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Original Article

Nintendo Wii Balance Board for Rehabilitation in Children with Cerebral Palsy: A Systematic Review and Meta-Analysis

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Abstract

Background: Cerebral palsy (CP), the leading cause of childhood motor disability, is commonly associated with impaired balance, postural control, and functional mobility. Virtual reality–based interventions, including the Nintendo Wii Balance Board, have been increasingly integrated into pediatric neurorehabilitation. However, the overall effectiveness of Wii-based rehabilitation in children with CP remains uncertain. **Objective:** This systematic review and meta-analysis evaluated the effects of Nintendo Wii Balance Board–based therapy on balance, motor, and mobility outcomes in children with CP. **Methods:** Randomized controlled trials were identified through a systematic search of major electronic databases, including PubMed, Scopus, Google Scholar, and Web of Science, without publication timeframe restrictions. Eligible studies included pediatric patients with cerebral palsy undergoing Nintendo Wii Balance Board–based rehabilitation, rehabilitation games, or neurological therapy. Outcomes included balance, gross motor function, coordination, motor control, and therapy engagement, measured pre- and post-intervention using standardized clinical scales. Effect sizes were calculated as standardized mean differences (SMDs) with 95% confidence intervals (CIs**)**, and heterogeneity was assessed using the I^2 statistic. **Results:** Ten trials involving 257 participants were included. Intervention durations ranged from 8 to 12 weeks and were compared with traditional therapy or no intervention. A meta-analysis of ten studies showed significant improvements in balance favoring Wii-based rehabilitation (SMD = 0.84, 95% CI 0.54–1.15; p = 0.0015), with low heterogeneity (I^2 = 26%). No significant effects were observed for functional mobility outcomes, including the 1-Minute Walk Test and Timed Up and Go. Individual studies also reported improvements in gross motor function and coordination, as well as increased motivation and engagement. **Conclusion:** Nintendo Wii Balance Board–based therapy may improve balance outcomes in ambulatory children with cerebral palsy; however, further high-quality randomized trials with standardized protocols are required.

Keywords: Cerebral Palsy, Pediatric, Rehabilitation, Neurology, Nintendo, Balance, Pediatric Rehabilitation, Meta-Analysis.

INTRODUCTION

Cerebral palsy (CP) is the most widespread etiology of enduring motor disability in childhood, with a worldwide prevalence rate of around 1-3 cases per 1000 live births (Valluri et al., 2025; Shevell et al., 2013). It is a collection of irreversible, non-progressive movement and postural disorders caused by early impairments of the developing brain (Sadowska et al., 2020; Basoya et al., 2023). The motor impairments in children with CP are often associated with deficits in balance, coordination, muscle strength, and postural control, which significantly restrict functional mobility and participation in everyday activities (Pavão et al., 2014; Bertoncelli et al., 2023). Impaired balance is a significant factor that leads to a lack of independence, an increased risk of falls, and reduced quality of life (Valluri et al., 2025). The main goals of rehabilitation strategies for children with CP are to improve functional mobility, postural stability, and participation through task-oriented, repetitive, and engaging interventions (Gonzalez et al., 2023; Sharma et al., 2023). Traditional physical therapy measures, such as neurodevelopmental therapy, strength training, and balance therapy, have proven effective to varying degrees (Khanna et al., 2023; Abd-Elfattah et al., 2022). Nevertheless, it remains difficult to maintain motivation and compliance, particularly in pediatric age groups, when therapeutic exercises are repeated, a process that can be tedious (Khanna et al., 2023). As a result, the idea of integrating technology-assisted and game-based interventions to improve engagement while focusing on the principles of motor learning has gained greater popularity (Gilbertson et al., 2020; Demers et al., 2021). Exergaming and virtual reality (VR) platforms have emerged as potential adjuncts to the neurorehabilitation of children (Tobaiqi et al., 2023). These systems provide enhanced environments that offer multisensory feedback, real-time performance feedback, and high-intensity repetition in an enjoyable setting (Lampropoulos et al., 2025). One of these technologies is the Nintendo Wii Balance Board (WBB), which has received considerable attention for its low price, portability, and ability to provide interactive balance-based activities (Raipure & Kasatwar, 2022). The WBB is a force platform that detects changes in the center of pressure, enabling users to manipulate on-screen avatars by shifting their weight and adjusting their posture (Seo et al., 2022). This process is a direct intervention on postural control and dynamic balance, which are usually affected in children with CP (Seo et al., 2022). Early clinical research has suggested that WBB-based interventions can enhance balance performance, gross motor function, and postural stability in children with CP (Shakiba et al., 2021). The standardized outcome measures reported to have improved include the Gross Motor Function Measure (GMFM), Pediatric Balance Scale (PBS), and center-of-pressure parameters (Choi, 2024). Additionally, the game-based training could be more engaging, leading to increased motivation and therapy compliance, and ultimately greater functional gains (Shakiba et al., 2021). However, the available literature is rather heterogeneous in design, sample size, intervention protocols, duration, and outcome measures, making it difficult to draw any conclusive conclusions about efficacy. Thus, the purpose of this systematic review and meta-analysis is to critically evaluate and quantitatively synthesize current evidence on the effectiveness of the Nintendo Wii Balance Board as a rehabilitation tool for improving balance and motor function in children with cerebral palsy. Previous studies using the Nintendo Wii Balance Board have employed heterogeneous methods and reported inconsistent outcomes, warranting a new meta-analysis to clarify its effectiveness and identify remaining evidence gaps. This review aims to determine whether Wii Balance Board–based interventions provide clinically meaningful benefits and to identify methodological gaps in the current literature.

METHODOLOGY

This meta-analysis and systematic review were done using the Preferred Reporting Items of Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Figure 1). The PICO framework was used to develop the review question. The final literature search was completed in July 2025. The sample included pediatric patients with cerebral palsy of any subtype, severity, and level of functional classification. The intervention included rehabilitation programs using the Nintendo Wii Balance Board or Wii-based therapeutic games as part of neurological rehabilitation. A comparator group was not mandatory; therefore, studies with or without an active control group were eligible. Both randomized controlled trials and quasi-experimental studies were included, provided they evaluated the effect of Wii Balance Board–based interventions on rehabilitation outcomes. cerebral palsy of any subtype, severity, and functional classification level. The intervention focused on rehabilitation programs that used the Nintendo Wii Balance Board or Wii-based therapeutic games in neurological rehabilitation. The main outcomes of interest included the improvements of balance, gross motor functioning, coordination, motor control, and therapy engagement or adherence.

This study was registered in the International Prospective Register of Systematic Review (PROSPERO) (ID: CRD420251066113). With no new human participants involved in this review.

An extensive electronic search was conducted across several databases, including PubMed/MEDLINE, Scopus, Web of Science, the Cochrane Central Register of Controlled Trials (CENTRAL), and Embase, from the inception of each database to the latest available date. The search strategy involved controlled vocabulary terms and free-text keywords, including cerebral palsy, Nintendo Wii, Wii Balance Board, virtual reality, exergaming, rehabilitation, and randomized controlled trial. Manual screening of the reference lists of the relevant articles was also conducted to identify additional eligible studies. No limitations were put on publication year. The inclusion criterion was the publication in English.

To be included in the studies, the study had to satisfy the following inclusion criteria: (1) randomized study design or Quasi-Experimental studies (2) presence of pediatric participants with a diagnosis of cerebral palsy; (3) the use of a rehabilitation intervention based on the Nintendo Wii Balance Board or Wii-based therapeutic games; (4) reporting of quantitative pre- and post-intervention outcomes related to balance, gross motor function, coordination, motor control, or therapy engagement. Non-randomized studies, case reports, case series, conference abstracts without complete data, adult participants, studies involving patients with cerebral palsy, studies with interventions other than Wii-based rehabilitation, and the absence of relevant outcome measures aligned with the predefined PICO framework were all exclusion criteria.

Titles and abstracts were screened by two independent reviewers to identify potentially eligible articles, and the selected articles were then assessed in full text. Disputes were addressed by discussion and consensus. A standardized data collection form designed by the authors and reviewed and edited by experts in the field was used to extract data, including the study characteristics (author, year, country), sample size, participant demographics, intervention type and duration, outcome measures, and reported results. When data were missing, the authors contacted the study authors; for those who did not respond, the studies were excluded.

The main outcomes were balance changes, which were measured with the help of such tools as the

Pediatric Balance Scale or Wii-derived balance measures; gross motor function, measured by such tools as the Gross Motor Function Measure (GMFM-66 or GMFM-88); coordination and motor control, measured with the help of such measures as the Movement Assessment Battery of Children (MABC) or Timed Up and Go (TUG) test; and therapy engagement or adherence, measured with the help of attendance records or structured questionnaires. Results were obtained as pre- and post-intervention values, and follow-up data were obtained where possible.

To analyze the continuous outcomes of a quantitative synthesis, mean differences (MD) were used when the same measurement scale was applied across all studies, and standardized mean differences (SMD) when the measurement scales assessed similar constructs. Confidence intervals were computed at the 95% level. The I2 statistic and the chi-square test were used to assess heterogeneity among studies. When heterogeneity was significant, a random-effects model was used; when it was low, a fixed-effects model was used. The outcomes of engagement and adherence were summarized using descriptive statistics, as pooling was not feasible. Proper meta-analysis software (RevMan version 5.4) was used to perform statistical analyses.

The Cochrane Risk of Bias tool was used to assess the methodological quality and risk of bias of the included randomized studies across the following domains: random sequence generation, allocation concealment, blinding, incomplete outcome data, selective reporting, and other possible sources of bias. Every area was categorized under low, high, or unclear risk of bias. Any differences between reviewers were settled through discussion or by involving a third reviewer.

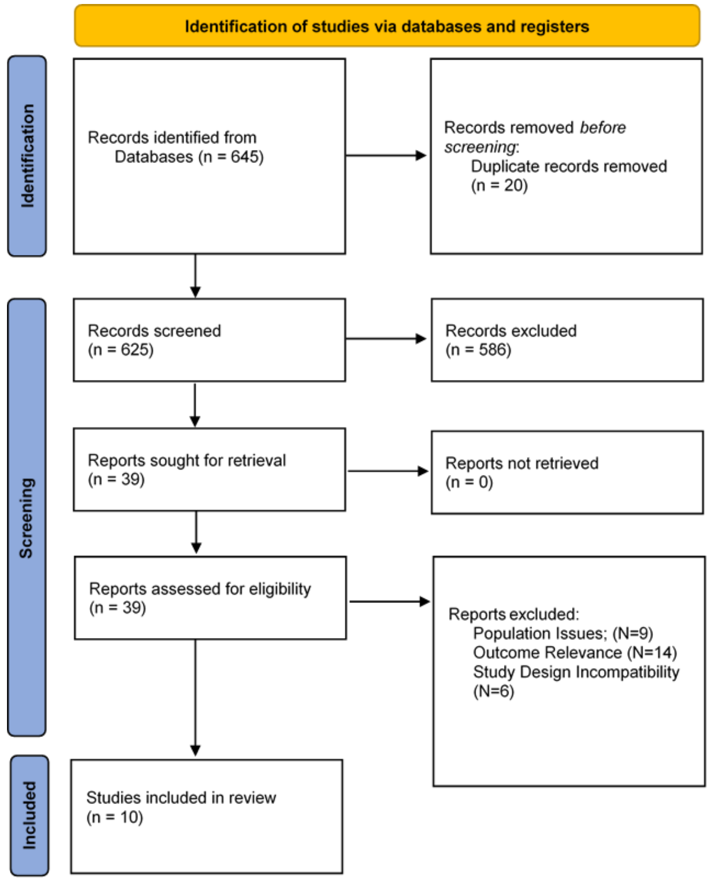


Figure 1. PRISMA flow for including studies

RESULTS

Nine interventional studies published between 2010 and 2021 were included in the review, most of which were randomized controlled trials; only one pre-post quasi-experimental exploratory study was found (Kachmar et al., 2021). The research was carried out across a wide geographic area encompassing Turkey, India, South Korea, Chile, Saudi Arabia, and Ukraine, demonstrating global interest in Wii-based rehabilitation for children with cerebral palsy. The sample sizes were quite small, ranging from 14 to 40 individuals, and the overall pooled enrolment exceeded 250 pediatric patients. The majority of the trials were balanced in terms of the number of participants in Nintendo Wii-based interventions and control or conventional therapy. In the literature, the results were mainly in the areas of balance and postural control, which are often measured using validated tools such as the

Pediatric Balance Scale (PBS), Timed Up and Go (TUG), Trunk Control Measurement Scale (TCMS), and center of pressure (COP) parameters. Other trials also measured gross motor function using the Gross Motor Function Measure (GMFM) and functional mobility tests, such as the 6-minute walk test (6MWT), 10-meter walk test (10MWT), and sit-to-stand tests. Other researchers extended the outcome measure to manual dexterity, participation, motivation, and functional independence (e.g., WeeFIM) (Tarakci et al., 2016; Cho et al., 2016; Han & Ko, 2010; Sharan et al., 2012). The follow-up periods were 2 to 12 weeks, with most interventions conducted within 8-12 weeks, indicating that they were short- to mid-term measures of therapeutic effects (Table 1).

Table 1: General characteristics of the included studies

Article ID	Year	Study design	Country of origin	Number of patients			Outcomes Measures	Follow up (week)
				Total	NWii-G	Placebo		
Kachmar [19]	2021	PPQEED	Ukraine	26	13	13	TCMS; TUGT; CoPPL; DBT	2
TARAKCI [20]	2016	RCT	Turkey	38	19	19	FFRT; SFRT; BBCG; TMWT; FIMC; WFA	12
GATICA-ROJAS [21]	2017	RCT	Chile	32	16	16	SBT	4
Sajan [22]	2021	RCT	India	20	10	10	PBT; ULFT; VPS; FA	3
Tarakci [23]	2013	RCT	Turkey	14	14	14	BFT	12
AlSaif [24]	2015	RCT	SAUDI ARABIA	40	20	20	MABC-2ed	12
Cho [25]	2016	RCT	SOUTH KOREA	18	9	9	GMFM; PBS; 2-MWT; 10-MWT	8
Han [26]	2010	RCT	SOUTH KOREA	20	10	10	PBS;FIMC; GMFCS	12
Ürgen [27]	2016	RCT	TURKEY	33	15	15	GMFCS; PBS; TUGT; GMPM	9
Sharan [28]	2012	RCT	India	16	8	8	PBS; MACS; PL; Motivation; Cooperation; Satisfaction	3

PPQEED: Pre-post quasi-experimental exploratory design; NWii-G: Nintendo Wii Group; TCMS: Trunk Control Measurement Scale; TUGT: Timed Up and Go Test; CoPPL: Center of Pressure Path Length; FFRT: Forward Functional Reach Test; SFRT: Sideways Functional Reach Test; BBCG: Balance-based Computer Games; SBT: Static Balance Test; GMFCS: Gross Motor Function Classification System;GMPM: Gross Motor Performance Measure; GMFM: Gross Motor Function Measure; PBS: Pediatric Balance Scale; 2-MWT: 2-Minute Walk Test; MACS: - Manual ability; Participation level; Motivation; Cooperartion; Satisfaction; Posture Control and Balance Test; ULFT: Upper Limb Fuction Test; VPS: Visual Perceptual Skills; FA: Functional Ambulation; BFT: Balance Function Test; MABC-2ed:Movement Assessment Battery for Children, Second Edition; PA: Participation level; DBT: Dynamic Balance Test; 10-MWT: 10-Meter Walk Test; FIMC: Functional Independence Measure for Children; WFA: Wii Fit Age.

The studies included randomized school-aged children with cerebral palsy, with a mean age of about 9-12 years, in the control group and the intervention group. The gender balance was relatively equal, with a few cohorts having slight male dominance. Cerebral palsy has different types, with the most commonly represented types being spastic diplegia and quadriplegia, and the less common dyskinetic types being less represented in the literature. The functional severity, according to the Gross Motor Function Classification System (GMFCS), was largely in levels I to III, indicating that the majority of participants had mild to moderate functional impairments. The few studies that reported higher-severity cases found only a small percentage of children at IV and V (Sajan et al., 2016). Comparability between the Nintendo Wii and control groups at baseline was generally balanced in terms of age, sex distribution, and GMFCS levels. In instances where separate reporting was conducted for the standing and walking domains (e.g., Cho et al., 2016), baseline functional scores were similar across groups (Table 2).

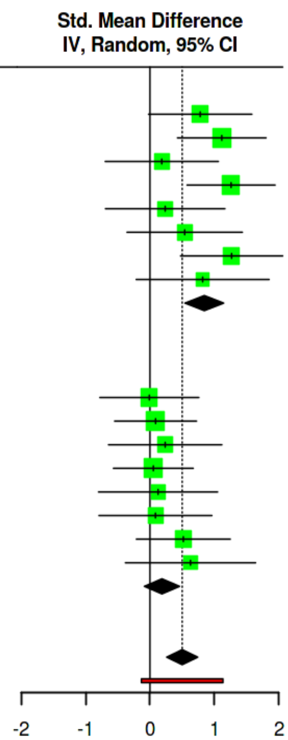
Table 2: Patients characteristics.

Article ID	Year	Age, Mean (SD, Range)		Male, N (N%)		Type of CP (I/P)			GMFCS median	
		NWii-G	Placebo	NWii-G	Placebo	Quadriplegia	Diplegia	Dyskinetic	Group 1	Group 2
Kachmar [19]	2021	11.5 (3.1, 5-18)	10.8 (3.3, 5-18)	6 (46.2%)	9 (69.2%)	13/12		1/0	Level 1 = 4 , Level 2=7 ,Level 3 =2	Level 1 = 4 ,Level2=6, Level 3 =2
TARAKCI [20]	2016	10.46 (2.69, NA)	10.53 (2.79, NA)	10 (52.6%)	9 (47.4%)	7/7	5/5	0/3	2 (1-2)	2(1-3)
GATICA-ROJAS [21]	2017	10.2 (3.1, 7-14)	11.2 (3.6, 7-14)	10 (62.5%)	9 (56.3%)	4/5	7/NA	2/NA	Level 1 = 3 Level 2= 5	Level 1 = 3 Level 2= 6
Sajan [22]	2021	10.6 (3.78, 5-20)	12.4 (4.93, 5-20)	6 (60%)	6 (60%)	1//2	5//7	4//1	Level 1 = 0 Level 2= 1 Level 3= 7 Level 4= 2 Level 5= 0	Level 1 = 1 Level 2= 2 Level 3= 6 Level 4= 1 Level 5= 0
Tarakci [23]	2013	12.07 (3.36, 5-17)		11 (78.6%)		5/ NA	7/NA	2/NA	Level 1=4, Level 2=8, Level 3=1	
AlSaif [24]	2015	NA (NA, 6-10)		NA	NA	NA	NA	NA	N/A	N/A
Cho [25]	2016	10.22 (3.4, 4-16)	9.4 (3.8, 4-16)	NA	NA	NA	NA	NA	Standing, 63.1/22.4 Walking, 52.7/24.9	Standing, 62.0/27.3 Walking 47.1/25.8
Han [26]	2010	9.50 (2.46, NA)	8.90 (2.37, NA)	5 (50%)	5 (50%)	6//5	4//5	0	Level 1-9/ Level 2 1	Level 1-8/ Level 2, 2
Ürgen [27]	2016	11.07(2.3, 7-14)	11.33(2.19 , 7-14)	7 (46.7%)	7 (46.7%)	NA	NA	NA	91.89/3.80	87.95/6.04
Sharan [28]	2012	NA (NA,NA)	NA (NA,NA)	NA	NA	NA	NA	NA	N/A	N/A

NWii-G: Nintendo Wii Group; N: Number of participants; SD: Standard Deviation

There was moderate variability in intervention protocols regarding the frequency, duration, and total training exposure (Table 3). The majority of studies used Wii-based therapy two to three times a week, with sessions lasting 15 to 50 minutes. The average duration of intervention was 8 to 12 weeks, but 2-4-week protocols were also documented (Kachmar et al., 2021; Gatica-Rojas et al., 2017; Sharan et al., 2012). The most common platforms were the Nintendo Wii Balance Board and the Wii Fit software, which regularly included games involving balance-based activities designed to encourage weight shifting, postural changes, and dynamic stability. The control groups usually received standard physiotherapy, balance training, treadmill training, muscle-stretching exercises, or no further intervention. In all studies that reported quantitative measures, Wii-based rehabilitation was mostly linked to improvements in balance performance, gross motor function, and coordination. As an illustration, manual dexterity and total MABC-2 scores improved in intervention groups and showed insignificant improvement in control groups (AlSaif & Alsenany, 2015). The 6MWT showed greater post-intervention improvement in the Wii-based training groups than in the controls in terms of functional walking capacity (Tarakci et al., 2013). Treatments that assessed broader motor domains, such as GMFM and PBS, also showed post-treatment improvement following virtual reality-based balance training (Cho et al., 2016; Han & Ko, 2010). Motivation and cooperation, which are engagement-related outcomes, were also described positively in trials that assessed psychosocial aspects of therapy participation (Sharan et al., 2012). In addition, a meta-analysis was conducted over ten studies, showing a significantly greater improvement in balance score between pre and post intervention in the Nintendo Wii balance board group (SMD = 0.84, 95% CI: 0.54–1.15) compared with the placebo group (SMD = 0.19, 95% CI: -0.09–0.46) with a significant difference (P= 0.0015). No significant heterogeneity between studies was reported (I^2=26.0%, P=0.1623) (Figure 2). Considering the 1-minute walking test, no significant difference was reported between the two groups, with an SMD of 0.00 (95% CI: -0.40–0.40) in the Nintendo group and 0.04 (95% CI: -0.36–0.44) between pre- and post-intervention (P=0.8915) (Figure 3). Moreover, the meta-analysis showed no significant difference between the two groups on the Timed Up and Go test, with SMDs of -0.31 (95% CI: -0.75 to 0.14) in the Nintendo group and -0.23 (95% CI: -0.56 to 0.25) (P=0.1116) (Figure 4).

Study or Subgroup	Post Mean	Post SD	Post Total	Pre Mean	Pre SD	Pre Total	Weight	Std. Mean Difference IV, Random, 95% CI
subgroup = Nintendo Wii Balance Board								
Kachmar 2021	5.20	1.0500	13	4.32	1.1300	13	6.3%	0.78 [-0.02; 1.58]
TARAKCI 2016	2.73	1.0000	19	1.59	1.0000	19	7.7%	1.12 [0.43; 1.80]
Sajan 2021	18.70	16.3300	10	15.70	14.7700	10	5.5%	0.18 [-0.69; 1.06]
AlSaif 2015	16.10	3.1000	20	12.10	3.1200	20	7.8%	1.26 [0.58; 1.94]
Cho 2016	34.60	13.5000	9	31.30	13.0000	9	5.1%	0.24 [-0.69; 1.17]
Han 2010	52.70	3.0000	10	50.80	3.7000	10	5.4%	0.54 [-0.36; 1.44]
Ürgen 2016	96.05	2.4300	15	91.89	3.8000	15	6.4%	1.27 [0.48; 2.06]
Sharan 2012	45.00	8.7300	8	35.57	12.6700	8	4.3%	0.82 [-0.21; 1.85]
Total (95% CI)			**104**			**104**	**48.4%**	**0.84 [0.54; 1.15]**
Heterogeneity: Tau^2 = 0.0140; Chi^2 = 7.4, df = 7 (P = 0.3889); I^2 = 5.4%								
subgroup = Placebo								
Kachmar 2021	4.11	2.4900	13	4.13	1.7300	13	6.7%	-0.01 [-0.78; 0.76]
TARAKCI 2016	1.25	1.0000	19	1.16	1.0000	19	8.5%	0.09 [-0.55; 0.72]
Sajan 2021	25.00	17.7100	10	20.44	19.1000	10	5.5%	0.24 [-0.64; 1.12]
AlSaif 2015	12.70	3.7400	20	12.50	3.6200	20	8.7%	0.05 [-0.57; 0.67]
Cho 2016	30.20	15.6000	9	28.10	16.0000	9	5.1%	0.13 [-0.80; 1.05]
Han 2010	46.70	7.9700	10	46.00	7.6700	10	5.5%	0.09 [-0.79; 0.96]
Ürgen 2016	90.92	5.0500	15	87.95	6.0400	15	7.1%	0.52 [-0.21; 1.25]
Sharan 2012	36.07	14.3800	8	26.40	14.6300	8	4.5%	0.63 [-0.38; 1.64]
Total (95% CI)			**104**			**104**	**51.6%**	**0.19 [-0.09; 0.46]**
Heterogeneity: Tau^2 = 0; Chi^2 = 2.14, df = 7 (P = 0.9520); I^2 = 0%								
Total (95% CI)			**208**			**208**	**100.0%**	**0.50 [0.26; 0.74]**
Prediction interval								**[-0.13; 1.13]**



Heterogeneity: Tau^2 = 0.0732; Chi^2 = 20.26, df = 15 (P = 0.1623); I^2 = 26.0%
Test for overall effect: Z = 4.07 (P < 0.0001)
Test for subgroup differences: Chi^2 = 10.07, df = 1 (P = 0.0015)

Figure 2. Forest plot of the difference in balance score pre-post intervention between Nintendo Wii balance board and placebo group.

The risk-of-bias assessment using the Cochrane RoB 2 tool demonstrated variability in methodological quality across the included studies (Figure 5). Three trials were judged to have an overall low risk of bias, reflecting adequate randomization procedures, low attrition, and minimal reporting concerns. The majority of studies were classified as having a moderate risk of bias, primarily due to unclear allocation concealment and insufficient blinding of participants, personnel, or outcome assessors. One study was rated as high risk of bias, largely due to concerns about selection and attrition bias. Performance and detection bias were the most frequently identified methodological limitations, consistent with rehabilitation trials, where participant and therapist blinding is often challenging.

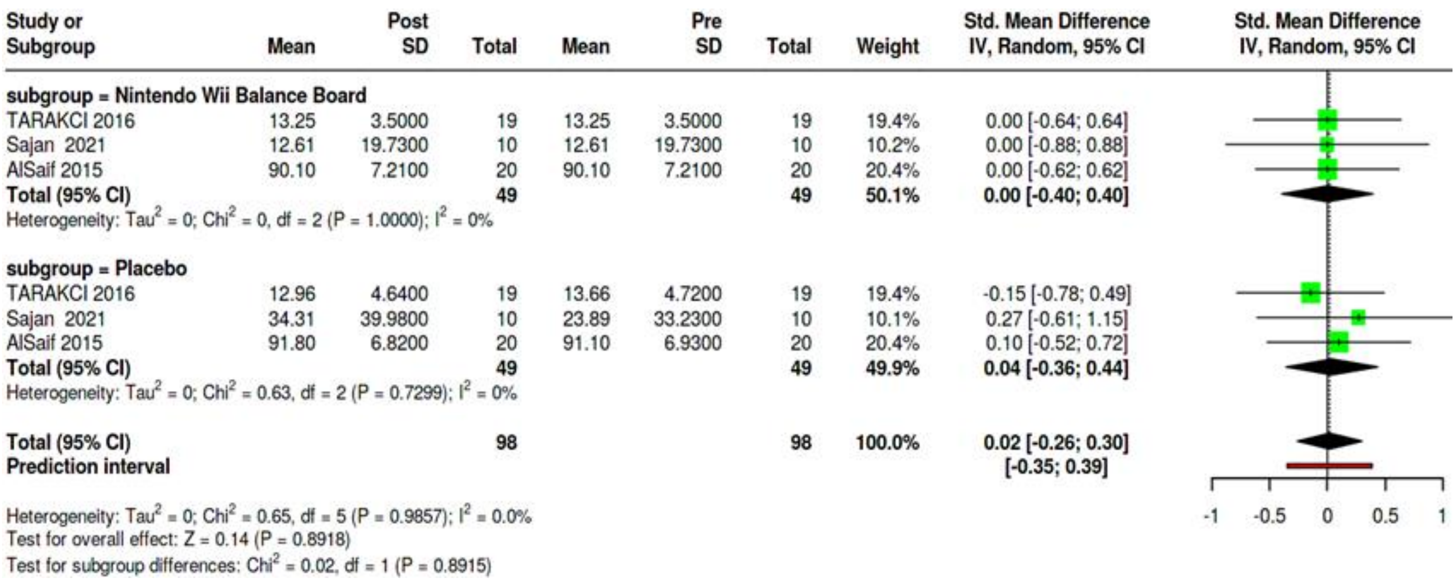


Figure 3: Forest plot of the difference in 1-minute walk test score pre-post intervention between Nintendo Wii balance board and placebo groups.

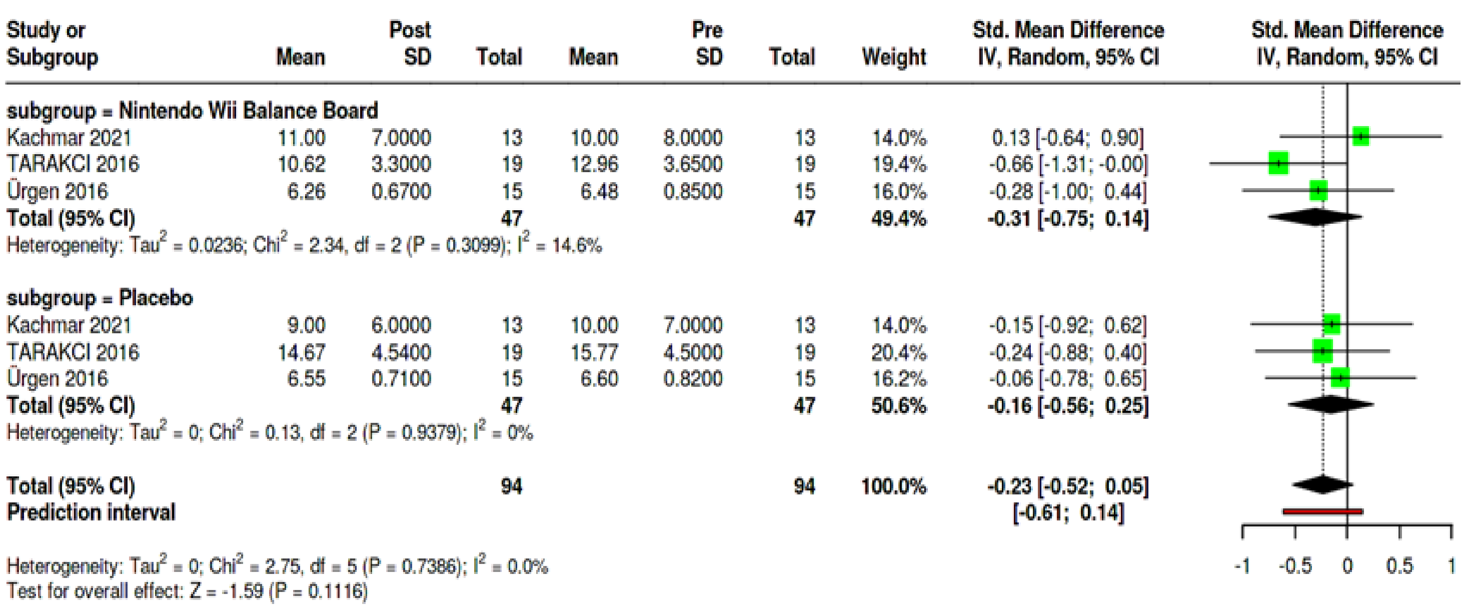


Figure 4: Forest plot of the difference in Timed Up and Go Test (sec) pre-post intervention between the Nintendo Wii balance board and placebo groups.

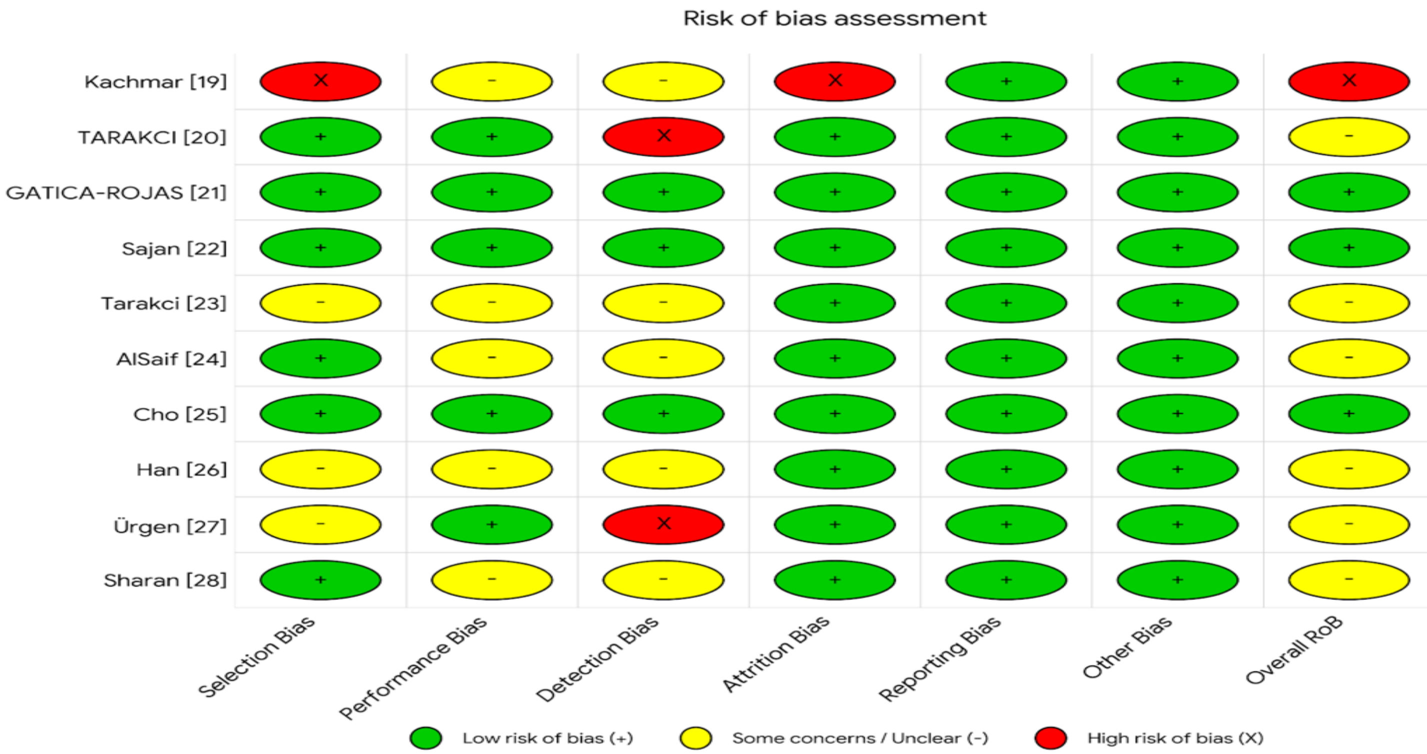


Figure 5: Bias Assessment for Included Studies using Cochrane risk-of-bias tool for randomized trials (RoB 2).

DISCUSSION

This systematic review summarized the results of 9 interventional trials and 1 quasi-experimental study on the effectiveness of the Nintendo Wii Balance Board in children with cerebral palsy, most of which were randomized controlled trials. Internal validity of the results is reinforced by the predominance of randomized studies, but the sample sizes observed in these studies are consistent with the broader pediatric neurorehabilitation literature, where large-scale studies are frequently hampered by recruitment difficulties and heterogeneity in presentation (Irzan et al., 2022). The geographic diversity of the included studies indicates the growing global popularity of integrating low-cost virtual reality technologies into pediatric rehabilitation programs. The most commonly studied outcomes were balance and postural control, which align with the core motor impairments found in cerebral palsy. Postural instability and the inability to respond to anticipatory and reactive balance demands are well-documented characteristics of this population and are strongly associated with functional limitations and restrictions of participation (Luna et al., 2024). The reliability of the reported findings is also enhanced using validated instruments, such as the Pediatric Balance Scale, Timed Up and Go test, Trunk Control Measurement Scale, and center-of-pressure parameters, on a regular basis. Past studies have highlighted that neuroplastic changes and positive postural control in children with CP can be achieved through task-oriented balance training and repetitive weight-shifting exercises, which provide a plausible mechanistic basis for the reported improvements following Wii-based interventions (Shumway-Cook et al., 2003; Chen et al., 2017). The intervention protocols varied in duration and frequency, but most studies used Wii-based therapy 2 or 3 times per week for 8–12 weeks. This dosage aligns with motor learning concepts that highlight intensity, repetition, and task specificity as paramount factors for functional enhancement (Leech et al., 2021). The multisensory, interactive feedback from the Wii Balance Board can be useful for improving motor learning by supporting appropriate movement strategies and encouraging active engagement (Gatica-Rojas et al., 2017). Furthermore, the presentation of motivational and engagement-related outcomes across multiple studies indicates growing awareness that adherence and enjoyment are the most important predictors of effective pediatric rehabilitation. Earlier studies have indicated that exergaming platforms can improve intrinsic motivation and adherence to therapy compared with traditional repetitive exercises (Pacheco et al., 2020). The pooled meta-analysis showed that balance outcomes were significantly and clinically better in the Nintendo Wii group, with a large standardized mean difference and low heterogeneity. The effect size of the findings is similar to that reported in past meta-analyses of virtual reality interventions in children with cerebral palsy, which have reported moderate to large effects on balance and postural stability (AlSoqih et al., 2025; Liu et al., 2022). The low heterogeneity implies relative consistency across studies despite dissimilar protocols, supporting the strength of the balance-related results. However, the 1-minute walking test and the Timed Up and Go test showed no significant differences. Such results suggest that although Wii-based training can be effective in addressing both static and dynamic balance, it might not be as effective in translating to overall functional mobility outcomes during short-term interventions (Padala et al., 2017; Zardo et al., 2025). Functional ambulation is not only reliant on balance but also on muscle strength and endurance, selective motor control, and cardiorespiratory capacity (Zardo et al., 2025). Thus, balance-only gaming interventions might be insufficient to improve all the determinants of walking performance. The same discrepancies between balance and gait-related outcomes have been observed in previous trials in pediatric neurorehabilitation, indicating that combined or multimodal interventions may be required to achieve substantial improvements in walking speed and mobility (Zardo et al., 2025). Although the current review showed good results, the findings should be interpreted with several limitations in mind, including heterogeneity in intervention protocols and treatment durations across studies, variability in outcome measures for assessing balance and motor performance, limited long-term follow-up data, and the possibility of publication bias. These factors may affect the comparability of pooled results and the strength of overall conclusions. Future research should prioritize larger multicenter randomized trials, the development of standardized exergaming protocols, and the evaluation of long-term functional outcomes to strengthen the evidence base for Wii-based rehabilitation in children with cerebral palsy.

CONCLUSIONS

Overall, the results support the use of the Nintendo Wii Balance Board as a viable supplement to traditional therapy for improving balance outcomes in ambulatory children with cerebral palsy. The strongest evidence was observed in balance-related measures. However, short follow-up periods limit conclusions regarding the long-term sustainability of these benefits. Further research should investigate the impact of Wii-based rehabilitation on functional mobility, participation, and quality of life through larger randomized trials with longer follow-up and broader representation across functional severity levels.

Author Contributions

All authors contributed to the conception and design of the review, literature search, study selection, data charting, and interpretation of findings. All authors drafted or critically revised the manuscript, approved the final version, and agree to be accountable for all aspects of the work.

Ethical Approval and Patient Consent

Ethical approval was not required for this study, as it is a systematic review based exclusively on previously published and publicly available data. No human participants were directly involved; therefore, informed consent was not required.

Data Availability Statement

This scoping review is based solely on published and publicly available sources. No new datasets were generated or analyzed. All data supporting the findings are included within the article and its referenced sources.

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Conflicts of Interest

Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

Declaration of generative AI and AI-assisted technologies

The authors used generative AI tools solely to improve language clarity and correct grammatical issues during manuscript preparation. All content was carefully reviewed and revised by the authors, who take full responsibility for the accuracy, integrity, and originality of the final published work.

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