THE EFFECT OF DIFFERENT WALKING DEVICES ON BODY FUNCTIONS, ACTIVITY AND PARTICIPATION IN CHILDREN WITH CEREBRAL PALSY; A SYSTEMATIC LITERATURE REVIEW

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Aim

1. **Description and classification** of assistive devices that facilitate walking

2. **Evidence** of the impact the different devices have on
   - ➢ Body structure and function
   - ➢ Activity and Participation

Definition

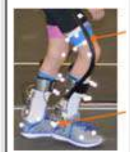
A device that uses the residual capacity of the child to stand and walk and assists in standing, balance and locomotion by:

- increasing the base of support
- reducing the load on the affected limbs
- providing sensory information
- reducing the deviation of the center of gravity

(Fas A et al , 1995)

- providing actuated movements of the legs to support or replace self-iniated movements

Classification

Handheld Walkers	Gait Trainers	Robotic Devices			
		Static		Dynamic	
		Threadmill with PBWS	Robotic stationary systems	Overground walking systems	Wearable Exoskeleton
					

Method: systematic literature study

EFFECT OF DIFFERENT WALKING DEVICES

Inclusion criteria : Cerebral Palsy, 0-18 Y, GMFCS I-V, walking aids ,walking devices PRISMA

Excluded : Non CP , +18 Y, Systematic Reviews

Date : Jan 1990- March 2019 Pubmed, WoS, Embase, Cochrane,

Study 1	Study 2	Study 3
TRUNK AND PELVIS MOVEMENTS DURING GAIT, WITH AND WITHOUT EXTERNAL CONTROL	EFFECT ON KINEMATICS OF THE GAIT PATTERN	EFFECT ON HAND FUNCTION, (HAND) ACTIVITIES AND PARTICIPATION
11 studies	12 studies analysed	11 studies

Study 4 Synthesis
EVIDENCE OF THE IMPACT THE DIFFERENT DEVICES HAVE ON BODY STRUCTURE AND FUNCTION, ACTIVITY AND PARTICIPATION
44 studies

Method: search flowchart

Articles identified (n=1838)

→ Duplicates (n=201)

Potentially relevant (n=1614)

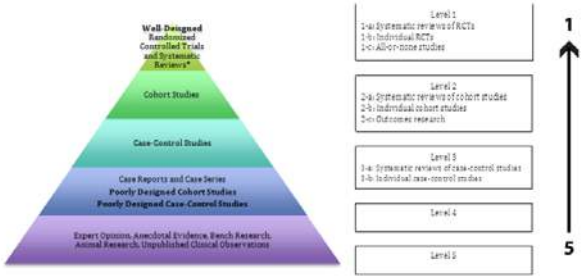
→ Articles excluded based on abstract or title (n=1541)

Potentially relevant articles remained (n=73)

→ Articles excluded (n=29)
- Not CP patients
- Not in English
- Full text and/or abstract not available
- Not relevant for this search

Studies identified (n=44)

Levels of evidece



Results: handheld walkers

Author	Year	Aim	Group	Conclusion	Evidence
Effect on upper extremities					
Baker et al.	2004	posterior walkers	N= 25	Throughout a gait cycle, the shoulders and wrist are in extension and the elbows are flexed. It also reveals that the elbows are the most asymmetrical joint of the upper extremities during walker-assisted ambulation	IV
Konop et al.	2011	shoulder, elbow, wrist joints AW-PW	N=10, spastic DP	Anterior and posterior walkers produce similar UE motion and peak loading values. Wrist and elbow joint derotation (adjusted grip) alters the dynamic effects experienced by the UEs. UE motion analysis during aided gait can be useful for optimizing UE loading conditions to limit pathology later in life	IV
Effect on lower extremities and pelvis					
Krautwurst et al.	2016	forearm crutches and PW	N=26 GMFCS II-III	Independent of the type of assistive devices, more anterior trunk tilt and pelvic tilt (7°± 6° and 3° ± 2°) and with a maximum ankle dorsiflexion decreased by 2° (±3°) when walking with assistive devices, enhancing the mal-positioning present without device. Oppositely, the knees on average are more extended by 6° (±4°) when using the assistive devices.	IV
Comparison of anterior and posterior walkers					
Bachschmidt et al.	2000	AW-PW gait kinematics	N=9, spastic DP, 8-17 y	increased double limb support time (24.3%-30.7%) with the AW, increased walking speed (16.7%-21.4%) with PW. Elbow extensor and wrist flexor demands greater with AW (-0.19 "/kg, 0.07 "/kg) than with the posterior walker (-0.06 " k g , 0.02 "/kg).	II b
Logan et al.	1990	AW-PW	N=8, 2.5-8 y;	Posterior walker: SL increased significant by 41%, period of gait cycle spent in double support decreased significantly by 39%, GV increased by 40% but difference was not significant, Trunk flexion significantly less than anterior walker on every point in the gait cycle, hip flexion decreased at each point in gait cycle, significantly at mid-stance, pre-swing and mid-swing, knee flexion slightly less at every point of gait cycle but difference was not significant;	
Mattsson et al.	1997	AW-PW	N=10, spastic DP	No diffeences in the measured speed, energy cost and perceived exertion in walking between AW & PW in children familiar with both walkers ;most of the children preferred PW	IV
Park et al.	2001	Gait pattern and energy consumption	N=10, spastic DP	O2 consumption + cost significantly lower in PW. No significant difference between AW-PW in walking speed. Step length, single support time and double support time significanlty different for the two walkers. Flexion angles of the trunk, hip and knee lower in PW.	II b
Strifling et al	2008	UE kinesmatics	N=10, spastic DP	Both walkers are relatively similar: shoulders extended, elbows flexed, and wrists extended. Energy expenditure, walking speed and stride length also similar AW or PWs. Anterior torso tilt reduced in PW; shoulder extension and elbow flexion were increased. Differences in upper extremity torso and joint motion were not dependent on spasticity or hand dominance.	IIb

Results: gait trainers

Results gait trainers partial bodyweight support

Authors	year	Study	Intervention	Group	Conclusions	LoE
Botega et al.	2013	Cross-sectional	Walking aid with axillary support (WAAS)	N=6, spastic DP	Improved lower limbs muscle synergism by reducing coactivation of antagonistic muscles, during swing . Improved trunk stability	IV
Fergus et al	2017	Case study	Upsee harness + Kinesiotape	N=1, CP GMFCS III	Gross Motor Function Measure-66 improved by 11.4.	V
Paleg et al.	2013	Qualitative study	Hartman Walker ; parent interviews	N=19	better communication , more independent , better participation	V
Whinnery et al	2002	Case study	Rifton pacer	N=1	Increased number of steps	IV
Willoughby et al.	2010	RCT	To compare overground walking and walking in gait trainer	N=34	no signicant difference; trend towards increased distance in over ground walking group	IIb
Wright et al.	2016	Cohort study	look for improvement of activity (gait,participation) using the Hartman Walker	N=19	No change in walking speed and GMFCS after 1 y follow up. Increased self care and social function	III

Conclusions 1

Handheld Walkers	Gait Trainers	Robotic Devices			
		Static		Dynamic	
		PBWSS Treadmill	STATIC Systems	Overground walking systems	Wearable Exoskeleton
• **GRADE quality LOW** • May affect **Body function and structure** ➢ **PW more** upright positioning and energy conservation **than AW** ➢ **Malalignment** present without walker i= **enhanced by use of PW and AW .** Bachschmidt et al 2000 Park et al 2001 Strifling et al 2008	• **GRADE quality LOW** • **Heterogeneity and variety of walkers** • ***May*** affect all levels of ICF better bowel function, bony density , level of activity ,motivation and participation • Further research needed in all aspects of gait trainer assessment, selection and implementation Willoughby et al. 2010	• **Conflicting results** • **GRADE quality mostly LOW** • *May* affect **activity** ➢ Higher walking speed and distance ➢ Improving gross motor functions Borggräfe et al ;Druzbicki;Meyer-Heim et al.;Peri E. et al. ;Romei et al ;Schroeder AS et al.;Smania et al. ; Wallard L. et al;		• **GRADE quality LOW** • **Most are prototypes** • **May affect all levels of ICF** ➢ Muscle strength,endurance,postural control ➢ Higher walking speed and distance ➢ Improve participation &QoL Bayon et al.2016	• Evidence for ➢ a wearable knee extension exoskeleton to improve crouch gait ➢ Powered ANKLE assistance augmented, rather than simply replaced, biological function to produce a more efficient gait pattern Lerner et al 2017

Conclusions study trunk & pelvis control

1. Trunk tilt and obliquity, pelvis tilt, spine obliquity, kyphosis and lordosis of the increased in children with CP.
2. The range of motion gets higher when the GMFCS-level increases
3. movements of the lumbar spine are higher in CP-children.
4. Because of these bigger ranges, children with CP use their muscles less effectively and for that reason they need more muscle activity ➔higher energy consumption + bigger forces on the lower spine.
5. trunk extension is less when supported by crutches + anterior pelvic tilt ROM is bigger.
6. When external control given by an AW or PW, the ROM of the pelvis is higher.

Final Conclusions: nothing is final

- Wide diversity of walking aids
- Heterogenity of population: different external and personal factors
- Most studies are dealing with body functions
- Almost no studies on participation: what about outside the therapy room?
- Significant effects on activity = ?
- Small sample studies
- Low level of evidence

Need for:
- Study effect on activity and participation as well
- N=1 studies with broad outcome variables and documenting all ICF components
- Larger samples
- Multicenter
- Longer term intervention
- Control groups

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Thank you

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