

Postural Control and Therapeutic Suits in Children with Cerebral Palsy: A Narrative Review

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ABSTRACT:

Cerebral palsy is one of the leading causes of motor disability in childhood and requires interventions aimed at optimizing postural control and motor function. This narrative review aimed to analyze the scientific evidence regarding the effectiveness of therapeutic suits on postural control in children with cerebral palsy. A bibliographic search was conducted in the PubMed database, including studies published between 2014 and 2024, such as clinical trials, observational studies, and systematic reviews. Methodological quality was assessed using the QUADAS-2 and AMSTAR-2 tools. The available evidence indicates that therapeutic suits improve postural alignment, balance, motor function, and gait, particularly when incorporated into multidisciplinary rehabilitation programs. It is concluded that therapeutic suits represent a promising complementary intervention; however, further high-quality studies are needed to strengthen the current evidence.

Keywords: Cerebral palsy; Postural control; Therapeutic suits; Dynamic orthoses; Motor function. (source: DeCS/MeSH BIREME).

Introduction

Cerebral palsy (CP) is the most common cause of motor disability in childhood and includes a group of permanent disorders of the development of movement and posture, caused by a non-progressive injury to the developing brain (1). This condition is characterized by alterations in muscle tone, postural control, and voluntary movement, which limit the execution of functional activities and restrict the child's participation in the different contexts of their daily life (1,2). Due to its wide clinical heterogeneity, CP represents a challenge for rehabilitation professionals, who must design individualized interventions aimed at enhancing the patient's functionality and independence (3).

Worldwide, the estimated prevalence of IPC ranges between 2.0 and 2.5 cases per 1,000 live births (3), while in Peru a prevalence of approximately 5.9 cases per 1,000 live births has been reported (4). These figures reflect the magnitude of the problem and show the need to implement therapeutic strategies based on the best available scientific evidence, which optimize the motor performance and quality of life of this population.

In recent decades, neuromotor rehabilitation has undergone significant advances through the incorporation of orthoses and assistive devices that promote body alignment, postural control, and motor function (5–7). Within these interventions, therapeutic suits have acquired special interest due to their ability to provide dynamic support through compressive and alignment forces, favoring proximal stability, sensorimotor integration, and the execution of functional movements (8–10). Their application as a complement to intensive physiotherapy programs has shown favorable results in variables such as balance, gait, coordination, and motor performance, also contributing to an increase in functional participation and quality of life in children with CP (11–16).

However, despite the growing number of published studies, the available evidence continues to show heterogeneous results regarding the efficacy of therapeutic suits on

postural control. Differences in methodological designs, the type of suit used, the duration of the interventions, the functional levels of the participants, and the outcome variables evaluated make it difficult to compare between studies and limit the possibility of establishing consistent clinical recommendations (17,18). This variability highlights the need to integrate and critically analyze the available information to better understand the impact of this intervention on the rehabilitation of children with cerebral palsy.

In this context, this narrative review aims to analyze the scientific evidence on the efficacy of therapeutic suits in the postural control of children with cerebral palsy, through the critical synthesis of studies published during the last decade. It also seeks to identify the main benefits, limitations and clinical implications of this intervention as a complement to rehabilitation programs, with the purpose of providing updated information that contributes to evidence-based decision-making and guides future lines of research in pediatric neurorehabilitation.

Methodology

A narrative review with a systematic approach was carried out, adopting systematized procedures for the search, selection, and analysis of evidence, with the purpose of increasing the transparency and methodological rigor of the review process, aimed at analyzing the efficacy of therapeutic suits in the postural control of children with cerebral palsy. The literature search was carried out between July and December 2024 in PubMed/MEDLINE, using MeSH and free terms (Cerebral Palsy, Postural Control, Suit Therapy, TheraSuit, TheraTogs, Lycra, Dynamic Elastomeric Fabric Orthoses [DEFO], Adeli Suit) combined using DNA/OR (Table 1). The selection of studies was structured under the PICO strategy, considering children and adolescents aged 2 to 18 years with cerebral palsy (GMFCS I–V), the use of therapeutic suits alone or combined with rehabilitation as an intervention, conventional interventions without a suit as a comparator, and as the main outcome the efficacy on postural control, along with motor function, balance and gait. Studies published

between 2014 and 2024 in English, Spanish and Portuguese (clinical trials, observational trials and systematic reviews) were included, excluding editorials, letters, comments, case reports, studies in other pathologies, exclusive evaluations of rigid orthoses and insufficient information. Identification and selection were carried out independently by two investigators, with discrepancies resolved by consensus with a third, documenting the process using the PRISMA flowchart (Figure 1). Author, year, design, sample characteristics, type of suit, intervention, assessment instruments, and results on postural control and motor function were extracted from each study, synthesizing the evidence through narrative analysis grouped by methodological characteristics and clinical outcomes. The methodological quality of systematic reviews was assessed with AMSTAR-2, while primary studies received a critical assessment according to their design, in order to identify biases and support the interpretation of the findings.

Discussion

TheraTogs® type therapeutic suits

TheraTogs® therapeutic suits were one of the most represented devices among the included studies (26,28,29). Their design is based on a system of adjustable elastic bands that provide dynamic compression and continuous proprioceptive feedback, favoring body alignment and proximal stability during the execution of functional activities. The reviewed evidence showed consistent improvements in postural control, balance, and gross motor function, especially when these devices were used as an adjunct to intensive rehabilitation programs.

Ehlert et al. (26) reported significant improvements in posture, gait, and functional performance after the use of TheraTogs®, while Emara et al. (28) showed favorable effects on postural control and functional endurance in children with spastic diplegia. For their part, Shaari et al. (29) compared the pressure exerted by TheraTogs® and Dynamic Lycra®, observing that both devices generated compressive stimuli capable of favoring postural stability, although

with differences in the distribution of forces on the axial axis.

Taken together, the findings suggest that TheraTogs® is one of the most scientifically supported therapeutic suits in the recent literature. However, the heterogeneity of the intervention protocols and the small sample size of some studies limit the generalizability of the results.

Lycra® Therapeutic Suits

Garments made with Lycra® fabric represent another of the most studied interventions in the rehabilitation of children with cerebral palsy (22,29). Its main mechanism of action is based on the circumferential compression exerted on the trunk and limbs, providing an increase in proprioceptive information and favoring postural alignment during functional activities.

Romeo et al. (22) described improvements in postural control and movement organization after the use of these garments, while Shaari et al. (29) demonstrated that Dynamic Lycra® generated a higher pressure than that obtained with TheraTogs®, particularly on the axial axis. However, the available evidence does not yet allow us to establish whether greater pressure necessarily translates into better functional results, due to the absence of studies that directly relate the intensity of compression with the changes observed in postural control.

Although the results are promising, questions remain regarding the optimal dosage of the treatment, the time of use and the influence of the pressure exerted on the soft structures, aspects that should be addressed in future research.

TheraSuit Therapeutic Suits®

The TheraSuit® system has been used mainly as part of intensive neuromotor rehabilitation programs, combining the use of the suit with functional exercises aimed at postural control and gait training (27).

The included studies showed improvements in variables related to postural stability and functional performance; however, the evidence

remains limited due to the limited number of available studies and the variability between therapeutic protocols. In addition, differences in the duration of the interventions and in the functional characteristics of the participants make it difficult to draw definitive conclusions about their clinical efficacy.

Therefore, although TheraSuit® is a widely used alternative in clinical practice, there is still a need for clinical trials of higher methodological quality to confirm its benefits and define standardized application protocols.

Elastomeric Tissue Therapeutic Suits (DEFO)

Dynamic elastomeric tissue orthoses (DEF) were mainly evaluated by BahramiZadeh et al. (10) and Giray et al. (12), who reported improvements in balance, seated stability, and gross manual dexterity when these garments were incorporated into rehabilitation programs.

However, the results also showed that the benefits on short-term postural control were discrete and that the greatest effects were observed in proximal stability and body alignment. These findings suggest that the main contribution of OFOs could be related to the optimization of postural organization rather than to immediate changes in global motor function.

AdeliSuit® type therapeutic suits

Evidence related to AdeliSuit® was less abundant than that found for other devices. The available studies described improvements in gait and some gross motor skills when the suit was combined with neurointensive treatment (23,24). However, the limited amount of research and small sample sizes limit the strength of the conclusions.

Consequently, although the initial results are favorable, the available scientific evidence is insufficient to establish robust clinical recommendations regarding its use.

Comparison of efficacy between different therapeutic suits

The joint analysis of the evidence indicates that TheraTogs® and Lycra® concentrate the largest number of studies and present more consistent results on postural control, proximal stability and

balance. In contrast, TheraSuit®, DEFO and AdeliSuit® show favorable evidence, although supported by a smaller number of studies and with greater methodological heterogeneity.

Despite these differences, no device conclusively demonstrated clinical superiority over the others or over conventional physiotherapy. The benefits observed seem to depend, to a greater extent, on the integration of the therapeutic suit within structured rehabilitation programs, on the appropriate selection of the patient and on the individualization of the therapeutic objectives, rather than on the device used.

In addition, significant differences persist between studies in terms of time of use, treatment intensity, participant selection criteria, and outcome variables used, limiting direct comparison between studies and making it difficult to formulate universal clinical recommendations.

Clinical implications and future prospects

The present review shows that therapeutic suits are a complementary intervention with the potential to promote postural control and motor function in children with cerebral palsy, especially when their use is part of comprehensive rehabilitation programs. However, the evidence still has methodological limitations that prevent the establishment of standardized protocols on the most appropriate type of suit, the optimal intensity of treatment and the duration of the intervention.

Another relevant finding was the absence of studies that evaluate structured training programs aimed at health professionals, caregivers and family members for the correct indication, adaptation and monitoring of the use of these devices. Considering that the efficacy of therapeutic suits depends to a large extent on their proper prescription and use, the development of training strategies is a priority line for future research.

Finally, it is recommended that future studies include larger samples, robust methodological designs, long-term follow-ups, and homogeneous protocols that allow for an objective comparison

of the efficacy of different types of therapeutic suits and strengthen evidence-based clinical decision-making.

Conclusion

This narrative review allowed us to analyze the available scientific evidence on the efficacy of therapeutic suits in postural control of children with cerebral palsy. Overall, the studies reviewed indicate that these interventions constitute a promising complementary resource within rehabilitation programs, mainly favoring postural alignment, proximal stability, balance, gross motor function and, in some cases, gait quality. The greatest benefits were observed when therapeutic suits were used as part of structured and goal-oriented interventions, rather than as an isolated therapeutic strategy.

However, the available evidence remains heterogeneous due to differences in methodological designs, types of therapeutic suits, dosage of interventions, functional characteristics of participants, and outcome measures used. These limitations prevent establishing the superiority of a specific device or defining standardized protocols for its clinical use.

From a clinical perspective, the selection of the therapeutic suit should be based on an individualized evaluation of the child,

considering the functional level, the therapeutic objectives and the integration of the device within an interdisciplinary rehabilitation program. Likewise, the correct prescription, adaptation and follow-up of the treatment are determining factors to optimize functional results.

Finally, it is recommended to develop multicenter clinical trials with greater methodological rigor, representative samples, standardized intervention protocols, and medium- and long-term follow-ups. Similarly, it is a priority to investigate the training of health professionals and families, as well as to establish evidence-based clinical recommendations that guide the prescription and use of different types of therapeutic suits in children with cerebral palsy.

Roles according to CRediT. GI: conceptualization, research, data curation, methodology, project management, original draft writing, writing-revision, and editing. WD: conceptualization, research, writing-original draft, writing-revision, and editing. JP: conceptualization, research, methodology, project management, writing-revision, and editing.

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Table 1: Search Strategy

SEARCH	SEARCH TERMS	RESULTS
#1	Search: (((("Suits"[Title/Abstract]) OR ("Theratog"[Title/Abstract]) OR ("Lycra"[Title/Abstract]) OR ("Terapia de traje"[Title/Abstract]) OR "Suits"[Title/Abstract] OR "Theratog"[Title/Abstract] OR "Lycra"[Title/Abstract])	3647
#2	Search: ((((((("Suits"[Title/Abstract]) undefined ("Dynamic Elastomeric Fabric Orthoses"[Title/Abstract])) undefined ("Theratog"[Title/Abstract]) OR ("Lycra"[Title/Abstract]) OR ("Adely"[Title/Abstract]) OR ("Therasuit"[Title/Abstract]) OR ("Pediasuit"[Title/Abstract]) AND ("Suits"[Title/Abstract] AND "undefined"[All Fields]) AND "Dynamic Elastomeric Fabric Orthoses"[Title/Abstract]) AND "undefined"[All Fields]) AND "Theratog"[Title/Abstract] OR "Lycra"[Title/Abstract] OR "Adely"[Title/Abstract] OR "Therasuit" AND (y_10[Filter])	115
#3	Search: (((((((("Suits"[Title/Abstract]) undefined ("Dynamic Elastomeric Fabric Orthoses"[Title/Abstract])) undefined ("Theratog"[Title/Abstract]) OR ("Lycra"[Title/Abstract]) OR ("Adely"[Title/Abstract]) OR ("Therasuit"[Title/Abstract]) OR ("Pediasuit"[Title/Abstract]) AND ("Cerebral Palsy"[Title/Abstract]) AND ("Suits"[Title/Abstract] AND "undefined"[All Fields]) AND "Dynamic Elastomeric Fabric Orthoses"[Title/Abstract]) AND "undefined"[All Fields]) AND "Theratog"[Title/Abstract] OR "Lycra"[Title/Abstract] OR "Adely"[Title/Abstract] OR "Therasuit"[Title/Abstract]) AND "Cerebral Palsy"[Title/Abstract])	21

Source: Authors.

Table 2: Summary of the articles reviewed

Author's Name	Title	Magazine	Year of publication	Design Type
Toohey (18)	Effectiveness of postural interventions in cerebral palsy: umbrella systematic review	Paediatrics and Child Health	2024	Systematic Review
Emara (28)	Effect of the Dynamic Orthotic Garment on Postural Control, and Endurance in Children with Spastic Diplegic Cerebral Palsy: A Randomized Controlled Trial	J Multidiscip Healthc.	2024	a single-blind randomized controlled Trial
Elias(14)	Effects of the use of therapeutic garments in rehabilitation programs for children with cerebral palsy: an integrative literature review	Brazilian Journal of Science and Movement	2022	An integrative literature review
Belizon (15)	Effects of Dynamic Suit Orthoses on the Spatio-Temporal Gait Parameters in Children with Cerebral Palsy: A Systematic Review	Children	2021	Systematic Review
Novack (13)	Traffic lights of the state of the evidence 2029: systematic review of interventions to prevent and treat children with cerebral palsy	Current Neurology and Neuroscience Reports	2020	Systematic Review
Giray (12)	The effects of vest type dynamic elastomeric fabric orthosis on sitting balance and gross manual dexterity in children with cerebral palsy	Disability and Rehabilitation	2020	a single-blinded randomised controlled study
Shaari (29)	A case study on interface pressure pattern of two garment orthoses on a child with cerebral palsy.	Proc Inst Mech Eng H	2020	a single-blinded randomised controlled study
Karadağ (9)	The clinical aspects and effectiveness of suit therapies for cerebral palsy: A systematic review	Turk J Phys Med Rehab	2018	Systematic Review
Wells (17)	Garment Therapy does not Improve Function in Children with Cerebral Palsy: A Systematic Review	Physical & occupational therapy in pediatrics	2018	Systematic Review
Romeo (22)	Effects of Lycra suits in children with cerebral palsy	European Journal	2018	Experimental

		Paediatric Neurology		
Chavez (25)	Effect of the therapeutic suit on gross motor function of children with cerebral palsy	Cuban Journal of Pediatrics	2018	Observational, longitudinal and retrospective
Pavão (27)	Effects of Suit-Orthosis on Postural Adjustments During Seated Reaching Task in Children With Cerebral Palsy	Pediatric Physical Therapy	2018	Observational, longitudinal and retrospective
Ehlert (26)	Cerebral palsy: Influence of TheraTogs® on gait, posture and functional performance	Physioter	2017	a single-blinded randomised controlled study
Almeida (8)	Effects of interventions with therapeutic suits (clothing) on impairments and functional limitations of children with cerebral palsy: a systematic review	Brazilian Journal of Physical	2017	Systematic Review
Mi-Ra (23)	Effects of combined Adeli suit and neurodevelopmental treatment in children with spastic cerebral palsy with gross motor function classification system levels I and II	HongKong Physiotherapy Journal	2016	a single-blinded randomised
Bahramizadeh(10)	Effect of Dynamic Elastomeric Fabric Orthoses on Postural control in Children with Cerebral Palsy	Journal Pediatric Physiotherapy	2015	Experimental
Martins (30)	Efficacy of suit therapy on functioning in children and adolescents with cerebral palsy: a systematic review and meta-analysis.	Developmental Medicine and Child Neurology	2015	Systematic Review and meta-analysis
KO(24)	Effect of Adeli suit treatment on gait in a child with cerebral palsy: a single-subject report	Physiotherapy Theory Practice	2014	a single-blinded randomised controlled study
Matthews (16)	Effects of Dynamic Elastomeric Fabric Orthoses on Children with Cerebral Palsy	Prosthetic and Orthotics International	2009	Phase 1 exploratory study

Table 3: Summary of Critical Evaluation of Systematic Reviews of Health Intervention Studies - AMSTAR-2.

Author's Name	Title	Year of publication	Trust
Toohey (18)	Effectiveness of postural interventions in cerebral palsy: umbrella systematic review	2024	MEDIA
Elias(15)	Effects of the use of therapeutic garments in rehabilitation programs for children with cerebral palsy: an integrative literature review	2022	MEDIA
Belizon (14)	Effects of Dynamic Suit Orthoses on the Spatio-Temporal Gait Parameters in Children with Cerebral Palsy: A Systematic Review	2021	HIGH
Novack (13)	Traffic lights of the state of the evidence 2029: systematic review of interventions to prevent and treat children with cerebral palsy	2020	MEDIA
Karadağ (9)	The clinical aspects and effectiveness of suit therapies for cerebral palsy: A systematic review	2018	HIGH
Wells (17)	Garment Therapy does not Improve Function in Children with Cerebral Palsy: A Systematic Review	2018	MEDIA
Almeida (8)	Effects of Therapeutic Suit (Clothing) Interventions on Functional Impairments and Limitations of Children with Cerebral Palsy: A Systematic Review	2017	MEDIA
Martins (30)	Efficacy of suit therapy on functioning in children and adolescents with cerebral palsy: a systematic review and meta-analysis.	2015	HIGH

Table 4. Compare

Table 4. Comparison of the clinical of the clinical characteristics and evidence of the main therapeutic suits used in children with cerebral palsy.

Type of therapeutic suit	Biomechanical principle	Main benefits reported	Limitations of the evidence	Level of evidence
TheraTogs®	Adjustable elastic band system that provides dynamic compression, segmental alignment, and continuous proprioceptive feedback.	Improvements in postural control, proximal stability, balance, gait, and gross motor function when combined with intensive rehabilitation programs.	Heterogeneous protocols, small samples and poor long-term follow-up.	High
Lycra®	Elastomeric fabric	Improvements in postural	There is no	Moderate-

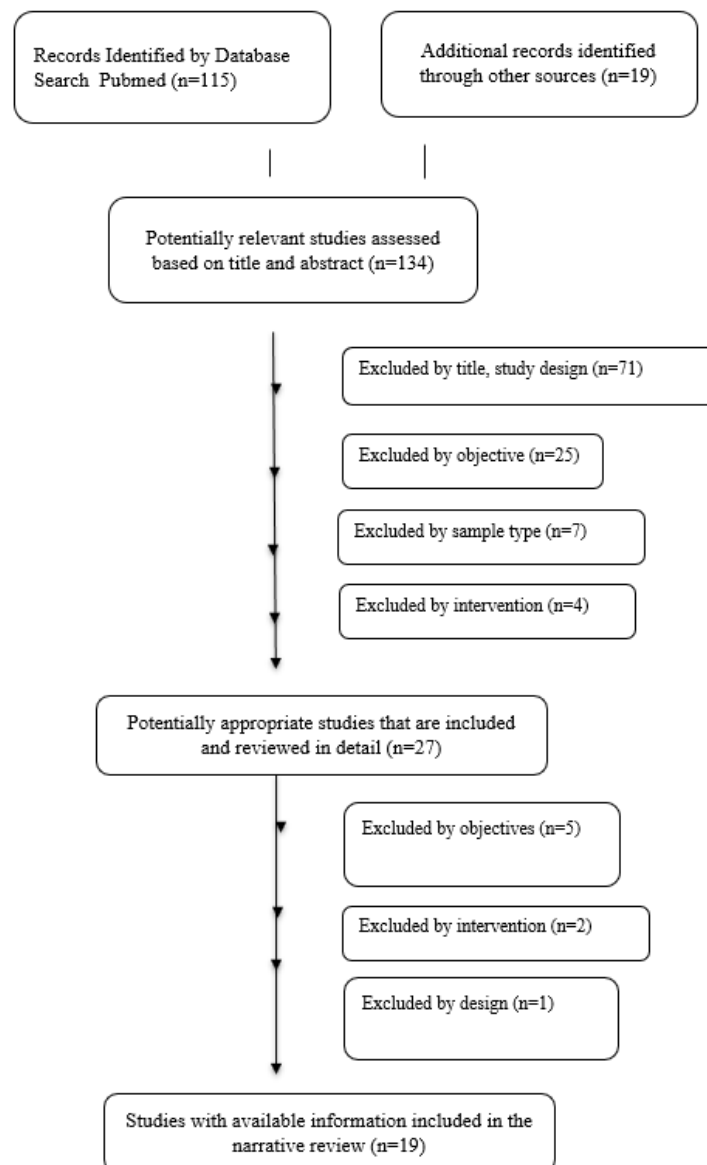
Type of therapeutic suit	Biomechanical principle	Main benefits reported	Limitations of the evidence	Level of evidence
	garment that exerts circumferential compression, favoring body alignment and increasing proprioceptive information.	alignment, trunk stability, balance and organization of movement.	consensus on optimal pressure or on the relationship between compression and functional outcomes.	High
TheraSuit®	System of elastic bands attached to the suit that facilitates body alignment during intensive functional exercises.	Improvements in postural control, gait, and some motor skills when integrated into intensive physical therapy programs.	Limited number of studies and high methodological variability.	Moderate
DEFO (Dynamic Elastomeric Fabric Orthosis)	Orthosis made with elastomeric fabric designed to provide postural stability through selective compression.	Promotes stability in sitting, balance and body alignment; improves gross manual dexterity.	Discrete benefits on immediate postural control and scarce evidence in prolonged follow-up.	Moderate
AdeliSuit®	Dynamic suit with elastic band system designed to facilitate functional movement patterns during intensive rehabilitation programs.	Improvements in gait and gross motor function when combined with neurodevelopmental treatment.	There is little scientific evidence, small sample sizes, and few recent clinical trials.	Low-Moderate

Table 5: Recommendations for clinical practice derived from evidence on the use of therapeutic suits in children with cerebral palsy.

Clinical Appearance	Evidence found	Recommendation
Control postural	Consistent evidence of improvement with TheraTogs® and Lycra® when used in conjunction with physiotherapy.	Use as an adjunct and not as an isolated treatment.
Balance	Improvements reported in most studies.	Especially indicated in programs oriented to proximal stability.
March	Benefits in speed and ride quality, mainly with TheraSuit® and AdeliSuit®.	Individualize according to functional level (GMFCS).

Clinical Appearance	Evidence found	Recommendation
Gross motor function	Moderate improvements when suits are part of intensive programs.	Always associate with task-oriented functional training.
Usage Time	Variable protocols (2–6 hours/day; 4–5 weeks).	There is no established optimal dose; individualize according to tolerance and therapeutic objectives.
Adverse events	Discomfort related to comfort and, occasionally, mild respiratory restriction.	Supervise suit fit and follow up regularly.
Knowledge gaps	There is little evidence in long-term follow-up and absence of standardized protocols.	Prioritize multicenter research with greater methodological rigor.

PRISMA Revised Study Selection Diagram



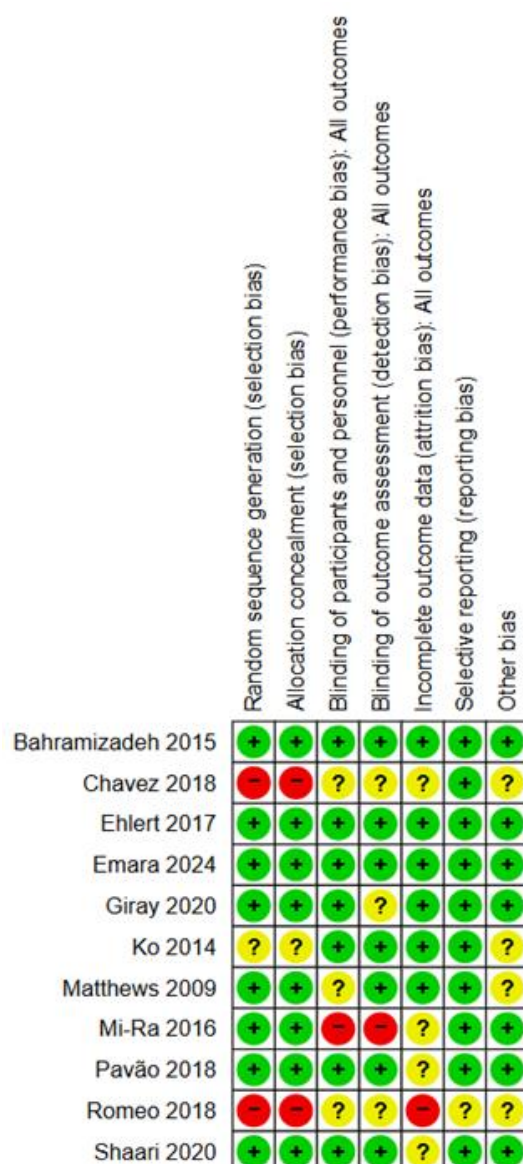


Figure 2: QUADAS-2. Probability of Risk and Concern about Applicability of Results. Green: low risk of bias; yellow: unclear risk of bias; red: high risk of bias.

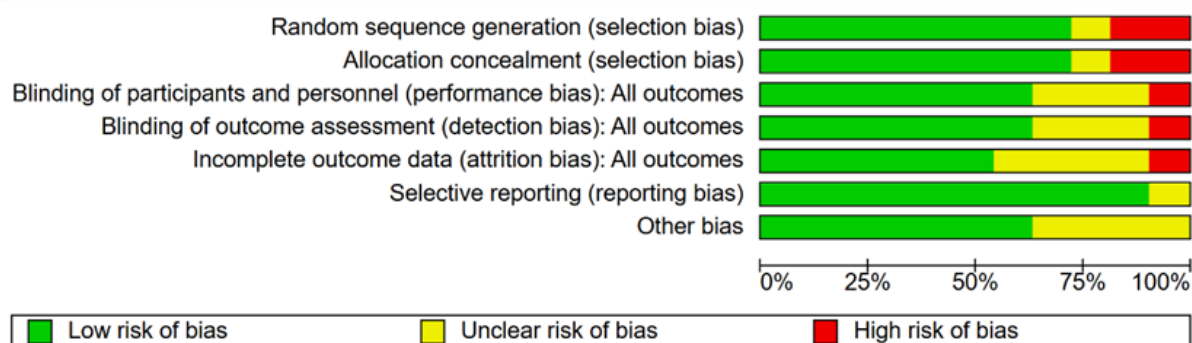


Figure 3: QUADAS-2. Overall risk of bias. Results are presented in percentages