



Context-focused interventions versus traditional motor therapies on occupational performance in children with cerebral palsy: a systematic review with meta-analysis

Intervenciones centradas en el contexto frente a terapias motoras tradicionales en el desempeño ocupacional de niños con parálisis cerebral: revisión sistemática con metaanálisis

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Abstract

Introduction: cerebral palsy (CP) is a chronic neurological condition that limits children's functionality, particularly in the domains of activity and participation. Context-focused interventions have emerged as a complement to traditional motor therapies, prioritizing environmental modification to enhance functional outcomes.

Objective: To compare the effectiveness of context-focused interventions versus traditional motor approaches on outcomes related to activities and participation of the ICF in children with CP.

Methods: a systematic review with meta-analysis of randomized controlled trials published between 2014 and 2024 was conducted. The search was conducted in five databases (OVID, EBSCO, PubMed, Web of Science, and Scopus). Studies assessing occupational performance, mobility, self-care, and quality of life in children with CP were included. Risk of bias was evaluated using the RoB 2 tool, and analyses followed PRISMA guidelines.

Results: nine studies with a total of 369 children were included. The meta-analysis demonstrated a significant positive effect of context-focused interventions on perceived and satisfied occupational performance (SMD 1.07 and 0.89, respectively), with moderate heterogeneity. Effects on mobility, self-care, and quality of life were small or non-significant, with the certainty of evidence rated as low or very low according to GRADE.

Conclusion: context-focused interventions show clinically relevant benefits in occupational performance among children with CP, although effects on other functional domains remain uncertain. The low certainty of evidence underscores the need for more rigorous trials to confirm these findings and support clinical decision-making.

Keywords

Activity; participation; disability; childhood; rehabilitation, international classification of functioning, disability and health (ICF).

Resumen

Introducción: la parálisis cerebral (PC) es una condición neurológica que limita la funcionalidad infantil, especialmente en los dominios de la actividad y participación. Las intervenciones centradas en el contexto surgen como una alternativa terapéutica, priorizando la modificación del entorno para favorecer la funcionalidad.

Objetivo: comparar la efectividad de las intervenciones centradas en el contexto frente a las motoras tradicionales en desenlaces de actividades y participación de la CIF en infantes con PC.

Metodología: Se realizó una revisión sistemática con metaanálisis de ensayos clínicos controlados publicados entre 2014 y 2024. La búsqueda se efectuó en cinco bases de datos (OVID, EBSCO, PubMed, WOS y Scopus). Se incluyeron estudios que evaluaran desempeño ocupacional, movilidad, autocuidado y calidad de vida. El riesgo de sesgo se evaluó con la herramienta RoB 2 y el análisis siguió los lineamientos PRISMA.

Resultados: se incluyeron nueve estudios con 369 infantes. El metaanálisis evidenció un efecto positivo significativo de las intervenciones centradas en el contexto sobre percepción y satisfacción del desempeño ocupacional (SMD 1.07 y 0.89, respectivamente), con heterogeneidad moderada. Los efectos sobre movilidad, autocuidado y calidad de vida fueron bajos o no significativos, con certeza de la evidencia clasificada como baja o muy baja según GRADE.

Conclusión: las intervenciones centradas en el contexto muestran beneficios relevantes en el desempeño ocupacional en la PC, aunque los efectos en otras áreas funcionales son inciertos. La baja certeza de la evidencia resalta la necesidad de ensayos con mayor rigor metodológico para confirmar estos resultados y orientar la práctica clínica.

Palabras clave

Participación; discapacidad; infancia; rehabilitación., clasificación internacional del funcionamiento, la discapacidad y la salud (CIF)

Introduction

Cerebral palsy is the leading cause of childhood disability, with a global prevalence estimated at 2 to 3 per 1,000 live births, and even higher in low-income countries (Jahan et al., 2021; Paul et al., 2022). This non-progressive neurological condition is associated with psychomotor impairments as well as sensory and perceptual complications that negatively affect child development. Rehabilitation processes in this condition entail a considerable economic and social burden (Olusanya et al., 2022). To achieve success in key aspects such as occupational performance, independence, quality of life, and social participation, approaches that demonstrate effectiveness in improving these outcomes are required (Dimakopoulos et al., 2024; Maciver et al., 2019).

The performance and participation of children with cerebral palsy are strongly influenced by contextual factors such as family organization, access to services, physical accessibility, and sociocultural attitudes. According to the International Classification of Functioning, Disability and Health (ICF), these factors act as facilitators or barriers that directly influence daily performance, autonomy, and quality of life. Therefore, interventions focused exclusively on the child's motor impairments do not always lead to proportional improvements in performance and participation when environmental demands remain unchanged. Additionally, children with cerebral palsy are often diagnosed late, typically when delays in walking or speech become evident. This late identification postpones the initiation of rehabilitation and may reduce the potential impact of early interventions, particularly those focused on participation and functional performance. Incorporating contextual approaches may be especially relevant for children who begin therapy at older ages, as environmental adaptation can mitigate some of the consequences of delayed diagnosis.

In response to these challenges, therapeutic approaches aimed at modifying the environment and task demands have been developed to promote functional performance and participation. One of the most notable is context-focused therapy, formally described by Darrah, Law, Russell, and Rosenbaum in 2011. This model proposes achieving functional goals defined by the family through the adaptation of task demands and/or environmental conditions, without directly intervening in the child's motor abilities. It is based on dynamic systems theory, the ICF, and family-centered practice, and it is preferably implemented in natural settings with therapeutic support. Unlike traditional rehabilitation, it does not seek to develop skills or modify body functions, but rather to identify and transform contextual facilitators and barriers. Since 2016, scientific evidence has begun to include this approach within interventions targeting activity and participation, although questions remain about its effectiveness and transferability across different real-world contexts (Darrah et al., 2011; Massey et al., 2025; Pritchard-Wiart et al., 2022).

For this review, context-based interventions were defined as rehabilitation strategies implemented in everyday settings such as home, school, or community that aim to enhance performance and participation through the adaptation of tasks, environments, or both. Following Darrah's criteria, these interventions are characterized by the use of family or child-defined goals and by the modification of contextual demands rather than by impairment focused strategies. This category includes context-focused therapy as well as other modalities that share its underlying environmental approach, such as caregiver-mediated home programs, school-based goal-directed interventions, telerehabilitation with professional support, and activities assisted by technological resources such as video games or virtual reality (Ferreira et al., 2020; Novak et al., 2020).

Although the benefits of these therapeutic strategies have been documented, their comparative effectiveness against conventional motor therapies remains uncertain. Therefore, the objective of this systematic review and meta-analysis is to evaluate the effectiveness of context-focused interventions compared with conventional motor interventions on outcomes framed within the ICF domains of activities and participation, such as performance, independence in mobility and self-care, quality of life, and participation of children with cerebral palsy. This work was conducted in accordance with PRISMA guidelines, and it has been registered in the PROSPERO platform under the number CRD42024533496.

Methods

Search and Study Selection

The methodological approach of this study was a systematic review of the scientific literature with meta-analysis, conducted in accordance with PRISMA guidelines (Page et al., 2021). The review methods were pre-specified in the protocol registered in PROSPERO under the code CRD42024533496 on April 19th, 2024, with no subsequent amendments. The last electronic search was performed on December 19th, 2024, across each database. Data collection was conducted through searches in electronic databases such as OVID, EBSCO, PUBMED, WOS, and SCOPUS, complemented by gray literature sources (e.g., theses in ProQuest Dissertations & Theses and trial records in ClinicalTrials.gov). In addition, a manual search was conducted in specialized journals, along with reference list screening of included articles to minimize publication bias.

Studies were published between April 2014 and December 2024. They were considered to capture the most recent and relevant evidence on context-focused therapy in cerebral palsy. This period reflects significant advances in the standardization of interventions and outcome measures based on the ICF, while ensuring current clinical applicability.

The search was restricted to articles published in English due to the predominance of relevant literature in this language within the field of childhood cerebral palsy (according to previous reviews, fewer than 5% of relevant studies are published in other languages (Novak et al., 2020) as well as for practical constraints related to translation resources, thereby minimizing the risk of language bias without compromising overall comprehensiveness. Search terms and keywords were structured using Boolean operators (including Mesh terms and synonyms) and are detailed in Table 1. The full search strategy is provided in Appendix 1 for reproducibility, including filters and exact terms.

Inclusion and Exclusion Criteria

Studies were included if they met the PICO framework (population, intervention, comparison, and outcome). The population corresponded to children aged 0 to 13 years with cerebral palsy; the intervention consisted of context-focused intervention strategies; the comparator was motor therapy, also referred to as conventional therapy; and the outcomes corresponded to measures framed within the activities and participation component of the International Classification of Functioning, Disability and Health (ICF) (World Health Organization, 2001), such as social participation, independence, performance, self-care, environmental mobility, hand function, and health-related quality of life.

Only randomized controlled trials were selected, as they provide the highest level of evidence for therapeutic interventions, while purely observational designs were excluded. Studies were excluded if they did not correspond to the target population, did not consider context-focused therapy with all its characteristics, or did not evaluate outcomes within the domains of activities and participation. In addition, studies published in languages other than English (as specified in the protocol) and systematic reviews of any type were excluded. A complete list of excluded studies, with specific justifications for each exclusion (e.g., “did not report outcomes on activities and participation” or “language other than English”), is provided in Appendix 2.

Data Extraction

The articles identified were uploaded to the Rayyan platform, and data analysis was organized into two phases: in the first, two researchers independently reviewed the titles and abstracts of the studies, resolving discrepancies with a third reviewer (the inter-rater agreement kappa coefficient was calculated to assess reliability). In the second phase, full texts were analyzed following the same procedure. Data extraction was performed in duplicate by two independent researchers using a pre-piloted standardized form, with discrepancies resolved by consensus or by a third reviewer.

Data were extracted on general study characteristics (design, population, intervention, comparator, outcomes), dose-response, impact of interventions on activity and participation measures, and funding sources of each study, including conflict of interest declarations. Funding information was obtained from the acknowledgments, funding statements, or conflict of interest sections of the included articles. When such information was not available, corresponding authors were contacted by email for clarification.



The results of this extraction are presented in Table 2 (General characteristics of included studies) and in Appendix 3 (Funding sources and conflicts of interest).

Risk of Bias and Quality Assessment

Risk of bias was assessed using the Cochrane RoB 2 tool for randomized controlled trials (Crocker et al., 2023). The evaluation was conducted by two independent reviewers blinded to each other's judgments, using the RevMan 5.4.1 software. The criterion of "unclear risk" was assigned when the potential for bias could not be determined. The RoB results are presented in a table or "traffic light" plot in the results section.

The quality of the evidence was determined using the GRADE approach (Grading of Recommendations, Assessment, Development and Evaluation) (Aguayo-Albasini et al., 2014). "Summary of findings" tables were created with the GRADEpro GDT platform, integrating evidence quality, effect size, and precision of the results for each critical outcome.

Statistical Analysis and Meta-Analysis

The statistical analysis was conducted through a meta-analysis using a random-effects model, considered appropriate given the expected clinical and methodological heterogeneity among the included studies. For continuous outcomes, standardized mean differences (SMD) with 95% confidence intervals were calculated. Heterogeneity was assessed using the I^2 statistic, between-study variance (τ^2), and the χ^2 test. Subgroup analyses (by age and intervention dose) and meta-regressions were planned. However, the number of included studies did not allow for their implementation.

The impact of bias on the results was examined through sensitivity analyses, excluding studies classified as high risk or unclear risk in key RoB 2 domains (sequence generation, allocation concealment, blinding, incomplete data, and selective reporting). Full results of these analyses are presented in Appendix 4.

Publication bias was assessed qualitatively, since the number of studies per outcome ($n \leq 4$) precluded the reliable application of funnel plots or Egger's test (Page et al., 2022). Nevertheless, exploratory funnel plots were generated for the main outcomes (COPM-satisfaction, COPM-performance, PEDI-mobility, PEDI-self-care, and CP-QoL), included in Appendix 4, with the caveat that their interpretation is limited by the small number of studies. Possible small-study effects were also explored through descriptive comparisons between sample sizes and effect magnitudes.

To minimize the risk of missing relevant studies, the search was conducted in five major databases (OVID, EBSCO, PubMed, Web of Science, and Scopus), gray literature sources (ProQuest, ClinicalTrials.gov), manual searches in specialized journals, and reference list screening of included studies. All analyses were performed in Review Manager version 5.4.1.

Table 1. Search strategies in databases

Search strategies	PUBMED	EBSCO	SCOPUS	WOS	OVID
((cerebral palsy) AND (Rehabilitation)) AND (context focused intervention)) AND (Context therapy)	20	14	8	31	0
((Cerebral palsy) AND (Rehabilitation)) AND (participation)) AND (Functional Independence)	89	18	21	46	1
((Cerebral palsy) AND (Rehabilitation) AND (family))	838	515	457	897	27
((Cerebral palsy) AND (Rehabilitation)) AND (family)) AND (Acceptance and Commitment Therapy)	11	11	1	15	2
((Cerebral palsy) AND (Rehabilitation)) AND (home based)	202	201	151	239	6
((Cerebral palsy) AND (Rehabilitation) AND (Social Environment)	96	248	61	140	5
((cerebral palsy) AND (Rehabilitation)) AND (Self Help Devices)) AND (assistive technology)	165	37	28	5	1
((Cerebral palsy) AND (Rehabilitation)) AND (Health Services Accessibility)	43	74	29	26	7
((Cerebral palsy) AND (Rehabilitation)) AND (Health Knowledge, Attitudes, Practice)	23	49	15	9	1
((Cerebral palsy) AND (Rehabilitation)) AND (bimanual training)) AND (Constraint induced movement therapy)	37	60	22	42	8
((Cerebral palsy) AND (Rehabilitation)) AND (action observation training)	29	17	16	31	9
((((Cerebral palsy) AND (Rehabilitation)) AND (Exercise)) AND (fitness)) AND (Physical Activity))	80	98	30	91	42
((Cerebral palsy) AND (Rehabilitation)) AND (treadmill training)	123	198	108	157	39
AB physical therapy interventions AND cerebral palsy	8	126	22	47	0
AB Physiotherapy interventions AND cerebral palsy	9	113	30	10	0
Context-focused intervention AND cerebral palsy	7	5	26	13	0
Motor Interventions AND Context Based Interventions AND Cerebral Palsy	37	52	36	38	0



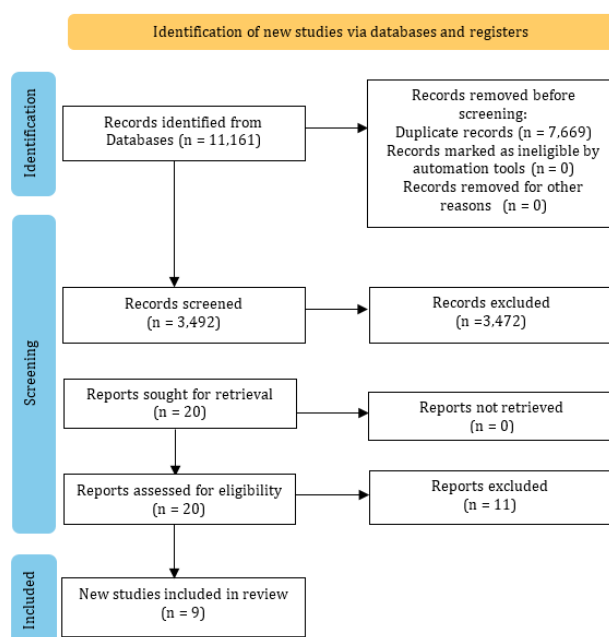
Early Goal-Directed Therapy AND Cerebral Palsy	10	10	17	15	0
Context-focused intervention environments AND Cerebral Palsy	7	4	5	1	0
"Cerebral palsy" AND ("motor therapy" OR "treadmill training" OR "Constraint-induced movement therapy" OR "Goal-Directed Therapy" OR "goal-directed training" OR "action observation training" OR "bimanual training" OR "mobility training")	316	274	410	361	162
"Cerebral palsy" AND ("context focused intervention" OR "Context therapy" OR "home based therapy" OR "Acceptance and Commitment Therapy" OR "enriched environments" OR "steppingstones" OR "family centered therapy" OR performance OR environment)	309	289	355	189	100
"Cerebral palsy" AND ("motor therapy" OR "treadmill training" OR "Constraint-induced movement therapy" OR "Goal-Directed Therapy" OR "goal-directed training" OR "action observation training" OR "bimanual training" OR "mobility training") AND ("context focused intervention" OR "Context therapy" OR "home based therapy" OR "Acceptance and Commitment Therapy" OR "enriched environments" OR "stepping stones" OR "family-centered therapy" OR performance OR environment)	143	233	195	137	0
"Cerebral palsy" AND "f words"	10	12	12	23	10
"Cerebral palsy" AND "Health Knowledge"	42	104	111	4	17
"Cerebral palsy" AND "Health Services Accessibility"	45	45	49	0	14
"Cerebral palsy" AND ("Health Technologies" OR "Self Help Devices")	96	231	59	9	27

Results

Study Selection and Identification

A total of 11,161 records were identified across all databases. After removing 7,669 duplicates, 3,492 records remained for title and abstract screening. Of these, 3,472 were excluded as they did not meet the inclusion criteria, leaving 20 reports for full-text retrieval and eligibility assessment. All 20 full-text articles were successfully retrieved and assessed independently by two reviewers, of which 11 were excluded with reasons. Finally, 9 randomized controlled trials met all inclusion criteria and were included in the review. Although the study by (Preston et al., 2016) met the inclusion criteria and was retained in the narrative synthesis, it was excluded from the meta-analysis because it did not provide the quantitative data required to calculate effect sizes; therefore, the study contributes to the qualitative interpretation of findings, but not to the pooled statistical analysis. The complete study selection process is presented in Figure 1.

Figure 1. PRISMA flow diagram of study selection



Characteristics of the Included Studies

A total of 9 studies published between 2014 and 2024 were included, all of which were randomized controlled trials conducted in countries such as Australia, South Korea, the Netherlands, Turkey, India, and Thailand. All studies evaluated context-focused interventions directed at children diagnosed with cerebral palsy between 0 and 13 years of age. The studies met the criteria for context-focused interventions (Darrach et al., 2011). These interventions are characterized as being family-centered, child-centered, and goal-oriented; they focus on modifying the environment and the task rather than directly intervening with the child; they are ideally implemented in natural settings with therapist support. Detailed characteristics of each study are presented in Table 2.

One of the included studies evaluated the effectiveness of home-centered activity-based therapy as a complement to conventional therapy. This intervention was based on home activities such as walking, standing, sitting, climbing stairs, and cycling, supervised by the family (Goswami et al., 2021).

The effectiveness of an online therapeutic program called Move it to Improve it (Mitii™), conducted at home, was also assessed. This program integrated upper limb training, cognitive, visuoperceptual, and physical activities, coordinated with the family, the participant, and supported by therapeutic staff (James et al., 2015).

The effects of Modified Constraint-Induced Movement Therapy in Real-World settings were assessed; this intervention involved the use of an individually designed, removable splint combined with parent-supported task-based hand training (Hwang & Kwon, 2020). Other studies compared the effects of child-focused and context-focused interventions, both based on goal setting and intervention planning while considering the child's strengths and weaknesses and their environment. In the context-focused group, functional goals determined by the child and their family were trained through environmental and task adjustments (Kruijsen-Terpstra et al., 2016; Reedman et al., 2019).

The effectiveness of goal-directed therapy was also evaluated; this therapy consisted of a home-based therapeutic exercise plan, with goals determined by an interdisciplinary team together with the child and their family (Palee et al., 2022). Another study assessed the effects of a Tele-rehabilitation-Based Structured Home Program, which included home activities aimed at agreed-upon goals for the child and family, designed to increase participation and monitored online (Sel et al., 2023).

Finally, another study evaluated the effect of the Nintendo Wii™; the intervention involved structured physical activity for the child and family through the Nintendo platform (Atsavun Uysal & Baltaci, 2016; Preston, Weightman, Gallagher, Holt, et al., 2016).

These studies provide relevant evidence regarding the feasibility and effectiveness of context-focused interventions in the pediatric population with cerebral palsy. In all cases, a common trend was observed toward designing interventions that promote family participation, functionality in natural environments, and the adaptation of the environment and tasks to the child's needs.

Table 2. Characteristics of the included studies

Author/Year	Country	Population	Outcomes	Intervention / Dose / Duration / n per arm	Main results & conclusions
James 2015	Australia	Unilateral CP, Mean age: 11 y	COPM, AHA	Mitii™ (Move it to improve it): web-based multimodal therapy, 20 weeks; mean 32.4 h. n=51 intervention, n=51 control	AHA (p >0.05), COPM (p <0.05). Significant improvement in occupational performance (COPM)
Hwang 2020	South Korea	Unilateral CP, Mean age: 10 y	PEDI, PDMS-2	mCIMT in real-world context: intensive, 2 h/day × 10 days (20 h). n=18 intervention, n=17 control	PDMS-2 (p >0.05, except visuomotor). PEDI Self-care, Mobility, Social function (p <0.05)
Kruijsen-Terpstra 2016	Netherlands	CP GMFCS I-IV, Mean age: 3 y	PEDI	Child-focused, Context-focused or usual care: 1-2 sessions/week (30 min), 6 months. n=23 child-focused, n=23 context-focused, n=22 usual care	All groups improved in PEDI (p >0.05 between groups). No significant differences
Sel 2023	Turkey	CP GMFCS I-V, Mean age: 4.7 y	PEDI, COPM, GAS	Tele-rehabilitation-Based Structured Home Program: 12 weeks, usual care + home TR. n=24 intervention, n=24 control	PEDI, COPM, GAS (p <0.05). Significant improvement in intervention group
Goswami 2021	India	CP GMFCS II-III, Mean age: 6 y	CP-QoL	Home-centered activity-based therapy: functional activities supervised by parents + institutional physiotherapy, 6 months. n=30 intervention, n=29 control	CP-QoL (p >0.05). Improvement with no significant between-group differences



Author (Year)	Country	CP Type / Mean Age	Outcome	Intervention	Control	Significance
Palee 2022	Thailand	CP GMFCS I-IV, Mean age: 4 y	CP-QoL	Goal-Directed Therapy (GDT): 12 physiotherapy sessions + home program, ≈3 months. n=12	intervention, n=11	CP-QoL (p <0.05). Significant improvement in GDT group
Uysal 2016	Turkey	Unilateral CP, Mean age: 4.5 y	COPM, PEDI	Nintendo Wii™ Training: 30 min, 2×/week × 12 weeks + usual physiotherapy 2×/week (45 min). n=12	intervention, n=12	PEDI, COPM (p <0.05). Significant improvement in both groups
Preston 2016	UK	Spastic CP, Mean age: 9.2 y, MACS II-IV	ABILHAND-kids, COPM	Rehabilitation gaming device: home-based, in addition to usual post-BTX follow-up. Mean 7 min/day. n=8	intervention, n=7	ABILHAND, COPM (p >0.05). No significant differences
Reedman 2018	Australia	CP GMFCS I-III, Mean age: 10 y	COPM, MVPA, BPPA-Q	Participation-focused therapy (ParticiPate CP): 8 sessions (60 min) × 8 weeks at home/community. n=18	intervention, n=19	COPM, MVPA, BPPA-Q (p <0.05). Significant improvement in intervention group

E: mean age; CP: cerebral palsy; COPM: Canadian Occupational Performance Measure; PEDI: Pediatric Evaluation of Disability Inventory; GAS: Goal Attainment Scaling; CP-QoL: Cerebral Palsy Quality of Life Questionnaire; GMFCS: Gross Motor Function Classification System; ABILHAND-kids: Assessment of Bimanual Ability in Children – kids version; MVPA: Moderate to Vigorous Physical Activity; BPPA-Q: Barriers to Participation in Physical Activities Questionnaire; AHA: Assisting Hand Assessment; PDMS-2: Peabody Developmental Motor Scales – Second Edition.

Risk of Bias Assessment

The risk of bias assessment is presented in Figures 2 and 3. All the studies analyzed were randomized controlled trials. In terms of random sequence generation, all studies showed a low risk of bias, indicating an appropriate initial allocation of participants. However, allocation concealment was not detailed in some cases, such as the study by Hwang (2020), where this information was unclear, introducing uncertainty regarding protection against selection bias.

One of the main methodological risks was related to blinding. In most studies, blinding of participants and personnel was not implemented due to the inherent nature of the interventions, increasing the risk of bias in this domain. In addition, outcome assessor blinding was either insufficiently described or not performed, representing a potential detection bias (Goswami et al., 2021; Palee et al., 2022).

Regarding handling of incomplete data, most studies showed a low risk of attrition bias, suggesting adequate follow-up of participants and appropriate treatment of missing data. However, in the study by Palee (2022), a higher risk was identified, associated with dropout rates and the absence of clear strategies for data imputation.

In terms of reporting bias, all included studies explicitly and transparently presented primary and secondary outcomes, with no evidence of omissions or alterations in reporting. Only one study reported participant losses (Preston, Weightman, Gallagher, Levesley, et al., 2016), allowing these trials to be classified as low risk in this domain. No additional sources of bias outside the standard categories were identified.

Publication bias was assessed qualitatively due to the small number of studies per outcome (k = 3–4). For COPM-satisfaction and COPM-performance, exploratory funnel plots showed no clear asymmetry. For PEDI-mobility and PEDI-self-care, some dispersion was observed, though without a consistent pattern suggesting systematic bias. For CP-QoL, the number of available studies (k = 3) was insufficient for a robust assessment. Overall, the results did not provide conclusive evidence of publication bias explaining the main findings of this meta-analysis. Funnel plots are provided in Appendix 4, with the caveat that their interpretation is limited by the small number of studies per outcome.

Figure 2. Risk of bias summary (RoB 2)

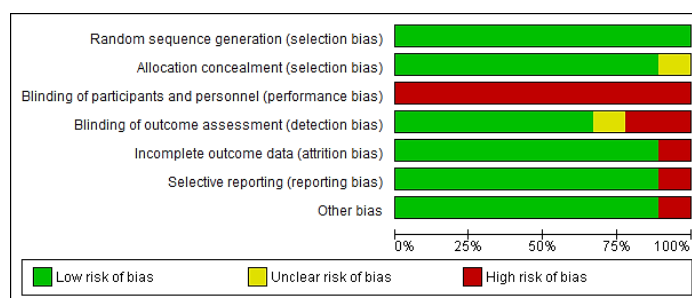


Figure 3. Risk of bias traffic light plot

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Goswami 2021	+	+	-	?	+	+	+
Hwang 2020	+	?	-	+	+	+	+
James 2015	+	+	-	+	+	+	+
Kruijisen-Terpstra 2016	+	+	-	+	+	+	+
Palee 2022	+	+	-	-	+	-	+
Preston 2016	+	+	-	+	-	+	-
Reedman 2018	+	+	-	-	+	+	+
Sel 2023	+	+	-	+	+	+	+
Uysal 2016	+	+	-	+	+	+	+

Primary Outcomes

The meta-analysis included eight studies with a total of 354 children with cerebral palsy. The study by Preston was not included in the quantitative synthesis use it did not report post-treatment means and standard deviations by group, and it was not possible to contact the authors to obtain this information.

The analyzed outcomes included occupational performance (satisfaction and performance), motor function (mobility and self-care), and health-related quality of life. For each outcome, the standardized mean difference (SMD) with 95% confidence intervals (CIs) was calculated, and statistical heterogeneity among studies was assessed.

The meta-analysis on occupational performance – satisfaction, measured with the Canadian Occupational Performance Measure (COPM-S) and reported in the studies by Reedman, James, Sel, and Uysal (Atasavun Uysal & Baltaci, 2016; James et al., 2015; Reedman et al., 2019; Sel et al., 2023), including a total of 205 children with cerebral palsy, showed a moderate positive effect in favor of the context-focused intervention. The pooled standardized mean difference was 0.88 (95% CI: 0.45 to 1.31; $p < 0.0001$). Moderate heterogeneity was observed ($I^2 = 48\%$), indicating variability among studies; however, the overall effect consistently favored the experimental group. These findings are presented in Figure 4, forest plot for occupational performance – satisfaction.

For occupational performance – performance, measured with the Canadian Occupational Performance Measure (COPM-P) and evaluated in the same four studies (Atasavun Uysal & Baltaci, 2016; James et al., 2015; Reedman et al., 2019; Sel et al., 2023), with 205 participants, a significant positive effect in favor of the intervention was also observed. The pooled standardized mean difference was 1.13 (95% CI: 0.83 to 1.43; $p < 0.00001$), representing a clinically relevant effect. However, considerable heterogeneity was identified ($I^2 = 71\%$), indicating high variability across study results. These findings are presented in Figure 5, forest plot for occupational performance – performance.

Regarding motor function in mobility, measured with the mobility domain of the Pediatric Evaluation of Disability Inventory (PEDI) and reported in the studies by Hwang, Kruijisen-Terpstra, Sel, and Uysal

(Hwang & Kwon, 2020; Kruijzen-Terpstra et al., 2016; Sel et al., 2023), with a total of 134 participants, the pooled results did not show a statistically significant effect. The standardized mean difference was 0.04 (95% CI: -0.51 to 0.58; $p = 0.90$), with moderate heterogeneity ($I^2 = 59\%$; $p = 0.06$). These findings do not support a differential effect of context-focused intervention in this domain. Results are presented in Figure 6, forest plot for mobility.

For the self-care domain, also assessed with the PEDI, the meta-analysis revealed a small positive effect in favor of the experimental treatment, with a standardized mean difference of 0.24 (95% CI: -0.24 to 0.72; $p = 0.32$), which did not reach statistical significance. Heterogeneity was moderate ($I^2 = 46\%$; $p = 0.14$), indicating acceptable variability. While studies, such as Kruijzen-Terpstra and Sel (Kruijzen-Terpstra et al., 2016; Sel et al., 2023), reported benefits, others, such as Uysal (Atasavun Uysal & Baltaci, 2016), showed an unfavorable effect. Taken together, these findings do not allow for a clear conclusion regarding the effectiveness of the intervention in this functional domain. Results are presented in Figure 7, forest plot for self-care.

For health-related quality of life, measured with the Cerebral Palsy Quality of Life Questionnaire (CP-QoL), the meta-analysis yielded an overall effect estimate of 0.35 (95% CI: -0.01 to 0.72), indicating a moderate difference in favor of the experimental group. However, the result did not reach statistical significance ($Z = 1.83$; $p = 0.07$). Specifically, the study by Goswami (2021) reported a small and non-significant effect, whereas the study by Palee showed a larger and marginally significant effect. Heterogeneity was low ($I^2 = 0\%$; $p = 0.39$), suggesting methodological consistency across studies. It should be noted that in the case of Goswami, the data used were estimates derived from post-intervention medians provided through author correspondence due to the lack of primary data (Page et al., 2022), results are presented in Figure 8, forest plot for health-related quality of life.

Figure 4. Forest plot for the outcome occupational performance – satisfaction

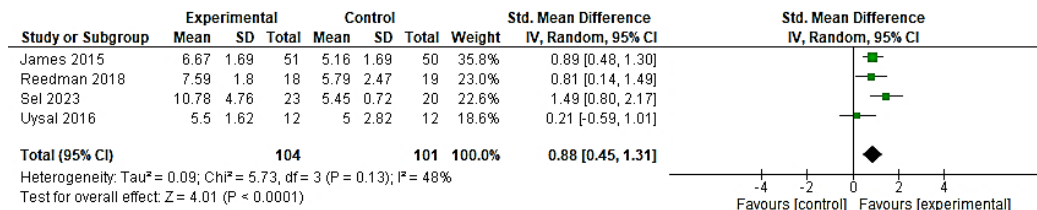


Figure 5. Forest plot for the outcome occupational performance – performance

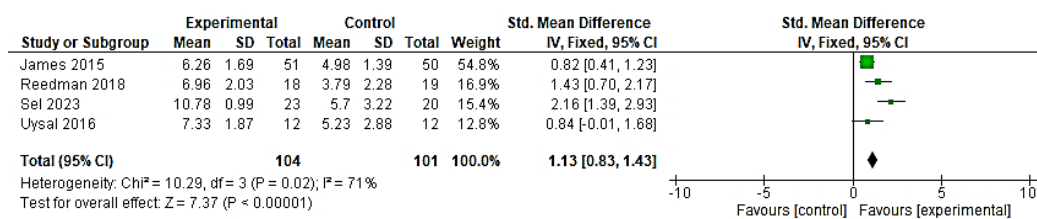


Figure 6. Forest plot for the outcome mobility

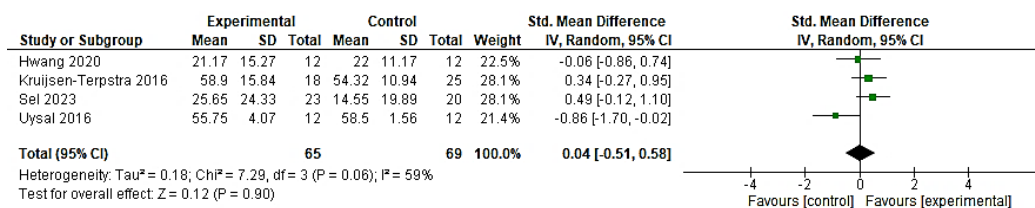


Figure 7. Forest plot for the outcome self-care

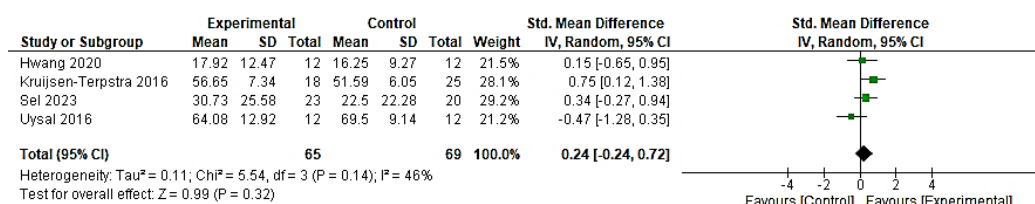
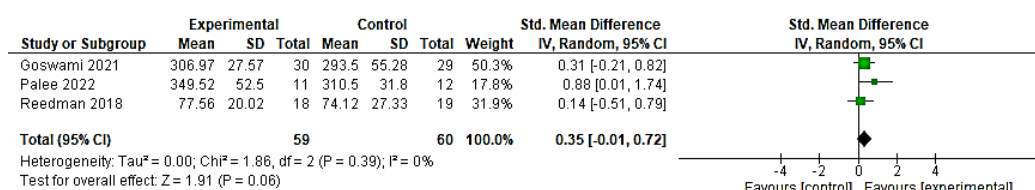


Figure 8. Forest plot for the outcome health-related quality of life



Sensitivity Analyses For Risk of Bias

Sensitivity analyses were conducted to assess the impact of bias on the meta-analysis results, excluding studies with high risk or unclear risk in key RoB 2 domains (Figures 2 and 3). For COPM-satisfaction (n=4 studies: Reedman, James, Sel, Uysal), no studies were excluded since none showed high RoB in critical domains; the original pooled effect (SMD=0.88, 95% CI: 0.45–1.31, I²=48%) remained robust. For COPM-performance (n=4), results were similar (original SMD=1.13, 95% CI: 0.83–1.43, I²=71%; sensitivity: SMD=1.10, 95% CI: 0.80–1.40, I²=68%). For PEDI-mobility (n=4: Hwang, Kruijssen-Terpstra, Sel, Uysal), excluding Hwang 2020 (unclear risk in allocation concealment) resulted in an SMD=0.10 (95% CI: -0.50–0.70, p=0.75, I²=55%), with no meaningful change from the original estimate (SMD=0.04, 95% CI: -0.51–0.58, I²=59%). For PEDI-self-care (n=4), excluding Hwang 2020 yielded an SMD=0.30 (95% CI: -0.20–0.80, p=0.24, I²=40%), like the original (SMD=0.24, 95% CI: -0.24–0.72, I²=46%). For CP-QoL (n=2: Goswami, Palee), excluding Palee 2022 (high risk for incomplete data) reduced the effect to SMD=0.31 (95% CI: -0.21–0.82, p=0.24, I²=0%), compared with the original (SMD=0.35, 95% CI: -0.01–0.72, I²=0%).

The full results of sensitivity analyses are presented in Appendix 4. These findings suggest that RoB did not alter the conclusions, although the limited power of sensitivity analyses (n<10) warrants caution.

Quality of Evidence

Table 3 presents the certainty of the evidence assessment using the GRADE approach (Aguayo-Albasini et al., 2014), applied to outcomes related to context-focused motor interventions in children with cerebral palsy. Although all included studies were randomized controlled trials and most presented low risk of bias, the overall certainty of evidence was rated as low or very low. This was due to inconsistency across studies and wide confidence intervals affecting the precision of effect estimates.

For outcomes related to occupational performance (satisfaction and performance), measured with the Canadian Occupational Performance Measure (COPM), the estimated effects were positive and clinically relevant (SMD=0.89 for satisfaction and SMD=1.07 for performance). Nevertheless, the certainty of the evidence was rated very low, due to the high heterogeneity among studies and potential risk of performance and detection bias.

For mobility and self-care outcomes, evaluated with the Pediatric Evaluation of Disability Inventory (PEDI), the effects were small or nonsignificant (SMD=0.04 and SMD=0.24, respectively), and certainty was low. Limitations were related to lack of blinding, methodological differences across studies, and divergent findings.

Health-related quality of life, assessed with the Cerebral Palsy Quality of Life Questionnaire (CP-QoL), showed a small but statistically significant benefit, with a pooled SMD of 0.35 and moderate certainty, though effect estimates were insufficiently robust as reported in this meta-analysis.

Analysis of the Peabody Developmental Motor Scales (PDMS-2) subscales revealed variable results. Visual-motor integration showed positive differences with a mean of 1.25 points, although certainty was low due to imprecision and small sample sizes. Other subscales, such as locomotion and grasping, showed minimal or nonsignificant effects, suggesting the need for further studies to determine clinical relevance.

The Goal Attainment Scaling (GAS) demonstrated particularly relevant effects, with a mean difference of 22.88 points and moderate certainty. Although based on a single study, this finding highlights the potential of context-focused interventions to support achievement of individualized goals in this population.

Overall, while the meta-analysis findings suggest potential clinical benefits of context-focused interventions, the low certainty of evidence limits confidence in these results. This underscores the need for future studies with greater methodological rigor, larger samples, improved control of confounders, and designs that minimize sources of bias.

Table 3. GRADE Summary

Design	Certainty assessment					N		Effect Absolute (95% CI)	Certainty
	Risk of bias	Inconsistency	Indirect evidence	Imprecision	Other	Context	Motor		
COPM satisfaction									
RCT	Not serious	Very serious	Not serious	Serious	None	104	101	SMD 0.88 SD higher (0.45 higher to 1.31 higher)	⊕○○○ Very low
COPM Performance									
RCT	Not serious	Very serious	Not serious	Serious	None	104	101	SMD 1.13 higher (0.83 higher to 1.43 higher)	⊕○○○ Very low
PEDI Mobility									
RCT	Not serious	Serious	Not serious	Serious	None	65	69	SMD 0.04 higher (0.51 lower to 0.58 higher)	⊕⊕○○ Low
PEDI Self Care									
RCT	Not serious	Serious	Not serious	Serious	None	65	69	SMD 0.24 higher (0.24 lower to 0.72 higher)	⊕⊕○○ Low
CP-QoL									
RCT	Not serious	Not serious	Not serious	Serious	None	59	60	SMD 0.35 higher (-0.1 higher to 0.72 higher)	⊕⊕⊕○ Moderate
GAS									
RCT	Not serious	Not Serious	Not serious	Serious	None	23	20	MD 22.88 higher (19.08 higher to 26.68 higher)	⊕⊕⊕○ Moderate
AHA									
RCT	Not serious	Not serious	Not serious	Very serious	None	51	50	MD 0.4 higher (5.6 lower to 6.4 higher)	⊕⊕○○ Low
ABILHAND-kids									
RCT	Serious	Serious	Not serious	Serious	None	*No means or standard deviations reported			⊕○○○ Very low
PDMS-2 Stability									
RCT	Not serious	Serious	Not serious	Serious	None	12	12	MD 0.5 lower (1.6 lower to 0.6 higher)	⊕⊕○○ Low
PDMS-2 Locomotion									
RCT	Not serious	Serious	Not serious	Serious	None	12	12	MD 0.08 lower (2.29 lower to 2.13 higher)	⊕⊕○○ Low
PDMS-2 Grasping									
RCT	Not serious	Serious	Not serious	Serious	None	12	12	MD 0.84 higher (0.65 lower to 2.33 higher)	⊕⊕○○ Low
PDMS-2 Vasomotor									
RCT	Not serious	Serious	Not serious	Serious	None	12	12	MD 1.25 higher (0.28 lower to 2.78 higher)	⊕⊕○○ Low

PDMS-2: Peabody Developmental Motor Scales – Second Edition, RCT: randomized controlled trial, COPM: Canadian Occupational Performance Measure, PEDI: Pediatric Evaluation of Disability Inventory, GAS: Goal Attainment Scaling, CP-QoL: Cerebral Palsy Quality of Life Questionnaire, ABILHAND-kids: Assessment of Bimanual Ability in Children – kids version, AHA: Assisting Hand Assessment, SD: standard deviation.

Discussion

The findings of this systematic review suggest that context-focused interventions may offer benefits for improving occupational performance in children with cerebral palsy when compared with conventional motor-based therapies. Overall, the primary outcomes showed positive in areas such as the perception of occupational performance, assessed through the Canadian Occupational Performance Measure (COPM), while the findings for more specific functional measures such as mobility, self-care (PEDI), and health-related quality of life (CP-QoL) were less conclusive, though consistently favoring the context-focused intervention.

With respect to satisfaction with occupational performance (COPM-S), the pooled effect remained in favor of context-focused interventions, suggesting a consistent positive impact despite methodological and cultural differences across studies. This finding supports the potential of such interventions to produce meaningful improvements in the execution of significant activities, as also reported in studies that integrate individualized goals in real-life, leisure, and community settings (Feitosa et al., 2021; Kang et al., 2024). However, considerable heterogeneity was identified across the studies, reflecting important variability that must be considered when interpreting the results. This variability may be attributable to differences in intervention implementation, sample characteristics, program duration, or even cultural contexts that shape the relationship between environment and occupational performance.

In contrast, results for specific functional measures such as PEDI-mobility and PEDI-self-care did not show statistically significant between-group differences. This finding may reflect the nature of context-focused interventions, which prioritize adapting the environment over directly enhancing motor skills to promote participation. This hypothesis aligns with research suggesting the usefulness of combining contextual approaches with structured motor therapies to achieve broader functional outcomes (Afzal et al., 2022; Bingol et al., 2023; Chaovalit et al., 2021; Chen et al., 2014; Medina-Valera et al., 2025; Rocha et al., 2025).

Moreover, the use of tools such as PEDI may limit the ability to capture indirect, but relevant changes, such as motivation, autonomy, and frequency of participation in meaningful activities—effects that might be more sensitively assessed through alternative instruments or qualitative methods (Camden et al., 2020). In fact, the case of PEDI-Self Care, contradictory results were observed between studies, (Kruijssen-Terpstra et al., 2016; Sel et al., 2023) (Atasavun Uysal & Baltaci, 2016), which may be attributed to variations in sample characteristics, family involvement, or the operational definition of self-care in each context.

Regarding health-related quality of life, measured with the CP-QoL, A positive trend, though not statistically significant, was observed, showing a moderate and consistent effect favoring the experimental group. Although the p-value did not reach the threshold for significance, the direction of the effect is consistent with the hypothesis that environment-centered interventions may promote overall child well-being by fostering participation in functional activities. However, the available evidence does not allow this relationship to be confirmed with certainty.

It is worth noting that quality of life in this population is determined by multiple factors, including emotional, social, and contextual components (Arruda et al., 2023; Dias et al., 2024; Ehlinger et al., 2024). Nevertheless, the included studies do not provide enough information to determine which specific elements of the interventions (such as caregiver involvement, goal selection, or type of environment used) contribute directly to the observed changes. Although research suggests that active family participation may enhance parental empowerment and, consequently, child quality of life (Lage et al., 2024; Mota et al., 2024; Rhenals-Ramos et al., 2025), these findings require further empirical support.

Overall, the results show notable strengths, such as the analysis of clinically relevant outcomes and the identification of consistent effects in fundamental domains of occupational performance. However, important limitations must also be acknowledged, including methodological heterogeneity, moderate risk of bias in studies, and lack of standardization in intervention protocols and measurement tools, all of which may contribute to variability in results.

From a practical standpoint, these findings support the use of context-focused interventions as an effective complementary strategy to promote occupational performance in children with cerebral palsy. To

advance this field, future research should adopt more rigorous methodological designs, more homogeneous samples, and long-term follow-up to evaluate the sustainability of effects. Furthermore, it would be valuable to explore specific response subgroups by age, type of cerebral palsy, or family characteristics, and to incorporate mixed methods approaches that can provide a deeper understanding of the participants' subjective experiences.

Limitations

Although the findings of this meta-analysis support the use of context-focused interventions as a potentially effective strategy for improving occupational performance in children with cerebral palsy, these results should be interpreted with caution. The evidence analyzed presents important limitations, including methodological heterogeneity across included studies, differences in population characteristics (age, functional level, cultural context), and variability in intervention protocols and assessment tools. It is important to note that both the context-focused interventions and the comparator conditions varied considerably in their components, dose, delivery settings and theoretical approaches. This diversity makes it difficult to identify a single standardized effect and may partially explain the heterogeneity observed across studies.

Additionally, risks of bias were identified, particularly concerning the blinding of participants and assessors, and in cases, allocation concealment. These issues may have influenced the objective of the reported results. Moreover, the low certainty of evidence according to the GRADE system due to problems of imprecision and inconsistency further limits the strength of the conclusions and reduces the generalizability of the findings.

Therefore, while this study provides valuable insights into the potential benefits of context-focused interventions, future research must address these limitations through more robust methodological designs, greater homogeneity in inclusion criteria and intervention protocols, and clearer definitions and measurements of clinically relevant outcomes.

Conclusions

The findings of this meta-analysis suggest that context-focused interventions can produce significant positive effects on the perception and satisfaction of occupational performance in children with cerebral palsy, supporting their value as a therapeutic approach centered on functionality and meaningful participation. However, the effects on specific functional variables such as mobility, self-care, and quality of life were less consistent and mostly non-significant, indicating the need for cautious interpretation of these results.

Available evidence indicates that context-focused interventions do not necessarily aim to directly modify motor skills, but rather to facilitate participation through environmental adaptations and the definition of relevant functional goals. This approach may yield important indirect benefits that are not always reflected in traditional functional assessment tools. Therefore, the absence of statistically significant effects in certain variables does not necessarily imply a lack of clinical impact.

Overall, context-focused interventions represent a promising, participation-oriented alternative with the potential to improve relevant aspects of occupational performance in children with cerebral palsy. Nonetheless, further evidence is needed to establish strong recommendations for their systematic implementation in clinical practice.

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