical wellness

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